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# LispWorks® User Guide and Reference Manual

Version 7.1



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*LispWorks User Guide and Reference Manual*

Version 7.1

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### Address

LispWorks Ltd  
St. John's Innovation Centre  
Cowley Road  
Cambridge  
CB4 0WS  
England

### Telephone

From North America: 877 759 8839  
(toll-free)  
From elsewhere: +44 1223 421860

### Fax

From North America: 617 812 8283  
From elsewhere: +44 870 2206189

[www.lispworks.com](http://www.lispworks.com)

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# Contents

**Preface** **ii**

**1 Starting LispWorks 1**

The usual way to start LispWorks 1  
Passing arguments to LispWorks 1  
Starting the LispWorks Graphical IDE 3  
Using LispWorks with SLIME 3  
Quitting LispWorks 4

**2 The Listener 5**

First use of the listener 5  
Standard listener commands 6  
The listener prompt 8

**3 The Debugger 9**

Entering the REPL debugger 10  
Simple use of the REPL debugger 11  
The stack in the debugger 12  
REPL debugger commands 13  
Debugger troubleshooting 23  
Debugger control variables 23  
Remote debugging 25

**4 The REPL Inspector 37**

Describe 37  
    Inspect 38  
    Inspection modes 40

## **5 The Trace Facility 47**

    Simple tracing 47  
    Tracing options 49  
    Example 56  
    Tracing methods 57  
    Tracing subfunctions 58  
    Trace variables 59  
    Troubleshooting tracing 60

## **6 The Advice Facility 63**

    Defining advice 64  
    Combining the advice 65  
    Removing advice 66  
    Advice for macros and methods 67  
    Advising subfunctions 69  
    Examples 70  
    Advice functions and macros 73

## **7 Dspecs: Tools for Handling Definitions 75**

    Dspecs 75  
    Forms of dspecs 76  
    Dspec namespaces 77  
    Types of relations between definitions 81  
    Details of built-in dspec classes and aliases 82  
    Subfunction dspecs 85  
    Tracking definitions 87  
    Finding locations 89  
    Users of location information 89

## **8 Action Lists 95**

    Defining action lists and actions 96  
    Exception handling variables 96  
    Other variables 97

Diagnostic utilities	97
Examples	97
Standard Action Lists	99

## **9 The Compiler 101**

Compiling a function	102
Compiling a source file	103
Compiling a form	103
How the compiler works	103
Compiler control	104
Declare, proclaim, and declaim	109
Optimizing your code	110
Compiler parameters affecting LispWorks	116

## **10 Code Coverage 119**

Using Code Coverage	119
Manipulating code coverage data	121
Preventing code generation for some forms	122
Code coverage and multithreading	123
Counting overflow	123
Memory usage and code speed	123
Understanding the code coverage output	124
Coloring code that has changed	127

## **11 Memory Management 129**

Introduction	129
Guidance for control of the memory management system	130
Memory Management in 32-bit LispWorks	135
Memory Management in 64-bit LispWorks	146
The Mobile GC	151
Common Memory Management Features	163

## **12 The Profiler 167**

What the profiler does	167
Setting up the profiler	168
Running the profiler	169
Profiler output	170

Profiling pitfalls	172
Profiling and garbage collection	173
Profiler tree file format	174

## **13 Customization of LispWorks 177**

Introduction	177
Configuration and initialization files	178
Saving a LispWorks image	179
Saved sessions	182
Load and open your files on startup	184
Customizing the editor	185
Finding source code	186
Controlling redefinition warnings	187
Specifying the initial working directory	187
Using ! for :redo	188
Customizing LispWorks for use with your own code	188
Structure printing	189
Configuring the printer	189

## **14 LispWorks as a dynamic library 191**

Introduction	191
Creating a dynamic library	192
Initialization of the dynamic library	193
Relocation	194
Multiprocessing in a dynamic library	195
Unloading a dynamic library	195

## **15 Java interface 197**

Types and conversion between Lisp and Java	198
Calling from Lisp to Java	200
Calling from Java to Lisp	206
Working with Java arrays	210
Initialization of the Java interface	213
Utilities and administration	213
Loading a LispWorks dynamic library into Java	217
CLOS partial integration	218
Java interface performance issues	220

**16 Android interface 223**

- Delivering for Android 224
- Directories on Android 227
- The Othello demo for Android 227

**17 iOS interface 241**

- Delivering for iOS 241
- Initializing LispWorks 243
- Using Objective-C from Lisp 243
- Limitations of the iOS Runtime 243
- The Othello demo for iOS 244
- The Mobile GC 247

**18 The Metaobject Protocol 249**

- Metaobject features incompatible with AMOP 249
- Metaobject features additional to AMOP 252
- Common problems when using the MOP 252
- Implementation of virtual slots 253

**19 Multiprocessing 261**

- Introduction to processes 261
- Processes basics 262
- Atomicity and thread-safety of the LispWorks implementation 265
- Locks 277
- Modifying a hash table with multiprocessing 279
- Process Waiting and communication between processes 280
- Synchronization between threads 285
- Killing a process, interrupts and blocking interrupts 288
- Timers 293
- Process properties 294
- Other processes functions 294
- Native threads and foreign code 296
- Low level operations 299

**20 Common Defsystem and ASDF 305**

- Introduction 305
- Defining a system 306

Using ASDF	311
<b>21 The Parser Generator</b>	<b>313</b>
Introduction	313
Grammar rules	313
Functions defined by defparser	315
Error handling	316
Interface to lexical analyzer	317
Example	317
<b>22 Dynamic Data Exchange</b>	<b>321</b>
Introduction	321
Client interface	323
Server interface	327
<b>23 Common SQL</b>	<b>331</b>
Introduction	331
Initialization	334
Functional interface	346
Object oriented interface	354
Symbolic SQL syntax	358
Working with date fields	370
SQL I/O recording	372
Error handling in Common SQL	372
Using MySQL	373
Using Oracle	379
Oracle LOB interface	380
Using ODBC	390
Using SQLite	392
<b>24 User Defined Streams</b>	<b>399</b>
Introduction	399
An illustrative example of user defined streams	399
<b>25 TCP and UDP socket communication and SSL</b>	<b>407</b>
Running a server that accepts connections	407
Connecting to a server	408

Specifying the target for connecting and binding a socket	408
Information about IP addresses	409
Waiting on a socket stream	410
Special considerations	410
Asynchronous I/O	411
Using SSL	418
Socket streams with Java sockets and SSL on Android	432

## **26 Internationalization: characters, strings and encodings 435**

Introduction	435
Unicode support	435
Character and String types	436
String accessors	440
String Construction	441
External Formats	443
16-bit External formats guide	445
External Formats and File Streams	447
External Formats and the Foreign Language Interface	450
Unicode character and string functions	451

## **27 LispWorks' Operating Environment 453**

The Operating System	453
Site Name	453
The Lisp Image	454
The Command Line	454
Address Space and Image Size	458
Startup relocation	459
Calling external programs	462
Snapshot debugging of startup errors	463
System message log	463
Exit status	463
Creating a new executable with code preloaded	464
User Preferences	464
File system interface	465
Special locations in the file system	466
Accessing the Windows registry	468

Pathname comparison on Mac OS X	469
<b>28 Miscellaneous Utilities</b>	<b>471</b>
Object addresses and memory	471
Optimized integer arithmetic and integer vector access	472
Transferring large amounts of data	476
Rings	476
Conditional throw and checking for catch in the dynamic environment	476
Checking for a dynamic binding	476
<b>29 64-bit LispWorks</b>	<b>477</b>
Introduction	477
Heap size	478
Architectural constants	479
Speed	479
Memory Management and cl:room	479
Greater allocation expected in 64-bit LispWorks	479
Float types	480
External libraries	480
<b>30 Self-contained examples</b>	<b>481</b>
COMM examples	481
Streams examples	482
DDE examples	482
Parser generator examples	482
Examples for save-image in a Mac OS X application bundle	482
Miscellaneous examples	483
<b>31 The CLOS Package</b>	<b>485</b>
break-new-instances-on-access	485
break-on-access	486
class-extra-initargs	487
compute-class-potential-initargs	488
compute-discriminating-function	490
compute-effective-method-function-from-classes	490
copy-standard-object	493
funcallable-standard-object	494

process-a-class-option 495  
process-a-slot-option 497  
replace-standard-object 499  
set-clos-initarg-checking 501  
set-make-instance-argument-checking 502  
slot-boundp-using-class 502  
slot-makunbound-using-class 503  
slot-value-using-class 504  
trace-new-instances-on-access 505  
trace-on-access 506  
unbreak-new-instances-on-access 509  
unbreak-on-access 509  
untrace-new-instances-on-access 510  
untrace-on-access 510

## 32 The COMM Package 513

accept-tcp-connections-creating-async-io-states 513  
accepting-handle 517  
accepting-handle-collection 518  
accepting-handle-name 519  
accepting-handle-local-port 520  
accepting-handle-socket 520  
accepting-handle-user-info 521  
apply-in-wait-state-collection-process 522  
async-io-state 523  
async-io-state-abort 523  
async-io-state-abort-and-close 525  
async-io-state-address 526  
async-io-state-attach-ssl 526  
async-io-state-buffered-data-length 528  
async-io-state-ctx 529  
async-io-state-detach-ssl 529  
async-io-state-collection 530  
async-io-state-discard 531  
async-io-state-finish 532  
async-io-state-get-buffered-data 533  
async-io-state-handshake 534  
async-io-state-max-read 535  
async-io-state-name 536

async-io-state-object 536  
async-io-state-old-length 537  
async-io-state-peer-address 538  
async-io-state-read-buffer 538  
async-io-state-read-status 540  
async-io-state-write-status 540  
async-io-state-read-timeout 541  
async-io-state-write-timeout 541  
async-io-state-read-with-checking 542  
async-io-state-receive-message 545  
async-io-state-send-message 547  
async-io-state-send-message-to-address 549  
async-io-state-ssl 551  
async-io-state-ssl-side 551  
async-io-state-write-buffer 552  
async-io-state-user-info 553  
attach-ssl 554  
call-wait-state-collection 556  
close-accepting-handle 557  
close-async-io-state 558  
close-wait-state-collection 559  
create-and-run-wait-state-collection 560  
create-async-io-state 562  
create-async-io-state-and-connected-tcp-socket 564  
create-async-io-state-and-connected-udp-socket 567  
create-async-io-state-and-udp-socket 569  
connect-to-tcp-server 572  
destroy-ssl 574  
destroy-ssl-ctx 575  
detach-ssl 575  
do-rand-seed 576  
ensure-ssl 577  
get-default-local-ipv6-address 578  
get-host-entry 578  
get-ip-default-zone-id 581  
get-service-entry 582  
get-socket-address 583  
get-socket-peer-address 584  
get-verification-mode 585  
ip-address-string 585

ipv6-address 586  
ipv6-address-p 587  
ipv6-address-scope-id 587  
ipv6-address-string 588  
make-ssl-ctx 588  
loop-processing-wait-state-collection 589  
make-wait-state-collection 590  
open-tcp-stream 591  
open-tcp-stream-using-java 595  
openssl-version 599  
parse-ipv6-address 600  
pem-read 602  
read-dhparams 603  
replace-socket-stream-socket 604  
server-terminate 605  
set-verification-mode 606  
set-ssl-ctx-dh 608  
set-ssl-ctx-options 610  
set-ssl-ctx-password-callback 610  
set-ssl-library-path 611  
socket-error 612  
socket-stream 612  
socket-stream-address 617  
socket-stream-ctx 618  
socket-stream-handshake 618  
socket-stream-peer-address 619  
socket-stream-shutdown 620  
socket-stream-ssl 621  
socket-stream-ssl-side 622  
ssl-cipher-pointer 622  
ssl-cipher-pointer-stack 622  
ssl-closed 623  
ssl-condition 623  
ssl-ctx-pointer 624  
ssl-error 624  
ssl-failure 624  
ssl-new 625  
ssl-pointer 625  
ssl-x509-lookup 626  
start-up-server 626

start-up-server-and-mp 632  
string-ip-address 633  
switch-open-tcp-stream-with-ssl-to-java 634  
wait-for-wait-state-collection 635  
wait-state-collection 636  
wait-state-collection-stop-loop 636  
with-noticed-socket-stream 637

### **33 The COMMON-LISP Package 639**

apropos 639  
apropos-list 640  
base-string 641  
simple-base-string 641  
close 641  
coerce 642  
compile 643  
compile-file 645  
concatenate 650  
declaim 650  
declare 651  
defclass 657  
defpackage 661  
describe 663  
directory 663  
disassemble 668  
documentation 668  
double-float 669  
\*features\* 670  
input-stream-p 676  
interactive-stream-p 676  
load-logical-pathname-translations 677  
long-float 678  
long-site-name 678  
loop 679  
make-array 680  
make-hash-table 682  
make-instance 684  
make-sequence 685  
make-string 686

make-string-output-stream 687  
map 688  
merge 688  
open 689  
open-stream-p 691  
output-stream-p 692  
proclaim 693  
restart-case 694  
room 695  
short-float 700  
short-site-name 701  
simple-string 702  
single-float 703  
software-type 703  
software-version 704  
\*standard-input\* 705  
\*standard-output\* 705  
\*trace-output\* 705  
\*error-output\* 705  
\*query-io\* 705  
\*debug-io\* 705  
step 706  
stream-element-type 709  
string 710  
time 711  
trace 713  
truename 720  
untrace 721  
update-instance-for-different-class 722  
update-instance-for-redefined-class 723  
with-output-to-string 723

## 34 The COMPILER Package 725

deftransform 725

## 35 The DBG Package 729

close-remote-debugging-connection 729  
configure-remote-debugging-spec 730  
create-client-remote-debugging-connection 734

create-ide-remote-debugging-connection 734  
\*debug-print-length\* 738  
\*debug-print-level\* 738  
\*default-client-remote-debugging-server-port\* 739  
\*default-ide-remote-debugging-server-port\* 740  
ensure-remote-debugging-connection 741  
executable-log-file 741  
\*hidden-packages\* 742  
ide-attach-remote-output-stream 744  
ide-connect-remote-debugging 745  
ide-eval-form-in-remote 747  
ide-funcall-in-remote 747  
ide-set-remote-symbol-value 747  
ide-find-remote-debugging-connection 750  
ide-set-default-remote-debugging-connection 750  
ide-list-remote-debugging-connections 750  
ide-open-a-listener 753  
log-bug-form 754  
logs-directory 755  
output-backtrace 756  
\*print-binding-frames\* 757  
\*print-catch-frames\* 759  
\*print-handler-frames\* 760  
\*print-invisible-frames\* 762  
\*print-open-frames\* 763  
\*print-restart-frames\* 764  
remote-debugging-connection 765  
client-remote-debugging 765  
ide-remote-debugging 765  
remote-debugging-connection-add-close-cleanup 765  
remote-debugging-connection-remove-close-cleanup 765  
remote-debugging-connection-name 767  
remote-debugging-connection-peer-address 768  
remote-debugging-stream-peer-address 769  
remote-inspect 770  
remote-object-p 772  
remote-object-connection 772  
set-debugger-options 773  
set-default-remote-debugging-connection 774  
set-remote-debugging-connection 775

start-client-remote-debugging-server 776  
start-ide-remote-debugging-server 779  
start-remote-listener 781  
\*terminal-debugger-block-multiprocessing\* 783  
with-debugger-wrapper 785  
with-remote-debugging-connection 788  
with-remote-debugging-spec 789

## 36 The DSPEC Package 791

\*active-finders\* 791  
at-location 792  
canonicalize-dspec 793  
def 794  
define-dspec-alias 795  
define-dspec-class 796  
define-form-parser 799  
discard-source-info 803  
dspec-class 803  
\*dspec-classes\* 804  
dspec-defined-p 804  
dspec-definition-locations 805  
dspec-equal 806  
dspec-name 806  
dspec-primary-name 807  
dspec-progenitor 808  
dspec-subclass-p 808  
dspec-undefiner 809  
find-dspec-locations 809  
find-name-locations 810  
get-form-parser 811  
local-dspec-p 812  
location 813  
name-defined-dspecs 813  
name-definition-locations 814  
name-only-form-parser 815  
object-dspec 816  
parse-form-dspec 817  
record-definition 817  
\*record-source-files\* 818

\*redefinition-action\* 819  
replacement-source-form 820  
save-tags-database 821  
single-form-form-parser 822  
single-form-with-options-form-parser 822  
traceable-dspec-p 823  
tracing-enabled-p 824  
tracing-state 825

## **37 The EXTERNAL-FORMAT Package 827**

:bmp 827  
:bmp-native 827  
:bmp-reversed 827  
:unicode 829  
:utf-16 830  
:utf-16be 830  
:utf-16le 830  
:utf-16-native 830  
:utf-16-reversed 830  
:utf-32 831  
:utf-32le 831  
:utf-32be 831  
:utf-32-native 831  
:utf-32-reversed 831  
char-external-code 833  
decode-external-string 834  
encode-lisp-string 835  
external-format-error 835  
external-format-foreign-type 836  
external-format-type 836  
find-external-char 837  
valid-external-format-p 838

## **38 The HCL Package 839**

add-code-coverage-data 839  
reverse-subtract-code-coverage-data 839  
subtract-code-coverage-data 839  
destructive-add-code-coverage-data 839  
destructive-subtract-code-coverage-data 839

destructive-reverse-subtract-code-coverage-data 839  
add-special-free-action 841  
add-symbol-profiler 842  
allocation-in-gen-num 843  
analysing-special-variables-usage 844  
android-build-value 848  
android-funcall-in-main-thread 849  
android-funcall-in-main-thread-list 849  
android-get-current-activity 851  
\*android-main-process-for-testing\* 852  
android-main-thread-p 852  
any-capi-window-displayed-p 853  
array-single-thread-p 854  
array-weak-p 854  
augment-environment 855  
avoid-gc 857  
\*background-input\* 858  
\*background-output\* 858  
\*background-query-io\* 858  
binds-who 860  
block-promotion 861  
building-universal-intermediate-p 862  
calls-who 863  
cd 864  
change-directory 864  
check-fragmentation 865  
clean-down 866  
clean-generation-0 868  
clear-code-coverage 869  
reset-code-coverage 869  
restore-code-coverage-data 869  
code-coverage-data 870  
code-coverage-data-generate-coloring-html 871  
code-coverage-data-generate-statistics 877  
code-coverage-file-stats 879  
code-coverage-set-editor-colors 881  
code-coverage-set-editor-default-data 883  
code-coverage-set-html-background-colors 884  
collect-generation-2 885  
collect-highest-generation 886

*compiler-break-on-error*	887
compile-file-if-needed	887
copy-code-coverage-data	889
copy-current-code-coverage	889
load-code-coverage-data	889
save-code-coverage-data	889
save-current-code-coverage	889
copy-to-weak-simple-vector	891
create-macos-application-bundle	892
create-temp-file	895
open-temp-file	895
create-universal-binary	897
current-function-name	897
current-stack-length	898
date-string	899
declaration-information	900
*default-package-use-list*	901
*default-profiler-collapse*	901
*default-profiler-cutoff*	902
*default-profiler-limit*	902
*default-profiler-sort*	903
defglobal-parameter	903
defglobal-variable	904
define-declaration	905
delete-advice	907
delivered-image-p	908
deliver-to-android-project	909
*disable-trace*	914
do-profiling	915
editor-color-code-coverage	917
enlarge-generation	920
enlarge-static	921
ensure-hash-entry	922
error-situation-forms	923
expand-generation-1	924
extend-current-stack	925
extended-time	926
fasl-error	929
fast-directory-files	930
fdf-handle-directory-p	930

fdf-handle-directory-string 930  
fdf-handle-last-access 930  
fdf-handle-last-modify 930  
fdf-handle-link-p 930  
fdf-handle-size 930  
fdf-handle-writable-p 930  
file-string 932  
file-writable-p 933  
filter-code-coverage-data 933  
find-object-size 935  
find-throw-tag 936  
finish-heavy-allocation 936  
flag-not-special-free-action 937  
flag-special-free-action 938  
function-information 939  
get-code-coverage-delta 940  
reset-code-coverage-snapshot 940  
set-code-coverage-snapshot 940  
gc-generation 942  
gc-if-needed 946  
generate-code-coverage 946  
get-default-generation 949  
get-gc-parameters 950  
get-temp-directory 951  
get-working-directory 952  
gethash-ensuring 952  
\*handle-existing-defpackage\* 954  
\*handle-old-in-package\* 955  
\*handle-old-in-package-used-as-make-package\* 956  
hash-table-weak-kind 957  
load-data-file 957  
\*load-fasl-or-lisp-file\* 961  
make-ring 962  
make-unlocked-queue 964  
unlocked-queue-read 964  
unlocked-queue-peek 964  
unlocked-queue-ready 964  
unlocked-queue-send 964  
unlocked-queue-count 964  
unlocked-queue-size 964

map-code-coverage-data 966  
map-ring 967  
mark-and-sweep 967  
\*max-trace-indent\* 969  
merge-code-coverage-data 970  
destructive-merge-code-coverage-data 970  
modify-hash 971  
normal-gc 972  
\*packages-for-warn-on-redefinition\* 973  
parse-float 975  
position-in-ring 976  
position-in-ring-forward 976  
print-profile-list 977  
\*print-string\* 981  
profile 981  
\*profiler-threshold\* 982  
\*profile-symbol-list\* 983  
profiler-tree-from-function 983  
profiler-tree-to-function 984  
reduce-memory 985  
references-who 987  
remove-special-free-action 988  
remove-symbol-profiler 989  
reset-profiler 989  
reset-ring 990  
ringp 991  
ring-length 991  
ring-name 992  
ring-pop 992  
ring-push 993  
ring-ref 994  
rotate-ring 995  
safe-format-to-string 996  
safe-format-to-limited-string 996  
safe-prin1-to-string 996  
safe-princ-to-string 996  
save-argument-real-p 997  
save-current-profiler-tree 998  
save-current-session 1000  
save-image 1001

save-image-with-bundle 1010  
save-universal-from-script 1011  
set-array-single-thread-p 1012  
set-array-weak 1012  
set-default-generation 1014  
set-gc-parameters 1015  
set-hash-table-weak 1017  
set-minimum-free-space 1019  
set-process-profiling 1020  
set-profiler-threshold 1022  
set-promotion-count 1023  
set-system-message-log 1024  
set-up-profiler 1025  
sets-who 1030  
source-debugging-on-p 1031  
start-gc-timing 1031  
stop-gc-timing 1031  
get-gc-timing 1031  
start-profiling 1033  
string-trim-whitespace 1035  
stop-profiling 1036  
sweep-all-objects 1037  
switch-static-allocation 1038  
\*symbol-alloc-gen-num\* 1039  
symbol-dynamically-bound-p 1039  
throw-if-tag-found 1040  
toggle-source-debugging 1040  
total-allocation 1042  
\*traced-arglist\* 1043  
\*traced-results\* 1043  
\*trace-indent-width\* 1044  
\*trace-level\* 1045  
\*trace-print-circle\* 1046  
\*trace-print-length\* 1047  
\*trace-print-level\* 1048  
\*trace-print-pretty\* 1049  
\*trace-verbose\* 1050  
try-compact-in-generation 1051  
try-move-in-generation 1052  
undefine-declaration 1054

unlocked-queue 1055  
unwind-protect-blocking-interrupts 1055  
unwind-protect-blocking-interrupts-in-cleanups 1057  
variable-information 1058  
who-binds 1059  
who-calls 1060  
who-references 1061  
who-sets 1061  
with-code-coverage-generation 1062  
with-ensuring-gethash 1063  
with-hash-table-locked 1065  
with-heavy-allocation 1066  
with-output-to-fasl-file 1067  
dump-form 1067  
dump-forms-to-file 1067  
with-ring-locked 1071  
without-code-coverage 1071  
write-string-with-properties 1072

## **39 The LINK-LOAD Package 1075**

break-on-unresolved-functions 1075  
foreign-symbol-address 1076  
get-foreign-symbol 1077  
lisp-name-to-foreign-name 1078  
read-foreign-modules 1078

## **40 The LISPWORKS Package 1081**

8-bit-string 1081  
16-bit-string 1082  
append-file 1082  
appendf 1083  
\*autoload-asdf-integration\* 1083  
base-character 1084  
base-character-p 1084  
base-char-p 1085  
base-char-code-limit 1085  
base-string-p 1086  
simple-base-string-p 1086  
bmp-char 1086

bmp-char-p 1087  
bmp-string 1088  
simple-bmp-string 1088  
bmp-string-p 1089  
simple-bmp-string-p 1089  
\*browser-location\* 1089  
call-next-advice 1090  
choose-unicode-string-hash-function 1092  
compile-system 1092  
concatenate-system 1094  
copy-file 1096  
count-regexp-occurrences 1097  
current-pathname 1099  
defadvice 1100  
\*default-action-list-sort-time\* 1103  
\*default-character-element-type\* 1104  
define-action 1105  
define-action-list 1107  
defsystem 1109  
\*defsystem-verbose\* 1115  
delete-directory 1115  
deliver 1116  
\*describe-length\* 1117  
\*describe-level\* 1117  
\*describe-print-length\* 1119  
\*describe-print-level\* 1119  
dll-quit 1120  
dotted-list-length 1122  
dotted-list-p 1123  
do-nothing 1123  
\*enter-debugger-directly\* 1124  
environment-variable 1125  
errno-value 1126  
example-file 1127  
example-compile-file 1127  
example-edit-file 1128  
example-load-binary-file 1129  
execute-actions 1129  
extended-char 1131  
extended-character 1131

extended-character-p 1132  
extended-char-p 1132  
\*external-formats\* 1133  
false 1134  
file-directory-p 1134  
find-regexp-in-string 1135  
function-lambda-list 1137  
get-inspector-values 1138  
sort-inspector-p 1138  
get-unix-error 1142  
\*grep-command\* 1142  
\*grep-command-format\* 1143  
\*grep-fixed-args\* 1144  
\*handle-existing-action-in-action-list\* 1144  
\*handle-existing-action-list\* 1145  
\*handle-missing-action-list\* 1145  
\*handle-missing-action-in-action-list\* 1146  
\*handle-warn-on-redefinition\* 1146  
hardcopy-system 1147  
\*init-file-name\* 1148  
\*inspect-through-gui\* 1149  
lisp-image-name 1149  
\*lispworks-directory\* 1150  
load-all-patches 1152  
load-system 1153  
make-unregistered-action-list 1154  
make-mt-random-state 1156  
mt-random 1157  
\*mt-random-state\* 1157  
mt-random-state 1158  
mt-random-state-p 1158  
pathname-location 1159  
precompile-regexp 1160  
print-actions 1161  
print-action-lists 1161  
\*print-command\* 1162  
\*print-nickname\* 1162  
\*prompt\* 1163  
push-end 1164  
push-end-new 1164

quit 1165  
rebinding 1167  
regexp-find-symbols 1168  
remove-advice 1169  
removef 1171  
\*require-verbose\* 1171  
rotate-byte 1172  
round-to-single-precision 1172  
sbchar 1173  
sequencep 1174  
set-default-character-element-type 1174  
set-quit-when-no-windows 1176  
simple-char 1176  
simple-char-p 1177  
split-sequence 1177  
split-sequence-if 1178  
split-sequence-if-not 1179  
start-tty-listener 1180  
stchar 1181  
string-append 1182  
string-append\* 1183  
structurep 1184  
text-string 1185  
simple-text-string 1185  
text-string-p 1186  
simple-text-string-p 1186  
true 1186  
undefined-action 1187  
undefined-action-list 1188  
unicode-alpha-char-p 1188  
unicode-alphanumeric-p 1189  
unicode-both-case-p 1190  
unicode-char-equal 1191  
unicode-char-not-equal 1191  
unicode-char-greaterp 1192  
unicode-char-lessp 1192  
unicode-char-not-greaterp 1193  
unicode-char-not-lessp 1193  
unicode-lower-case-p 1194  
unicode-string-equal 1194

unicode-string-not-equal 1194  
unicode-string-greaterp 1196  
unicode-string-lessp 1196  
unicode-string-not-greaterp 1197  
unicode-string-not-lessp 1197  
unicode-upper-case-p 1198  
user-preference 1199  
when-let 1201  
when-let\* 1202  
whitespace-char-p 1203  
with-action-item-error-handling 1204  
with-action-list-mapping 1205  
with-unique-names 1206

## **41 The LW-JI Package 1209**

call-java-method 1209  
call-java-method-error 1210  
catching-java-exceptions 1211  
catching-exceptions-bind 1211  
check-lisp-calls-initialized 1213  
create-instance-from-jobject 1213  
create-instance-jobject-list 1214  
create-instance-jobject 1214  
create-java-object 1216  
create-java-object-error 1217  
default-constructor-arguments 1217  
default-name-constructor 1218  
define-field-accessor 1219  
define-java-caller 1220  
define-java-constructor 1220  
define-java-callers 1223  
define-lisp-proxy 1225  
ensure-lisp-classes-from-tree 1233  
ensure-supers-contain-java.lang.object 1235  
field-access-exception 1236  
field-exception 1237  
find-java-class 1238  
format-to-java-host 1239  
generate-java-class-definitions 1239

get-host-java-virtual-machine 1245  
get-java-virtual-machine 1246  
get-jobject 1247  
ensure-is-jobject 1247  
get-primitive-array-region 1248  
set-primitive-array-region 1248  
get-superclass-and-interfaces-tree 1250  
import-java-class-definitions 1251  
init-java-interface 1253  
setup-java-interface-callbacks 1253  
intern-and-export-list 1260  
jaref 1260  
java-array-element-type 1262  
java-array-error 1263  
java-array-indices-error 1263  
java-array-length 1264  
java-array-simple-error 1265  
java-bad-jobject 1265  
java-definition-error 1266  
java-class-error 1266  
java-method-error 1266  
java-field-error 1266  
java-exception 1267  
java-field-setting-error 1268  
java-id-exception 1269  
java-instance-without-jobject-error 1270  
java-interface-error 1270  
java-low-level-exception 1271  
java-method-exception 1271  
java-normal-exception 1272  
java-not-a-java-object-error 1273  
java-not-an-array-error 1274  
\*java-null\* 1274  
java-object-array-element-type 1275  
java-objects-eq 1275  
java-out-of-bounds-error 1276  
java-storing-wrong-type-error 1276  
java-primitive-array-element-type 1277  
java-serious-exception 1278  
java-type-to-lisp-array-type 1278

lisp-array-type-to-java-type 1278  
java-vm-poi 1280  
jboolean 1280  
jbyte 1280  
jchar 1280  
jdouble 1280  
jfloat 1280  
jint 1280  
jlong 1280  
jshort 1280  
jni-env-poi 1281  
jobject 1281  
jobject-class-name 1282  
jobject-ensure-global 1283  
jobject-of-class-p 1284  
jobject-p 1285  
jobject-pretty-class-name 1285  
jobject-string 1286  
jobject-to-lisp 1287  
jvref 1288  
lisp-java-instance-p 1290  
lisp-to-jobject 1290  
make-java-array 1291  
make-java-instance 1292  
make-lisp-proxy 1293  
make-lisp-proxy-with-overrides 1293  
map-java-object-array 1295  
primitive-array-to-lisp-array 1299  
lisp-array-to-primitive-array 1299  
read-java-field 1302  
checked-read-java-field 1302  
set-java-field 1302  
check-java-field 1302  
java-field-class-name-for-setting 1302  
record-java-class-lisp-symbol 1304  
report-error-to-java-host 1305  
reset-java-interface-for-new-jvm 1306  
send-message-to-java-host 1307  
setup-deliver-dynamic-library-for-java 1308  
setup-field-accessor 1312

setup-java-caller 1313  
setup-java-constructor 1313  
setup-lisp-proxy 1315  
standard-java-object 1315  
throw-an-exception 1317  
\*to-java-host-stream\* 1318  
\*to-java-host-stream-no-scroll\* 1319  
verify-java-caller 1320  
verify-java-callers 1321  
verify-lisp-proxy 1324  
verify-lisp-proxies 1324  
write-java-class-definitions-to-file 1326  
write-java-class-definitions-to-stream 1326

## 42 Java classes and methods 1331

com.lispworks.LispCalls 1331  
com.lispworks.LispCalls.callIntV 1332  
com.lispworks.LispCalls.callIntA 1332  
com.lispworks.LispCalls.callDoubleV 1332  
com.lispworks.LispCalls.callDoubleA 1332  
com.lispworks.LispCalls.callObjectV 1332  
com.lispworks.LispCalls.callObjectA 1332  
com.lispworks.LispCalls.callVoidV 1332  
com.lispworks.LispCalls.callVoidA 1332  
com.lispworks.LispCalls.checkLispSymbol 1334  
com.lispworks.LispCalls.createLispProxy 1335  
com.lispworks.LispCalls.waitForInitialization 1336

## 43 Android Java classes and methods 1339

com.lispworks.Manager 1339  
com.lispworks.Manager.init 1341  
com.lispworks.Manager.status 1343  
com.lispworks.Manager.init\_result\_code 1344  
com.lispworks.Manager.mInitErrorString 1346  
com.lispworks.Manager.loadLibrary 1346  
com.lispworks.Manager.LispErrorReporter 1347  
com.lispworks.Manager.setErrorReporter 1347  
com.lispworks.Manager.LispGuiErrorReporter 1347  
com.lispworks.Manager.setGuiErrorReporter 1347

com.lispworks.Manager.clearBugFormLogs 1350  
com.lispworks.Manager.mMaxErrorLogsNumber 1350  
com.lispworks.Manager.showBugFormLogs 1351  
com.lispworks.Manager.addMessage 1352  
com.lispworks.Manager.mMessagesMaxLength 1352  
com.lispworks.Manager.setMessageHandler 1354  
com.lispworks.Manager.MessageHandler 1354  
com.lispworks.Manager.setTextView 1354  
com.lispworks.Manager.getClassLoader 1355  
com.lispworks.Manager.getApplicationContext 1355  
com.lispworks.Manager.setCurrentActivity 1356  
com.lispworks.BugFormLogsList 1357  
com.lispworks.BugFormViewer 1357

## **44 The MP Package 1359**

allowing-block-interrupts 1359  
any-other-process-non-internal-server-p 1361  
barrier 1362  
barrier-arriver-count 1362  
barrier-block-and-wait 1363  
barrier-change-count 1366  
barrier-count 1367  
barrier-disable 1368  
barrier-enable 1368  
barrier-name 1369  
barrier-pass-through 1370  
barrier-unblock 1370  
barrier-wait 1372  
change-process-priority 1375  
condition-variable 1376  
condition-variable-broadcast 1376  
condition-variable-signal 1377  
condition-variable-wait 1378  
condition-variable-wait-count 1379  
\*current-process\* 1380  
current-process-block-interrupts 1380  
current-process-in-cleanup-p 1381  
current-process-kill 1382  
current-process-pause 1383

current-process-send 1385  
current-process-set-terminate-method 1386  
current-process-unblock-interrupts 1387  
debug-other-process 1388  
\*default-process-priority\* 1389  
ensure-process-cleanup 1389  
find-process-from-name 1391  
funcall-async 1392  
funcall-async-list 1392  
general-handle-event 1393  
get-current-process 1394  
get-process 1395  
get-process-private-property 1396  
initialize-multiprocessing 1397  
\*initial-processes\* 1398  
last-callback-on-thread 1399  
list-all-processes 1400  
lock 1401  
lock-and-condition-variable-broadcast 1401  
lock-and-condition-variable-signal 1402  
lock-and-condition-variable-wait 1404  
lock-locked-p 1406  
lock-owned-by-current-process-p 1407  
lock-recursive-p 1407  
lock-recursively-locked-p 1408  
lock-name 1409  
lock-owner 1409  
mailbox 1411  
mailbox-count 1411  
mailbox-empty-p 1412  
mailbox-full-p 1413  
mailbox-not-empty-p 1414  
mailbox-peek 1414  
mailbox-read 1415  
mailbox-reader-process 1416  
mailbox-send 1417  
mailbox-send-limited 1418  
mailbox-size 1420  
mailbox-wait 1421  
mailbox-wait-for-event 1422

\*main-process\* 1424  
make-barrier 1424  
make-condition-variable 1426  
make-lock 1427  
make-mailbox 1429  
make-named-timer 1430  
make-semaphore 1431  
make-timer 1432  
map-all-processes 1433  
map-all-processes-backtrace 1433  
map-process-backtrace 1434  
map-processes 1435  
notice-fd 1436  
process-alive-p 1436  
process-all-events 1437  
process-allow-scheduling 1438  
process-arrest-reasons 1438  
process-break 1439  
process-continue 1439  
process-exclusive-lock 1440  
process-exclusive-unlock 1441  
process-idle-time 1442  
\*process-initial-bindings\* 1442  
process-internal-server-p 1444  
process-interrupt 1445  
process-interrupt-list 1446  
process-join 1447  
process-kill 1448  
process-lock 1449  
process-mailbox 1450  
process-name 1450  
process-p 1451  
process-plist 1451  
process-poke 1452  
process-priority 1454  
process-private-property 1455  
process-property 1456  
process-reset 1457  
process-run-function 1458  
process-run-reasons 1461

process-run-time 1462  
process-send 1463  
process-sharing-lock 1465  
process-sharing-unlock 1466  
process-stop 1467  
process-stopped-p 1468  
process-terminate 1468  
process-unlock 1470  
process-unstop 1471  
process-wait 1472  
process-wait-for-event 1473  
process-wait-function 1474  
process-wait-local 1474  
process-wait-local-with-periodic-checks 1477  
process-wait-local-with-timeout 1478  
process-wait-local-with-timeout-and-periodic-checks 1479  
process-wait-with-timeout 1480  
process-whostate 1482  
processes-count 1482  
pushnew-to-process-private-property 1483  
pushnew-to-process-property 1484  
ps 1485  
remove-from-process-private-property 1486  
remove-from-process-property 1486  
remove-process-private-property 1487  
remove-process-property 1488  
schedule-timer 1489  
schedule-timer-milliseconds 1491  
schedule-timer-relative 1493  
schedule-timer-relative-milliseconds 1494  
semaphore 1496  
semaphore-acquire 1496  
semaphore-count 1498  
semaphore-name 1498  
semaphore-release 1499  
semaphore-wait-count 1500  
set-funcall-async-limit 1500  
simple-lock-and-condition-variable-wait 1501  
symeval-in-process 1503  
timer-expired-p 1504

timer-name 1505  
unnotice-fd 1506  
unschedule-timer 1506  
wait-processing-events 1508  
with-exclusive-lock 1509  
with-interrupts-blocked 1510  
with-lock 1510  
with-sharing-lock 1511  
without-interrupts 1512  
without-preemption 1513  
yield 1514

## **45 The PARSERGEN Package 1515**

defparser 1515

## **46 The SERIAL-PORT Package 1517**

open-serial-port 1517  
close-serial-port 1519  
get-serial-port-state 1520  
serial-port 1520  
read-serial-port-char 1521  
read-serial-port-string 1521  
serial-port-input-available-p 1522  
set-serial-port-state 1523  
wait-serial-port-state 1524  
write-serial-port-char 1524  
write-serial-port-string 1525

## **47 The SQL Package 1527**

accepts-n-syntax 1527  
add-sql-stream 1528  
attribute-type 1529  
cache-table-queries 1531  
\*cache-table-queries-default\* 1532  
commit 1532  
connect 1533  
\*connect-if-exists\* 1541  
connected-databases 1542  
create-index 1542

create-table 1543  
create-view 1545  
create-view-from-class 1546  
database-name 1546  
decode-to-db-standard-date 1547  
decode-to-db-standard-timestamp 1547  
encode-db-standard-date 1548  
encode-db-standard-timestamp 1548  
\*default-database\* 1549  
\*default-database-type\* 1550  
\*default-update-objects-max-len\* 1550  
def-view-class 1551  
delete-instance-records 1558  
delete-records 1559  
delete-sql-stream 1560  
destroy-prepared-statement 1561  
disable-sql-reader-syntax 1561  
disconnect 1562  
do-query 1563  
drop-index 1564  
drop-table 1565  
drop-view 1565  
drop-view-from-class 1566  
enable-sql-reader-syntax 1567  
execute-command 1567  
find-database 1568  
initialize-database-type 1569  
\*initialized-database-types\* 1570  
insert-records 1570  
instance-refreshed 1572  
list-attribute-types 1573  
list-attributes 1574  
list-classes 1575  
list-sql-streams 1576  
list-tables 1576  
lob-stream 1577  
locally-disable-sql-reader-syntax 1578  
locally-enable-sql-reader-syntax 1579  
loop 1580  
map-query 1582

- \*mysql-library-directories\* 1583
- \*mysql-library-path\* 1584
- \*mysql-library-sub-directories\* 1585
- ora-lob-append 1586
- ora-lob-assign 1587
- ora-lob-char-set-form 1587
- ora-lob-char-set-id 1588
- ora-lob-close 1589
- ora-lob-copy 1590
- ora-lob-create-empty 1591
- ora-lob-create-temporary 1592
- ora-lob-disable-buffering 1593
- ora-lob-element-type 1594
- ora-lob-enable-buffering 1595
- ora-lob-env-handle 1596
- ora-lob-erase 1596
- ora-lob-file-close 1597
- ora-lob-file-close-all 1598
- ora-lob-file-exists 1599
- ora-lob-file-get-name 1600
- ora-lob-file-is-open 1600
- ora-lob-file-open 1601
- ora-lob-file-set-name 1602
- ora-lob-flush-buffer 1603
- ora-lob-free 1604
- ora-lob-free-temporary 1605
- ora-lob-get-buffer 1605
- ora-lob-get-chunk-size 1608
- ora-lob-get-length 1608
- ora-lob-internal-lob-p 1609
- ora-lob-is-equal 1610
- ora-lob-is-open 1610
- ora-lob-is-temporary 1611
- ora-lob-load-from-file 1612
- ora-lob-lob-locator 1613
- ora-lob-locator-is-init 1614
- ora-lob-open 1614
- ora-lob-read-buffer 1615
- ora-lob-read-into-plain-file 1618
- ora-lob-read-foreign-buffer 1619

ora-lob-svc-ctx-handle 1620  
ora-lob-trim 1620  
ora-lob-write-buffer 1621  
ora-lob-write-from-plain-file 1623  
ora-lob-write-foreign-buffer 1624  
p-oci-env 1625  
p-oci-file 1626  
p-oci-lob-locator 1626  
p-oci-lob-or-file 1626  
p-oci-svc-ctx 1626  
prepare-statement 1627  
prepared-statement 1629  
print-query 1629  
query 1631  
reconnect 1632  
restore-sql-reader-syntax-state 1633  
rollback 1634  
select 1634  
set-prepared-statement-variables 1639  
simple-do-query 1640  
sql 1642  
sql-connection-error 1643  
sql-database-data-error 1643  
sql-database-error 1643  
\*sql-enlarge-static\* 1644  
sql-expression 1645  
sql-expression-object 1647  
sql-fatal-error 1648  
sqlite-blob 1648  
sqlite-last-insert-rowid 1649  
sqlite-open-blob 1650  
sqlite-close-blob 1650  
sqlite-blob-p 1650  
sqlite-blob-length 1650  
replace-from-sqlite-blob 1650  
replace-into-sqlite-blob 1650  
sqlite-reopen-blob 1650  
sqlite-raw-blob 1654  
sqlite-raw-blob-p 1655  
sqlite-raw-blob-valid-p 1655

sqlite-raw-blob-length 1655  
sqlite-raw-blob-ref 1655  
copy-from-sqlite-raw-blob 1655  
replace-from-sqlite-raw-blob 1655  
\*sql-libraries\* 1659  
\*sql-loading-verbose\* 1660  
sql-operation 1660  
sql-operator 1662  
sql-recording-p 1663  
sql-stream 1664  
sql-temporary-error 1665  
sql-timeout-error 1665  
sql-user-error 1665  
standard-db-object 1666  
start-sql-recording 1666  
status 1667  
stop-sql-recording 1668  
string-needs-n-prefix 1668  
string-prefix-with-n-if-needed 1669  
table-exists-p 1670  
update-instance-from-records 1671  
update-objects-joins 1672  
update-records 1673  
update-records-from-instance 1674  
update-record-from-slot 1675  
update-slot-from-record 1675  
\*use-n-syntax-for-non-ascii-strings\* 1676  
with-sqlite-blob 1677  
with-transaction 1678

## 48 The STREAM Package 1681

buffered-stream 1681  
fundamental-binary-input-stream 1683  
fundamental-binary-output-stream 1684  
fundamental-binary-stream 1684  
fundamental-character-input-stream 1685  
fundamental-character-output-stream 1686  
fundamental-character-stream 1687  
fundamental-input-stream 1687

fundamental-output-stream 1688  
fundamental-stream 1688  
stream-advance-to-column 1689  
stream-check-eof-no-hang 1690  
stream-clear-input 1690  
stream-clear-output 1691  
stream-file-position 1692  
stream-fill-buffer 1692  
stream-finish-output 1693  
stream-flush-buffer 1694  
stream-force-output 1695  
stream-fresh-line 1695  
stream-line-column 1696  
stream-listen 1697  
stream-output-width 1698  
stream-peek-char 1698  
stream-read-buffer 1699  
stream-read-byte 1700  
stream-read-char 1701  
stream-read-char-no-hang 1701  
stream-read-line 1702  
stream-read-sequence 1703  
stream-read-timeout 1704  
stream-start-line-p 1704  
stream-terpri 1705  
stream-unread-char 1706  
stream-write-buffer 1706  
stream-write-byte 1707  
stream-write-char 1708  
stream-write-sequence 1708  
stream-write-string 1709  
with-stream-input-buffer 1710  
with-stream-output-buffer 1712

## 49 The SYSTEM Package 1715

allocated-in-its-own-segment-p 1715  
apply-with-allocation-in-gen-num 1716  
approaching-memory-limit 1717  
atomic-decf 1718

atomic-incf	1718
atomic-exchange	1719
atomic-fixnum-decf	1719
atomic-fixnum-incf	1719
atomic-pop	1720
atomic-push	1721
augmented-string	1722
simple-augmented-string	1722
augmented-string-p	1722
simple-augmented-string-p	1722
*binary-file-type*	1723
*binary-file-types*	1723
call-system	1724
call-system-showing-output	1727
cdr-assoc	1730
*check-network-server*	1731
coerce-to-gesture-spec	1731
compare-and-swap	1733
copy-preferences-from-older-version	1734
count-gen-num-allocation	1735
*debug-initialization-errors-in-snap-shot*	1736
default-eol-style	1737
*default-stack-group-list-length*	1738
define-atomic-modify-macro	1738
define-top-loop-command	1740
detect-eol-style	1742
detect-japanese-encoding-in-file	1743
detect-unicode-bom	1744
detect-utf32-bom	1744
detect-utf8-bom	1744
*directory-link-transparency*	1745
ensure-loads-after-loads	1746
ensure-memory-after-store	1746
ensure-stores-after-memory	1747
ensure-stores-after-stores	1748
*extended-spaces*	1748
*file-encoding-detection-algorithm*	1749
file-encoding-resolution-error	1751
*file-eol-style-detection-algorithm*	1751
*filename-pattern-encoding-matches*	1752

find-encoding-option 1752  
find-filename-pattern-encoding-match 1753  
gen-num-segments-fragmentation-state 1754  
generation-number 1755  
gesture-spec-accelerator-bit 1756  
gesture-spec-caps-lock-bit 1756  
gesture-spec-control-bit 1756  
gesture-spec-hyper-bit 1756  
gesture-spec-meta-bit 1756  
gesture-spec-shift-bit 1756  
gesture-spec-super-bit 1756  
gesture-spec-data 1758  
gesture-spec-modifiers 1758  
gesture-spec-p 1759  
gesture-spec-to-character 1760  
get-file-stat 1761  
get-folder-path 1762  
get-maximum-allocated-in-generation-2-after-gc 1765  
get-user-profile-directory 1767  
globally-accessible 1768  
guess-external-format 1769  
immediatelp 1770  
in-static-area 1771  
int32 1772  
int32\* 1773  
int32+ 1773  
int32- 1773  
int32/ 1773  
+int32-0+ 1774  
+int32-1+ 1774  
int32-1+ 1774  
int32-1- 1774  
int32/= 1775  
int32< 1775  
int32<= 1775  
int32= 1775  
int32> 1775  
int32>= 1775  
int32<< 1776  
int32>> 1776

int32-aref 1777  
int32-logand 1778  
int32-logandc1 1778  
int32-logandc2 1778  
int32-logbitp 1778  
int32-logeqv 1778  
int32-logior 1778  
int32-lognand 1778  
int32-lognor 1778  
int32-lognot 1778  
int32-logorc1 1778  
int32-logorc2 1778  
int32-logtest 1778  
int32-logxor 1778  
int32-minusp 1781  
int32-plusp 1781  
int32-zerop 1781  
int32-to-int64 1781  
int32-to-integer 1782  
int64 1783  
int64\* 1784  
int64+ 1784  
int64- 1784  
int64/ 1784  
+int64-0+ 1785  
+int64-1+ 1785  
int64-1+ 1785  
int64-1- 1785  
int64/= 1786  
int64< 1786  
int64<= 1786  
int64= 1786  
int64> 1786  
int64>= 1786  
int64<< 1787  
int64>> 1787  
int64-aref 1788  
int64-logand 1789  
int64-logandc1 1789  
int64-logandc2 1789

int64-logbitp 1789  
int64-logeqv 1789  
int64-logior 1789  
int64-lognand 1789  
int64-lognor 1789  
int64-lognot 1789  
int64-logorc1 1789  
int64-logorc2 1789  
int64-logtest 1789  
int64-logxor 1789  
int64-minusp 1791  
int64-plusp 1791  
int64-zerop 1791  
int64-to-int32 1792  
int64-to-integer 1793  
integer-to-int32 1793  
integer-to-int64 1794  
\*line-arguments-list\* 1795  
load-data-file 1795  
locale-file-encoding 1796  
low-level-atomic-place-p 1797  
make-current-allocation-permanent 1798  
make-gesture-spec 1800  
make-object-permanent 1805  
make-permanent-simple-vector 1807  
make-simple-int32-vector 1808  
make-simple-int64-vector 1809  
make-stderr-stream 1810  
make-typed-aref-vector 1811  
map-environment 1812  
marking-gc 1813  
memory-growth-margin 1815  
merge-ef-specs 1816  
mobile-gc-p 1817  
mobile-gc-sweep-objects 1818  
object-address 1819  
object-pointer 1820  
octet-ref 1821  
base-char-ref 1821  
open-pipe 1823

open-url	1827
package-flagged-p	1827
pipe-close-connection	1828
pipe-exit-status	1829
pipe-kill-process	1830
pointer-from-address	1832
print-pretty-gesture-spec	1833
*print-symbols-using-bars*	1834
product-registry-path	1835
release-object-and-nullify	1837
room-values	1838
run-shell-command	1839
safe-locale-file-encoding	1844
set-approaching-memory-limit-callback	1845
set-automatic-gc-callback	1846
set-blocking-gen-num	1848
set-default-segment-size	1851
set-delay-promotion	1852
set-expected-allocation-in-generation-2-after-gc	1853
set-file-dates	1857
set-generation-2-gc-options	1858
set-gen-num-gc-threshold	1860
set-maximum-memory	1862
set-maximum-segment-size	1863
set-memory-check	1865
set-memory-exhausted-callback	1866
set-promote-generation-1	1868
set-reserved-memory-policy	1869
set-signal-handler	1870
set-spare-keeping-policy	1871
set-split-promotion	1872
set-static-segment-size	1874
set-temp-directory	1875
setup-atomic-funcall	1876
*sg-default-size*	1877
simple-int32-vector	1878
simple-int32-vector-length	1879
simple-int32-vector-p	1879
simple-int64-vector	1880
simple-int64-vector-length	1880

simple-int64-vector-p 1881  
\*specific-valid-file-encodings\* 1881  
specific-valid-file-encoding 1882  
\*stack-overflow-behaviour\* 1883  
staticcp 1884  
storage-exhausted 1884  
sweep-gen-num-objects 1885  
typed-aref 1886  
wait-for-input-streams 1888  
wait-for-input-streams-returning-first 1889  
with-modification-change 1890  
with-modification-check-macro 1891  
with-other-threads-disabled 1892

## 50 Miscellaneous WIN32 symbols 1895

canonicalize-sid-string 1895  
connect-to-named-pipe 1896  
dismiss-splash-screen 1898  
impersonating-named-pipe-client 1899  
impersonating-user 1900  
known-sid-integer-to-sid-string 1901  
\*latin-1-code-pages\* 1902  
long-namestring 1903  
\*multibyte-code-page-ef\* 1904  
named-pipe-stream-name 1904  
open-named-pipe-stream 1905  
record-message-in-windows-event-log 1909  
security-description-string-for-open-named-pipe 1910  
set-application-themed 1914  
short-namestring 1915  
sid-string-to-user-name 1916  
str 1916  
lpcstr 1916  
lpstr 1916  
tstr 1917  
lpctstr 1917  
lptstr 1917  
wstr 1918  
lpcwstr 1918

lpwstr 1918  
user-name-to-sid-string 1919  
wait-for-connection 1919  
with-windows-event-log-event-source 1921

## **51 The Windows registry API 1923**

close-registry-key 1923  
collect-registry-subkeys 1924  
collect-registry-values 1925  
create-registry-key 1927  
delete-registry-key 1929  
enum-registry-value 1929  
open-registry-key 1932  
query-registry-key-info 1933  
query-registry-value 1934  
registry-key-exists-p 1935  
registry-value 1935  
set-registry-value 1937  
with-registry-key 1938

## **52 The DDE client interface 1941**

dde-advise-start 1941  
dde-advise-start\* 1944  
dde-advise-stop 1945  
dde-advise-stop\* 1947  
dde-client-advise-data 1948  
dde-connect 1949  
dde-disconnect 1950  
dde-execute 1950  
dde-execute\* 1951  
dde-execute-command 1952  
dde-execute-command\* 1953  
dde-execute-string 1955  
dde-execute-string\* 1955  
dde-item 1957  
dde-item\* 1958  
dde-poke 1960  
dde-poke\* 1962  
dde-request 1964

dde-request\* 1966  
define-dde-client 1967  
with-dde-conversation 1968

## **53 The DDE server interface 1971**

dde-server-poke 1971  
dde-server-request 1972  
dde-server-topic 1973  
dde-server-topics 1974  
dde-system-topic 1975  
dde-topic 1975  
dde-topic-items 1976  
define-dde-dispatch-topic 1977  
define-dde-server 1978  
define-dde-server-function 1979  
start-dde-server 1983

## **54 Dynamic library C functions 1985**

InitLispWorks 1985  
LispWorksDlsym 1988  
LispWorksState 1989  
SimpleInitLispWorks 1990  
QuitLispWorks 1991

## **Index 1993**

*Contents*

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# Preface

## About this manual

This manual contains a user guide section (previously published separately as the *LispWorks User Guide*) and a reference section (previously the *LispWorks Reference Manual*).

## User Guide section

The user guide section of this manual describes the main language-level features and tools available in LispWorks, and how to use them.

These chapters describe the central programming tools and features in LispWorks:

- Chapter 1, “Starting LispWorks” describes how to start LispWorks and supply command line arguments.
- Chapter 2, “The Listener” describes the read-eval-print loop (REPL) listener.
- Chapter 3, “The Debugger” describes the REPL debugger.
- Chapter 4, “The REPL Inspector” describes the REPL inspector.
- Chapter 5, “The Trace Facility” describes the tracer.
- Chapter 6, “The Advice Facility”.

- Chapter 7, “Dspecs: Tools for Handling Definitions” describes the naming system for Lisp definitions, and in particular how to locate these.
- Chapter 8, “Action Lists” describes how you can run code at various hook points.
- Chapter 9, “The Compiler” describes the compiler optimization qualities and some ways to optimize your code.
- Chapter 10, “Code Coverage” shows you how to determine and visualize which parts of your program have actually run.
- Chapter 11, “Memory Management” covers the behavior (and for wizard level users, configuration) of the garbage collector.
- Chapter 12, “The Profiler” describes a tool for identifying bottlenecks impeding performance of your program.

The next chapter, Chapter 13, “Customization of LispWorks”, explains how to perform some commonly required customizations, such as controlling start-up appearance of LispWorks.

The remaining user guide chapters describe features of specialist interest:

- Chapter 14, “LispWorks as a dynamic library” describes how LispWorks operates as a DLL, .dylib or .so.
- Chapter 15, “Java interface” describes the LispWorks Java interface.
- Chapter 16, “Android interface” describes the LispWorks Android interface, which allows you to include a LispWorks runtime in an Android app.
- Chapter 17, “iOS interface” describes the LispWorks iOS interface, which allows you to include a LispWorks runtime in an iOS app.
- Chapter 18, “The Metaobject Protocol” describes how the LispWorks MOP implementation differs from AMOP.
- Chapter 19, “Multiprocessing”, including locks.
- Chapter 20, “Common Defsystem and ASDF” describes how to use `defsystem` to combine a series of source files into a manageable project.
- Chapter 21, “The Parser Generator”.

- Chapter 22, “Dynamic Data Exchange” describes how to implement DDE functionality in your Microsoft Windows applications.
- Chapter 23, “Common SQL” explains how to use LispWorks to communicate with databases using SQL.
- Chapter 24, “User Defined Streams” provides an illustrative example showing how to define and implement your own streams.
- Chapter 25, “TCP and UDP socket communication and SSL” describes the use of socket streams, including the Secure Sockets Layer (SSL).
- Chapter 26, “Internationalization: characters, strings and encodings” provides an overview of using international characters.
- Chapter 27, “LispWorks’ Operating Environment” explains how to find information about the Operating System and how LispWorks was started.
- Chapter 28, “Miscellaneous Utilities” describes miscellaneous functionality which does not belong in other chapters.
- Chapter 29, “64-bit LispWorks” outlines differences between 64-bit LispWorks and 32-bit LispWorks.
- Chapter 30, “Self-contained examples” enumerates the example files which are relevant to the content of this manual and are available in the LispWorks library.

Please note that documentation for Graphics Ports is in the *CAPI User Guide and Reference Manual*.

## Reference section

Most of the reference section is organized by package: each chapter contains reference material for the exported symbols in a given package. The chapters are organized alphabetically by package name.

Generally one chapter covers each package, but the `WIN32` package symbols are split into four chapters, and the last chapter contains reference material for C functions. Within each chapter, the symbols are organized alphabetically (ignoring non-alphanumeric characters that are common in Lisp symbols, such as `*`). The chapters are:

- Chapter 31, “The CLOS Package”, describes the LispWorks extensions to CLOS, the Common Lisp Object System.
- Chapter 32, “The COMM Package”, describes the functions providing the TCP/IP interface.
- Chapter 33, “The COMMON-LISP Package”, describes the LispWorks extensions to symbols in the `COMMON-LISP` package. You should refer to the Common Lisp HyperSpec, supplied in HTML format with LispWorks, for full documentation about standard Common Lisp symbols.
- Chapter 34, “The COMPILER Package”, describes symbols available in the `COMPILER` package.
- Chapter 35, “The DBG Package”, describes symbols available in the `DBG` package, used to configure the debugging information produced by LispWorks.
- Chapter 36, “The DSPEC Package”, describes the symbols available in the `DSPEC` package, which are used for naming and locating definitions.
- Chapter 37, “The EXTERNAL-FORMAT Package”, describes symbols available in the `EXTERNAL-FORMAT` package.
- Chapter 38, “The HCL Package”, describes symbols available in the `HCL` package.
- Chapter 39, “The LINK-LOAD Package”, describes symbols available in the `LINK-LOAD` package. It applies to LispWorks for SPARC Solaris.
- Chapter 40, “The LISPWORKS Package”, describes symbols available in the `LISPWORKS` package.
- Chapter 41, “The LW-JI Package”, describes symbols available in the `LW-JI` package, which allows you to call to and from Java. This chapter describes the Java classes and methods available in LispWorks.
- Chapter 42, “Java classes and methods” describes the Java classes and methods available in LispWorks.
- Chapter 43, “Android Java classes and methods” describes the additional Java classes and methods available in LispWorks for Android Runtime.

- Chapter 44, “The MP Package”, describes symbols available in the **MP** package, giving you access to the multiprocessing capabilities of LispWorks.
- Chapter 45, “The PARSERGEN Package”, describes symbols available in the **PARSERGEN** package, the LispWorks parser generator.
- Chapter 46, “The SERIAL-PORT Package” documents the Serial Port API. This is implemented only in LispWorks for Windows.
- Chapter 47, “The SQL Package” documents symbols used in accessing LispWorks ODBC and SQL functionality.
- Chapter 48, “The STREAM Package” documents the symbols available in the **STREAM** package that provide users with the functionality to define their own streams for use by the standard I/O functions.
- Chapter 49, “The SYSTEM Package”, describes symbols available in the **SYSTEM** package.
- Chapter 50, “Miscellaneous WIN32 symbols”, describes miscellaneous symbols available in the **WIN32** package. It applies only to LispWorks for Windows.
- Chapter 51, “The Windows registry API”, describes the Windows registry API. It applies only to LispWorks for Windows.
- Chapter 52, “The DDE client interface”, describes the Dynamic Data Exchange (DDE) client API. It applies only to LispWorks for Windows.
- Chapter 53, “The DDE server interface”, describes the Dynamic Data Exchange (DDE) server API. It applies only to LispWorks for Windows.
- Chapter 54, “Dynamic library C functions”, describes C functions available in LispWorks dynamic libraries.

Many of these reference chapters should be used in conjunction with corresponding chapters in the user guide section. Reference material for some aspects of LispWorks can be found in other manuals.

## Conventions used for reference entries

Each entry is headed by the symbol name and type, followed by a number of fields providing further details. These fields consist of a subset of the follow-

ing: “Summary”, “Package”, “Signature”, “Method signatures”, “Arguments”, “Values”, “Initial value”, “Superclasses”, “Subclasses”, “Initargs”, “Accessors”, “Readers”, “Description”, “Notes”, “Compatibility notes”, “Examples” and “See also”.

Some symbols with closely-related functionality are coalesced into a single reference entry.

Throughout, variable arguments, slots and return values are italicised. They look *like-this*.

Throughout, exported symbols and example code are printed `like-this`. The package qualifier is usually omitted, unless the symbol is not documented in this manual.

Entries with a long “Description” section usually have as their first field a short “Summary” providing a quick overview of the symbol’s purpose.

The “Package” section shows the package from which the symbol is exported.

The “Signature” section shows the arguments and return values of functions and macros, and the parameters of types.

In a Generic Function entry there may be a “Method signatures” section showing system-defined method signatures.

The “Arguments” and "Values" sections show types of the arguments and return values.

In a Variable entry, the “Initial value” section shows the initial value.

In a Class entry the “Subclasses” section of lists the external subclasses, though not subclasses of those, and the “Superclasses” section lists the external superclasses, though not superclasses of those. The “Initargs” section describes the initialization arguments of the class, though note that initargs of superclasses are also valid. There may be an “Accessors” section listing accessor functions which are both readers and writers, and/or a “Readers” section listing accessor functions which are only readers. Accessor functions access the slot with matching name.

The “Description” section contains the detail of what the symbol does, how each argument is interpreted (and its default value if applicable), and how

each return value is derived. More incidental information may be shown in a “Notes” section.

A few entries have a “Compatibility notes” section describing changes in the symbol’s functionality relative to other LispWorks versions.

Examples are given under the “Examples” heading. Short examples are shown directly. Longer examples are supplied as source files in your LispWorks installation directory under `examples/`. The convenience function `example-edit-file` allows you to open these files in the LispWorks editor. The examples files are in a read-only directory and therefore you should compile them inside the IDE (by the Editor command `Compile Buffer` or the toolbar button or by choosing **Buffer > Compile** from the context menu), so it does not try to write a fasl file. If you want to manipulate an example file or compile it on the disk rather than in the IDE, then you need first to copy the file elsewhere (most easily by using the Editor command `Write File` or by choosing **File > Save As** from the context menu).

Finally, the “See also” section provides links to other related symbols and user guide sections.

## The LispWorks manuals

The LispWorks manual set comprises the following books:

- The Common Lisp HyperSpec contains the specification for Common Lisp itself.
- The *LispWorks User Guide and Reference Manual*—this book—describes the main language-level features and tools available in LispWorks, along with an extensive reference of the functions, macros, variables and classes organized by package. Where LispWorks extends the functionality of a Common Lisp symbol, this is mentioned in Chapter 33, “The COMMON-LISP Package”
- The *LispWorks IDE User Guide* describes the LispWorks IDE, the user interface for LispWorks. This is a set of windowing tools that let you develop and test Common Lisp code more easily and quickly.
- The *LispWorks Editor User Guide* describes the keyboard commands and programming interface to the LispWorks IDE editor tool.

- The *CAPI User Guide and Reference Manual* describes the CAPI. This is a library of classes, functions, and macros for developing graphical user interfaces for your applications. It comprises a tutorial guide to the CAPI and an in-depth reference text.
- The *LispWorks Foreign Language Interface User Guide and Reference Manual* explains how you can use C source code in applications developed using LispWorks.
- The *LispWorks Delivery User Guide* describes how you can deliver working, standalone versions of your LispWorks applications for distribution to your customers.
- *Developing Component Software with CORBA* describes how LispWorks can interoperate with other CORBA-compliant systems.
- The *LispWorks COM/Automation User Guide and Reference Manual* describes a toolkit for using Microsoft COM and Automation in LispWorks for Windows.
- The *LispWorks Objective-C and Cocoa Interface User Guide and Reference Manual* describes APIs for interfacing to Objective-C and Cocoa in LispWorks for Macintosh.
- The *KnowledgeWorks and Prolog User Guide* describes the LispWorks toolkit for building knowledge-based systems. Common Prolog is a logic programming system written in Common Lisp.
- The *LispWorks Release Notes and Installation Guide* explains how to install LispWorks and start it running. It also contains Release Notes describing the new features in this release and any issues that could not be included in the other manuals.

The LispWorks manuals are all available in Portable Documentation Format (PDF). You can use Adobe Reader to browse the PDF documentation online or to print it. Adobe Reader is available for free download from Adobe's web site at [www.adobe.com](http://www.adobe.com).

The LispWorks manuals are also available in HTML format. Commands in the **Help** menu of any of the LispWorks IDE tools give you direct access to the HTML documentation, using your web browser. Details of how to use these commands can be found in the *LispWorks IDE User Guide*.

Please let us know if you find any mistakes in the LispWorks documentation, or if you have any suggestions for improvements.

## Other documentation

The LispWorks manuals do not attempt to describe Lisp itself. For definitive information on Common Lisp, including CLOS, consult the American National Standard X3.226 for Common Lisp. An HTML version of this document is supplied with LispWorks and can be accessed from the **Help** menu.

For information on CLOS, Sonya E. Keene's book *Object-Oriented Programming in Common Lisp: A Programmers' Guide* is very helpful. This book is published by Addison-Wesley.

For an account of Metaobject protocols as well as a detailed study of an implementation of CLOS see Kiczales, des Rivières and Bobrow, *The Art of the Meta-Object Protocol*, published by MIT Press, often referred to as AMOP. The LispWorks MOP mostly conforms to chapters 5 & 6 of AMOP; the differences are mentioned here in Chapter 18, "The Metaobject Protocol".

## Notation and conventions

The LispWorks manuals follow the notation used in *Common Lisp: the Language (2nd Edition)*.

This manual often refers to example files in the LispWorks library, like this:

```
(example-edit-file "ssl/ssl-client")
```

These examples are Lisp source files in your LispWorks installation under `lib/7-1-0-0/examples/`. You can simply evaluate the given form to view the example source file.

Other references such as "... the LispWorks file `foo/bar.lisp`" mean a file `bar.lisp` in a subdirectory `foo` of the LispWorks library directory. Evaluate this form in your LispWorks image to obtain the full path of such a file:

```
(sys:lispworks-file "foo/bar.lisp")
```



# 1

---

---

# Starting LispWorks

Firstly you need LispWorks installed as described in the Release Notes and Installation Guide.

## 1.1 The usual way to start LispWorks

On Microsoft Windows and Mac OS X the simplest way to run LispWorks is that provided in the desktop environment. On Windows you can run LispWorks from the desktop Start menu, or the Start screen on Windows 8. On Mac OS X you can run LispWorks by clicking on the "LW" icon in the Dock. On both these platforms you can create a shortcut to LispWorks and place it somewhere that is convenient for you, such as the Windows 8 taskbar.

On non-Windows and non-Mac OS X systems you start LispWorks by entering the name of the LispWorks executable at a shell prompt.

## 1.2 Passing arguments to LispWorks

Occasionally you may need to start LispWorks with certain arguments. This section describes the most frequent of these occasions.

### 1.2.1 Saving a new image

**Note:** If you use the LispWorks IDE, you may find a saved session more convenient than saving an image as described in this section. See “Saved sessions” on page 182 for more information.

To save a new image "by hand", create a suitable file `save-config.lisp` as described in the section "Saving and testing the configured image" in the *LispWorks Release Notes and Installation Guide*. Such a file should load any desired configuration, modules and application code, and lastly call `save-image`.

Then you run LispWorks with a command line which passes your file as a build script.

On Mac OS X, run Terminal.app to get a shell, and enter a line like this at the prompt:

```
% lispworks-7-1-0-x86-darwin -build /tmp/save-config.lisp
```

On Microsoft Windows, run Command Prompt to get a DOS shell, and enter a line like this:

```
C:\Program Files\LispWorks>lispworks-7-1-0-x86-win32.exe -build  
C:\temp\save-config.lisp
```

On Linux, get a shell and enter a line like this:

```
% lispworks-7-1-0-x86-linux -build /tmp/save-config.lisp
```

On UNIX, get a shell and enter a line like this:

```
% lispworks-7-1-0-sparc-solaris -build /tmp/save-config.lisp
```

When the command exits, a new image has been saved. You can run this new image directly from the command line, or create a shortcut or symbolic link to make it convenient to run.

With all the command lines above, if you perform the task frequently, make a script or a shortcut containing the command line, and run that.

Note that `save-config.lisp` no longer needs to do `(load-all-patches)` because `-build` calls `load-all-patches` automatically in LispWorks 6.1 and later versions. However, if `save-config.lisp` does call `load-all-patches`, this is harmless.

## 1.2.2 Saving a console mode image

To save a LispWorks image which does not start the LispWorks IDE by default, make a script similar to `save-config.lisp` above, but where you call

```
(save-image "my-console-lispworks" :environment nil)
```

The resulting new image, `my-console-lispworks`, can be made to start the LispWorks IDE either by calling `env:start-environment` or by passing `-env` or `-environment` on the command line.

## 1.2.3 Bypassing initialization files

If you do not want to load your personal initialization file, for example to discover if the behavior of LispWorks is due to some setting of yours, pass `-init-` on the command line.

To start LispWorks without loading either the personal or site initialization files, start it like this:

```
lispworks -init - -siteinit -
```

## 1.2.4 Other command line options

Other less commonly-used LispWorks command line arguments are described in “The Command Line” on page 454

# 1.3 Starting the LispWorks Graphical IDE

In LispWorks images shipped on the Windows, Mac OS X, Linux, x86/x64 Solaris, FreeBSD and AIX platforms, the IDE starts automatically by default.

If you have an image saved such that the IDE does not start by default, you can start the IDE by calling the function `env:start-environment`. Such an image is shipped for UNIX platforms.

# 1.4 Using LispWorks with SLIME

Download SLIME from <http://common-lisp.net/project/slime/>

### 1.4.1 Using the Professional/Enterprise Editions with SLIME

To use LispWorks with SLIME it is best to use an image which does not start the LispWorks IDE automatically. You can create such an image with LispWorks Professional or Enterprise Edition. Save it as `~/lw-console` as described in “Saving a non-GUI image with multiprocessing enabled” on page 181.

Configure Emacs to use "`~/lw-console`" as the value of `inferior-lisp-program` as shown in the SLIME README.

### 1.4.2 Using the Personal Edition with SLIME

Start LispWorks Personal Edition, which starts the LispWorks IDE automatically.

Execute these forms in the LispWorks IDE:

```
(load "/path/to/slime/swank-loader")
(swank-loader:init)
(swank:create-server :port 4005)
```

Inside Emacs, `Meta+X slime-connect`. Use the same port given above.

## 1.5 Quitting LispWorks

To quit LispWorks from the LispWorks IDE, use one of the following:

- The menu command **File > Exit** all platforms except Mac OS X.
- The menu command **LispWorks > Quit LispWorks** on Mac OS X.
- The key `Command+Q` on Mac OS X
- The key sequence `ctrl+x ctrl+c` in an editor-based tool such as the Editor or Listener
- A platform/window-manager-specific exit gesture such as clicking a close button on the Podium window
- Call the function `quit`.

To quit LispWorks when running in console mode or via SLIME, simply call `quit`.

# 2

---

## The Listener

The listener is another name for the read-eval-print loop (REPL) which allows you to interactively evaluate Lisp forms and see their output and return values. Lisp programmers typically do incremental development and testing in a listener before saving the working code to disk.

This chapter describes the basic use of a LispWorks listener. You might access this in a terminal (Unix shell) or MS-DOS command window. Alternatively the LispWorks IDE contains a graphical Listener tool which runs a REPL and supports all the functionality described in this chapter, as well as its own graphical features. Please refer to the *LispWorks IDE User Guide* for details specific to the graphical Listener tool.

### 2.1 First use of the listener

LispWorks runs a top-level REPL on startup. The listener by default appears with a prompt. The name of the current package (that is, the value of `cl:*package*`) is printed followed by a positive integer, like this:

```
CL-USER 1 >
```

Enter a Lisp form after the prompt and press `Return`:

```
CL-USER 1 > (print 42)
```

```
42
42
```

```
CL-USER 2 >
```

The first ‘42’ printed is the output of the call to `print`. You see it here because output sent to `*standard-output*` is written to the listener.

The second ‘42’ printed is the return value of the call to `print`.

After the return value a new prompt appears. Notice that it contains ‘2’ after the package name: your successive inputs are numbered. You can now proceed to develop and test pieces of your application code:

```
CL-USER 2 > (defstruct animal species name weight)
ANIMAL

CL-USER 3 > (make-animal :species "Hippopotamus" :name "Hilda"
  :weight 42)
#S(ANIMAL :SPECIES "Hippopotamus" :NAME "Hilda" :WEIGHT 42)
```

## 2.2 Standard listener commands

Generally the listener simply evaluates Lisp forms that you enter. However a few keywords, described in the this section, are specially recognized as shortcut for common listener operations.

### 2.2.1 Standard top-level loop commands

<code>:redo</code>	<i>Listener command</i>
--------------------	-------------------------

`:redo &optional command-identifier`

This option repeats a previous input. The *command-identifier* is either a number in the listener’s history list or a symbol or subform in the input to repeat. If *command-identifier* is not supplied, the last input is repeated.

<code>:get</code>	<i>Listener command</i>
-------------------	-------------------------

`:get name command-identifier`

**:get** retrieves a previously-entered input from the listener's history and places it in the variable *name*. The *command-identifier* is the history list number of the input to be retrieved.

**:use***Listener command*

**:use new old &optional command-identifier**

**:use** does a variant of a previous input. *old* matches a symbol or sub-form in the previous input, and is replaced with *new* to construct the new input. If supplied, *command-identifier* is the history list number of the input you want to modify.

**:his***Listener command*

**:his &optional n m**

**:his** produces a list of the input history. If *n* is supplied it should be a positive integer: the last *n* inputs are shown. If *m* is also supplied it should be a positive integer greater than *n*, when inputs numbered *n* through *m* in the history are shown.

**:bug-form***Listener command*

**:bug-form subject &key filename**

**:bug-form** prints a template bug report suitable for sending to Lisp Support. Supply a string *subject*. If you also supply *filename*, the report is printed to the file.

**:help***Listener command*

**:help**

**:help** prints a brief listing of the available listener commands.

**:?***Listener command*

**:?**

`:?` is a synonym for `:help`.

### 2.2.2 Examples

```

CL-USER 4 > :redo
(MAKE-ANIMAL :SPECIES "Hippopotamus" :NAME ...)
#S(ANIMAL :SPECIES "Hippopotamus" :NAME "Hilda" :WEIGHT 42)

CL-USER 5 > :his

1: (PRINT 42)
2: (DEFSTRUCT ANIMAL SPECIES NAME ...)
3: (MAKE-ANIMAL :SPECIES "Hippopotamus" :NAME ...)
4: (MAKE-ANIMAL :SPECIES "Hippopotamus" :NAME ...)

CL-USER 5 > :get make-hilda 3

CL-USER 5 > make-hilda
(MAKE-ANIMAL :SPECIES "Hippopotamus" :NAME "Hilda" :WEIGHT 42)

CL-USER 6 > :use "Henry" "Hilda"
(MAKE-ANIMAL :SPECIES "Hippopotamus" :NAME ...)
#S(ANIMAL :SPECIES "Hippopotamus" :NAME "Henry" :WEIGHT 42)

CL-USER 7 > :bug-form "Too many hippos..." :filename "bug-
report.txt"

```

## 2.3 The listener prompt

The variable `*prompt*` controls the appearance of the listener prompt. See `*prompt*`, page 1163 if you want to alter this.

If the default prompt contains a colon followed by a second positive integer then you are no longer in the top-level loop, but have entered the REPL debugger, as described in “The Debugger” on page 9.

# 3

---

## The Debugger

The debugger is an interactive tool for examining and manipulating the Lisp environment. Within the debugger you have access to not only the interpreter, but also to a variety of debugging tools. The default behavior when any error occurs is to enter the debugger. Users can then trace backwards through the history of function calls to determine how the error arose. They may inspect and alter local variables of the functions on the execution stack, and possibly continue execution by invoking a pre-defined restart (if available) or by forcing any function invocation on the stack to return user-specified values.

When writing an application it is possible to prevent entry to the debugger when an error occurs, by creating condition handlers to take some appropriate action to recover without user intervention. It is also possible to use restarts to specify some default methods of error recovery. The debugger is entered whenever an error is signaled (via a call to `error` or `cerror`) and not handled by an error handler, or it can be explicitly invoked via a call to `break`.

You can use the debugger in REPL mode (that is, in the listener read-eval-print loop) or using the graphical Debugger tool in the LispWorks IDE. This chapter describes the REPL debugger; please refer to the *LispWorks IDE User Guide* for details about the graphical Debugger tool.

The compiler generates information necessary for the use of the debugger during compilation. You can opt for faster compilation, at the expense of

reducing the information available to the debugger, using `toggle-source-debugging`.

## 3.1 Entering the REPL debugger

The following is a simple example.

```
CL-USER 2 > (defun make-a-hippo (name weight)
  (if (numberp weight)
      (make-animal 'hippo name weight)
      (error "Argument to make-a-hippo not a number")))
MAKE-A-HIPPO

CL-USER 3 > (make-a-hippo "Hilda" nil)

Error: Argument to make-a-hippo not a number
1 (abort) Return to level 0.
2 Return to top loop level 0.

Type :b for backtrace or :c <option number> to proceed.
Type :bug-form "<subject>" for a bug report template or :? for
other options.

CL-USER 4 : 1 >
```

The call to `error` causes entry into the debugger. The final prompt in the example contains a 1 to indicate that the top level of the debugger has been entered. The debugger can be entered recursively, and the prompt shows the current level. Once inside the debugger, you may use all the facilities available at the top-level in addition to the debugger commands.

The debugger may also be invoked by using the trace facility to force a break at entry to or exit from a particular function.

The debugger can also be entered by a keyboard interrupt. Keyboard interrupts are generated by the *break gesture*, which varies between the supported systems as follows:

Microsoft Windows

**Ctrl+Break**

GTK and Motif **Meta+Ctrl+C**

**Break** if keyboard has that key. Note that PC keyboards do not have **Break**, only **Ctrl+Break**, which is different. See also `capi:set-interactive-break-gestures`.

Cocoa	<b>Command+Control+,</b> (comma). This is only supported on Mac OS X 10.4 and newer.
-------	--

When the break gesture is used, LispWorks attempts to find a busy process to break. If there is no obvious candidate and the LispWorks IDE is running, then it displays the Process Browser tool.

## 3.2 Simple use of the REPL debugger

Upon entering the debugger as a result of an error, a message describing the error is printed and a number of options to continue (called restarts) are presented. Thus:

```
CL-USER 6 > (/ 3 0)

Error: Division-by-zero caused by / of (3 0)
  1 (continue) Return a value to use
  2 Supply new arguments to use
  3 (abort) return to level 0.
  4 return to top loop level 0.
  5 Destroy process.

Type :c followed by a number to proceed

CL-USER 7 : 1 >
```

To select one of these restarts, enter `:c` (continue) followed by the number of the restart. So in the above example you could continue as follows:

```
CL-USER 7 : 1 > :c 2

Supply first number: 33

Supply second number: 11
3

CL-USER 8 >
```

There are two special restarts, a continue restart and an abort restart. These are indicated by the bracketed word continue or abort at their start. The continue restart can be invoked by typing :c alone. Similarly, the abort restart can be invoked by entering :a. So an alternative continuation of the division example would be:

```
CL-USER 7 : 1 > :c  
Supply a form to be evaluated and used: (+ 4 5)  
9
```

### 3.3 The stack in the debugger

The debugger allows you to examine the state of the execution stack. This consists of a sequence of frames representing active function invocations, special variable bindings, restarts, active catchers, active handlers and system-related code. In particular the execution stack has a call frame for each active function call (that is for each function that has been entered but from which control has not yet returned). The top of the stack contains the most recently created frames (and so the innermost calls), and the bottom of the stack contains the oldest frames (and so the outermost calls). You can examine a call frame to find the function's name, and the names and values of its arguments.

The function call frames displayed are affected by any `hcl:alias` and `hcl:invisible-frame` declarations. See `declare`, page 651 for the details.

Catch frames are established by using the special form `catch`, and exist to receive throws to the matching tag. Restart frames correspond to restarts that have been set up, and handler frames correspond to the error handlers currently active. Binding frames are formed when special variables are bound. Open frames are established by the system. By default only the catch frames and the call frames are displayed. However the remaining types of frame are displayed if you set the appropriate variables (see Section 3.6 on page 23).

Within the debugger there are commands to examine a stack frame, and to move around the stack. These are explained in the following section. Typing `:help` in the debugger also produces a command listing.

One of the most useful features is that you can access a local variable in the current frame simply by entering its name as shown in the backtrace. See step 7 in “Example debugging session” on page 21.

## 3.4 REPL debugger commands

This section describes commands specific to the debugger. In the debugger, you can also do anything that you can do in the top-level loop including evaluation of forms and the standard listener commands.

Upon entry to the debugger the implicit current stack frame is set to the top of the execution stack. The debugger commands allow you to move around the stack, to examine the current frame, and to leave the debugger. The commands are all keywords, and as such case-insensitive, but are shown here in lower case for clarity.

You can get brief help listing these commands by entering `:?` at the debugger prompt.

### 3.4.1 Backtracing

A backtrace is a list of the stack frames starting at the current frame and continuing down the stack. The backtrace thus displays the sequence by which the functions were invoked, starting with the most recent. For instance:

### 3 The Debugger

```
CL-USER 10 > (defun function-1 (a b c)
                  (function-2 (+ a b) c))
FUNCTION-1

CL-USER 11 > (defun function-2 (a b)
                  (function-3 (+ a b)))
FUNCTION-2

CL-USER 12 > (defun function-3 (a) (/ 3 (- 111 a)))
FUNCTION-3

CL-USER 13 > (function-1 1 10 100)

Error: Division-by-zero caused by / of (3 0)
1 (continue) Return a value to use
2 Supply new arguments to use
3 (abort) return to level 0.
4 return to top loop level 0.
5 Destroy process.

Type :c followed by a number to proceed

CL-USER 14 : 1 > :bq 10

SYSTEM::DIVISION-BY-ZERO-ERROR <- / <- FUNCTION-3
<- SYSTEM::*%APPLY-INTERPRETED-FUNCTION <- FUNCTION-2
<- SYSTEM::*%APPLY-INTERPRETED-FUNCTION <- FUNCTION-1
<- SYSTEM::*%APPLY-INTERPRETED-FUNCTION <- SYSTEM:::%INVOKE <-
SYSTEM::%EVAL

CL-USER 15 : 1 >
```

In the above example the command to show a quick backtrace was used (`:bq`). Instead of showing each stack frame fully, this only shows the function name associated with each of the call frames. The number 10 following `:bq` specifies that only the next ten frames should be displayed rather than continuing to the bottom of the stack.

**:b**

*Debugger command*

`:b &optional verbose m`

This is the command to obtain a backtrace from the current frame. It may optionally be followed by `:verbose`, in which case a fuller description of each frame is given that includes the values of the arguments to the

function calls. It may also be followed by a number (*m*), specifying that only that number of frames should be displayed.

**:bq**

*Debugger command*

**:bq m**

This produces a quick backtrace from the current position. Only the call frames are included, and only the names of the associated functions are shown. If the command is followed by a number then only that many frames are displayed.

### 3.4.2 Moving around the stack

On entry to the debugger the current frame is the one at the top of the execution stack. There are commands to move to the top and bottom of the stack, to move up or down the stack by a certain number of frames, and to move to the frame representing an invocation of a particular function.

**:>**

*Debugger command*

This sets the current frame to the one at the bottom of the stack.

**:<**

*Debugger command*

This sets the current frame to the one at the top of the stack.

**:p**

*Debugger command*

**:p [m | fn-name | fn-name-substring]**

By default this takes you to the previous frame on the stack. If it is followed by a number then it moves that number of frames up the stack. If it is followed by a function name then it moves to the previous call frame for that function. If it is followed by a string then it moves to the previous call frame whose function name contains that string.

**:n** *Debugger command*

**:n [m | fn-name | fn-name-substring]**

Similar to the above, this goes to the next frame down the stack, or *m* frames down the stack, or to the next call frame for the function *fn-name*, or to the next call frame whose function name contains *fn-name-substring*.

### 3.4.3 Miscellaneous commands

**:v** *Debugger command*

This displays information about the current stack frame. In the case of a call frame corresponding to a compiled function the names and values of the function's arguments are shown. Closure variables (either from an outer scope or used by an inner scope) and special variables are indicated by {closing} or {special} as in this session:

```

CL-USER 32 > (compile (defun foo (*zero* one two)
                           (declare (special *zero*))
                           (list (/ one *zero*)) #'(lambda () one)
                           two))
FOO
NIL
NIL

CL-USER 33 > (foo 0 1 2)

Error: Division-by-zero caused by / of (1 0).
1 (continue) Return a value to use.
2 Supply new arguments to use.
3 (abort) Return to level 0.
4 Return to top loop level 0.

Type :b for backtrace or :c <option number> to proceed.
Type :bug-form "<subject>" for a bug report template or :? for
other options.

CL-USER 34 : 1 > :n foo
Call to FOO

CL-USER 35 : 1 > :v
Call to FOO {offset 114}
*ZERO* {Special} : 0
ONE {Closing} : 1
TWO : 2

CL-USER 36 : 1 >

```

For an interpreted function the names and values of local variables are also shown.

If the value of an argument is not known (perhaps because the code has been compiled for speed rather than other considerations), then it is printed as the keyword `:dont-know`.

:l

*Debugger Command*

`:l [m | var-name | var-name-substring]`

By default this prints a list of the values of all the local variables in the current frame. If the command is followed by a number then it prints the value of the `m`'th local variables (counting from 0, in the order shown

by the `:v` command). If it is followed by a variable name *var-name* then it prints the value of that variable (note that the same effect can be achieved by just entering the name of the variable into the Listener). If it is followed by a string *var-name-substring* then it prints the value of the first variable whose name contains *var-name-substring*.

In all cases, `*` is set to the printed value.

`:error`

*Debugger command*

This reprints the message which was displayed upon entry to the current level of the debugger. This is typically an error message and includes several continuation options.

`:cc`

*Debugger command*

`:cc &optional var`

This returns the current condition object which caused entry to this level of the debugger. If an optional *var* is supplied then this must be a symbol, whose symbol-value is set to the value of the condition object.

`:ed`

*Debugger command*

This allows you to edit the function associated with the current frame. If you are using TAGS, you are prompted for a TAGS file.

`:all`

*Debugger command*

`:all &optional flag`

This option enables you to set the debugger option to show all frames (if *flag* is non-nil), or back to the default (if *flag* is nil). By default, *flag* is t.

See also `set-debugger-options`.

**:lambda***Debugger command*

This returns the lambda expression for an anonymous interpreted frame. If the expression is not known, then it is printed as the keyword :**don't-know**

**:func***Debugger command*

**:func** &optional *disassemble-p*

This returns (and sets \*) the function object of the current frame. This is especially useful for the call frame of functions that are not the symbol function of some symbols, for example closures and method functions.

If *disassemble-p* is true, **:func** first disassembles the function, and then returns it and sets \*. The default value of *disassemble-p* is **nil**.

**:func** is applicable only in call frames.

**:if***Debugger command*

This command prints symbols from other packages corresponding to the symbol that was called, but could not be found, in the current package. Any such symbols are also offered as restarts when you first enter the debugger.

```
NEW 21 > (initialize-graphics-port)

Error: Undefined function INITIALIZE-GRAFICS-PORT called with
arguments ().

  1 (continue) Try invoking INITIALIZE-GRAFICS-PORT again.
  2 Return some values from the call to INITIALIZE-GRAFICS-PORT.
  3 Try invoking GRAPHICS-PORTS:INITIALIZE-GRAFICS-PORT with the
same arguments.
  4 Set the symbol-function of INITIALIZE-GRAFICS-PORT to the
symbol-function of GRAPHICS-PORTS:INITIALIZE-GRAFICS-PORT.
  5 Try invoking something other than INITIALIZE-GRAFICS-PORT
with the same arguments.
  6 Set the symbol-function of INITIALIZE-GRAFICS-PORT to
another function.
  7 (abort) Return to level 0.
  8 Return to top loop level 0.

Type :c followed by a number to proceed or type :? for other
options

NEW 22 : 1 > :lf
Possible candidates are (GRAPHICS-PORTS:INITIALIZE-GRAFICS-PORT)
GRAPHICS-PORTS:INITIALIZE-GRAFICS-PORT

NEW 23 : 1 >
```

### 3.4.4 Leaving the debugger

You may leave the debugger either by taking one of the continuation options initially presented, or by explicitly specifying values to return from one of the frames on the stack.

**:a** *Debugger command*

This selects the **:abort** option from the various continuation options that are displayed when you enter the current level of the debugger.

**:c** *Debugger command*

**:c &optional m**

If this is followed by a number then it selects the option with that number, otherwise it selects the **:continue** option.

**:ret***Debugger command***:ret value**

This causes *value* to be returned from the current frame. It is only possible to use this command when the current frame is a call frame. Multiple values may be returned by using the **values** function. So to return the values 1 and 2 from the current call frame, you could type

**:ret (values 1 2)****:res***Debugger command***:res m**

Restarts the current frame. If *m* is **nil**, you are prompted for new arguments which should be entered on one line, separated by whitespace. If *m* is true or is not supplied, the original arguments to the frame are used.

**:top***Debugger command*

Aborts to the top level of the debugger. A synonym is **:a :t**.

### 3.4.5 Example debugging session

This section presents a short interactive debugging session. It starts by defining a routine to calculate Fibonacci Numbers, and then erroneously calls it with a string.

1. First, define the **fibonacci** function shown below in a listener.

```
(defun fibonacci (m)
  (let ((fib-n-1 1)
        (fib-n-2 1)
        (index 2))
    (loop
      (if (= index m) (return fib-n-1))
      (incf index)
      (psetq fib-n-1 (+ fib-n-1 fib-n-2)
            fib-n-2 fib-n-1))))
```

2. Next, call the function as follows.

```
(fibonacci "turtle")
```

The system generates an error, since `c1 :=` expects its arguments to be numbers, and displays several continuation options, so that you can try to find out how the problem arose.

3. Enter `:bb` at the debugger prompt to obtain a full backtrace.

Notice that the problem is in the call to `fibonacci`.

You should have passed the length of the string as an argument to `fibonacci`, rather than the string itself.

4. Attempt to calculate this value now, by typing the following form at the debugger prompt.

```
(length "turtle")
```

You intended to call `fibonacci` with the length of the string, but entered `length` incorrectly. This takes you into the second level of the debugger. Note that the continuation options from your entry into the top level of the debugger are still displayed, and are listed after the new options. You can select any of these options.

5. Enter `:a` to abort one level of the debugger.

6. Enter `:error` to remind yourself of the original error that you need to handle. You need to fix the value passed as the second argument to `fibonacci`.

7. Enter `:n fibonacci` to move to the stack frame for the call to `fibonacci`.

8. Enter `:v` to display variable information about this stack frame:

```
Interpreted call to FIBONACCI:  
  M      : "turtle"  
  INDEX   : 3  
  FIB-N-2 : 1  
  FIB-N-1 : 2
```

You need to set the value of the variable `m` to be the length of the string `"turtle"`, rather than the string itself.

9. Enter this form:

```
(setq m (length "turtle"))
```

In order to get the original computation to resume using the new value of *m*, you still need to handle the original error.

**10.** Enter `:error` to remind yourself of the original error condition.

You can handle this error by returning `nil` from the call to `c1:=`, which is the result that would have been obtained if *m* had been correctly set initially.

**11.** Enter `:c` to invoke the `continue` restart, which in this case requires you to return a value to use.

**12.** When prompted for a form to be evaluated, enter `nil`.

This causes execution to continue as desired. Notice that the correct result `8` is returned.

## 3.5 Debugger troubleshooting

Code which modifies the readable case of the readtable can hinder debugger interaction. This is because standard commands entered as lowercase `:a` for example will not be recognized if the readtable case is `:preserve` or `:down-case`.

You can use `with-debugger-wrapper` together with `with-standard-io-syntax` to enable the debugger to recognize such input if the code in *body* should enter the debugger, like this:

```
(defun my-debugger-wrapper (func condition)
  (with-standard-io-syntax
    (funcall func condition)))

(dbg:with-debugger-wrapper
  'my-debugger-wrapper
  (let ((*readtable* (some-modified-readtable)))
    body))
```

## 3.6 Debugger control variables

`cl:*debug-io*`

The value of this variable is the stream which the debugger uses for its input and output.

`dbg:*debug-print-length*`

The value to which `cl:*print-length*` is bound during output from the debugger.

**`dbg:*debug-print-level*`**

The value to which `cl:*print-level*` is bound during output from the debugger.

**`dbg:*hidden-packages*`**

This variable should be bound to a list of packages. The debugger suppresses symbols from these packages (so, for example, it does not display call frames for functions in these packages).

**`dbg:*print-binding-frames*`**

This variable controls whether binding frames are displayed by the debugger. The initial value is `nil`. The value can be set directly or by calling `set-debugger-options` which may be more convenient.

**`dbg:*print-catch-frames*`**

This variable controls whether catch frames are displayed by the debugger. The initial value is `nil`. The value can be set directly or by calling `set-debugger-options` which may be more convenient.

**`dbg:*print-handler-frames*`**

This variable controls whether handler frames are displayed by the debugger. The initial value is `nil`. The value can be set directly or by calling `set-debugger-options` which may be more convenient.

**`dbg:*print-restart-frames*`**

This variable controls whether restart frames are displayed by the debugger. The initial value is `nil`. The value can be set directly or by calling `set-debugger-options` which may be more convenient.

.

## 3.7 Remote debugging

Remote debugging allows you to debug a LispWorks process that is running on one machine using a LispWorks IDE that is running on another machine. It is intended to make it easier to debug applications running on machines that do not have the LispWorks IDE, mainly mobile device applications on iOS and Android, but also applications running on servers where you cannot run the LispWorks IDE.

In the discussion below, the process being debugged is referred to as the "client", and the process running the LispWorks IDE is referred to the "IDE".

With remote debugging you can:

- Make the client, when it enters the debugger, open a GUI debugger in the IDE. The GUI debugger behaves like an ordinary GUI debugger, but the data it displays is from the client, and input into its Listener pane is read and evaluated by the client.
- Open a Listener in the IDE, where reading and evaluating input is done by the client. This can be done either by calling `start-remote-listener` on the client side, or `ide-open-a-listener` on the IDE side.
- Inspect remote objects, by using the Inspector as usual on the IDE side, or `remote-inspect` on the client side.
- Evaluate forms on the client side from the Editor on the IDE side.

When you look at the source code from an IDE tool that is displaying client side data (for example by using the **Find Source** menu item) or look at the class of a remote object, the IDE finds the matching source or class on its side. You need to ensure that the IDE and the client sides have the same sources and class definitions for that to work.

Remote debugging is based on "connections", which are implemented on top of streams connecting the two sides. In normal usage, LispWorks will open a TCP socket stream for a connection, but you can also create connections with your own streams or sockets.

A LispWorks process that has loaded the remote debugging module can be connected to several IDE processes simultaneously, and any IDE process can be connected to several clients. The same IDE process can act as the client side

and the IDE side at the same time. However, the most common usage is expected to be one client and one IDE, and the interface is designed towards this simple usage.

Communication across the connection is architecture-independent, and either side can be any architecture. It relies on there being a working Common Lisp reader.

The client side should load the client code by calling:

```
(require "remote-debugger-client")
```

Note that if the client is a delivered application, the call to `require` needs to happen at load time, before calling `deliver`. On the IDE side, the module "remote-debugger-full" (which includes "remote-debugger-client") is loaded automatically when needed.

### 3.7.1 Simple usage

In the simple usage scenario, you have one IDE and one client. To create the connection between them, you need to tell LispWorks how to create the TCP socket stream, which requires one side to be a TCP server, and the other side to have the address (or name) of the server-side machine to connect to. Therefore, in the simple case you will need to make a function call on both sides. Once you perform the two function calls, you can use most of the power of remote debugging.

There are two ways to specify the connection: one with the IDE acting as the TCP server, and one with the client acting as the TCP server.

#### 3.7.1.1 Using the IDE as the TCP server

On the IDE side, you should call:

```
(dbg:start-ide-remote-debugging-server)
```

On the client side, you should call:

```
(dbg:configure-remote-debugging-spec "ide-hostname")
```

After making these calls, whenever the debugger is entered on the client side, it will automatically display a GUI debugger on the IDE side. In addition, calls

to `start-remote-listener` and `remote-inspect` from the client side will automatically display tools on the IDE side.

These functions use TCP port 21101 by default (the initial value of `*default-ide-remote-debugging-server-port*`).

By default, `configure-remote-debugging-spec` delays opening the connection until it is actually needed (by entering the debugger, or a call to `start-remote-listener` or `remote-inspect`).

Note that within the LispWorks IDE, you can make the call to `start-ide-remote-debugging-server` using the **Start IDE Remote Debugging Server** button in the **Preferences** dialog **Debugger** options **Remote** tab.

### 3.7.1.2 Using the client as the TCP server

On the client side you should call:

```
(dbg:start-client-remote-debugging-server)
```

On the IDE side you should call:

```
(dbg:ide-connect-remote-debugging "client-hostname")
```

The call on the IDE side opens a connection, which the client will use when entering the debugger and in calls to `start-remote-listener` and `remote-inspect`.

These functions use TCP port 21102 by default (the initial value of `*default-client-remote-debugging-server-port*`).

Note that within the LispWorks IDE, you can make the call to `ide-connect-remote-debugging` using the **Connect To Debugging Client** button in the **Preferences** dialog **Debugger** options **Remote** tab.

## 3.7.2 The client side of remote debugging

The client side remote debugging API is intended to minimize the amount of work you need to do for simple configurations.

Once you have either specified the connection by calling `configure-remote-debugging-spec` on the client side and called `start-ide-remote-debugging-server` on the IDE side, or called `start-client-remote-debugging-`

`server` on the client side and the IDE has connected to it using `ide-connect-remote-debugging`, entering the debugger automatically opens a Debugger window on the IDE side (unless you are already inside a Remote Listener or Remote Debugger).

If you want to open a Remote Listener on the IDE side from the client side, you can call `start-remote-listener`. Also, you can call `remote-inspect` on the client side to inspect an object on the IDE side.

The interface allows you to have more complex configurations, as detailed by `configure-remote-debugging-spec`, `create-client-remote-debugging-connection` and `start-client-remote-debugging-server`.

### 3.7.3 The IDE side of remote debugging

The behavior of the Debugger, Listener and Inspector tools is described in the *LispWorks IDE User Guide*.

Remote Debugger windows are opened automatically when the client side enters the debugger.

Remote Listener windows are opened on request, either by using the IDE's menus, by calling `ide-open-a-listener`, or by calling `ide-connect-remote-debugging` with `:open-a-listener t` (or from the client side by `start-remote-listener`).

The Inspector inspects a remote object when you tell it to inspect in the same way as you would tell it to inspect an ordinary object (typically from the Debugger or Listener), or by calling `remote-inspect` on the client side.

#### 3.7.3.1 Accessing client side objects on the IDE side

Remote (client side) values can be used on the IDE side and the type of object affects how it is represented.

Remote numbers and characters are represented on the IDE side as their actual IDE side values.

Remote strings are represented on the IDE side as IDE side strings, which are copies of the string of the same element type. Note that, as a result, two separate occurrences in the IDE of the same client side string are not necessarily

the same object, and that modifying the characters in these strings does not affect the string on the client side.

Most other remote objects are represented in the IDE by remote handles (see below for exceptions). Handles are specific to a connection, so accessing the same remote object in the IDE multiple times over the same connection will always use the same (by `eq`) handle. However, accessing the same client object through different connections will use different handles, which are not equal at all, and there is no way to find if two handles from different connections refer to the same remote object.

Remote handles are printed like this:

```
#<Remote ... >
```

where the ... is the printing of the remote object by the client side.

Handles are opaque objects. The predicate `remote-object-p` can be used to check if an object is a remote object, and `remote-object-connection` returns the connection that the handle is associated with. If two handles are associated with the same connection, then they are `eq` if and only if they refer to the same object on the client side.

The generic function `get-inspector-values` has a method that specializes on handles to invoke `get-inspector-values` on the client side and return the results. Note that `get-inspector-values` also returns a setter, which allows you to set values inside the client's object. This method makes the IDE Inspector and the CL functions `inspect` and `describe` work on remote handles.

Apart from the interface in the previous paragraphs, there is no useful way to access handles on the IDE side. However, you can access the underlying remote object by using `ide-eval-form-in-remote` or `ide-funcall-in-remote`, by sending a form containing the handle. For example, assuming the value of `my-remote-simple-vector` is a remote handle for a simple-vector, you can read its first element by:

```
(dbg:ide-eval-form-in-remote `(svref ,my-remote-simple-vector 0))
```

This will call `svref` on the client's object that `my-remote-simple-vector` is a handle for, because the client side call receives the underlying object rather than the handle.

Each call to `ide-eval-form-in-remote` and `ide-funcall-in-remote` is associated with a specific connection, and only remote objects that are associated with the connection can be used in form arguments. Trying to use remote objects that are associated with another connection signals an error.

LispWorks represents certain client side conses/symbols as conses/symbols on the IDE side in cases where there is no need to access the remote object. For example, the lists that `get-inspector-values` returns are IDE side conses, and the symbols in the slot-names list are IDE side symbols (for symbols in packages that exist on the IDE side). By default, `ide-eval-form-in-remote` and `ide-funcall-in-remote` return handles to the values returned by the form, except for numbers, characters, strings and the top-level of lists. They have a keyword `:encoded-result` which gives you some control over whether the values are returned as handles or not.

When displaying the source code of a function, LispWorks uses source location information on the IDE side to find the source file. That means that the IDE side needs to have the same source files loaded as the client side. To find a subform inside the definition of a function, the debugger uses the information from the client side, which must be compiled with source-level-debugging (and kept if it is delivered) for this to work.

Invoking the Class Browser in the IDE for a remote object handle shows the class on the IDE side that has the same `class-name` as the class of the object on the client side. Calling `class-of` (and `type-of`) on the IDE side on a remote object handle return the internal class (and class name) of remote handles, which you should not be accessing.

### 3.7.3.2 Controlling the client side from the IDE side

The functions `ide-eval-form-in-remote` and `ide-funcall-in-remote` can be used to call functions on the client side (`ide-eval-form-in-remote` is used by the editor commands).

The function `ide-set-remote-symbol-value` can be used to set the global value of a symbol on the client side, which is a common operation. It is equivalent to calling `ide-funcall-in-remote` with `set`.

The function `ide-attach-remote-output-stream` can be used to create an output stream on the client side, such that any output into it will go to a

stream on the IDE side. It returns a remote object handle for the client side stream, which can then be used it calls to `ide-eval-form-in-remote` etc.

## 3.7.4 Troubleshooting

The sections below describe some unexpected problems that you might encounter when using remote debugging and suggest ways to solve them.

### 3.7.4.1 Failing to open connections

There are some basic things to check first.

1. Make sure that you use the right pair of functions. Either:

`start-client-remote-debugging-server` on the client side and `ide-connect-remote-debugging` on the IDE side.

Or:

`configure-remote-debugging-spec` on the client side and `start-ide-remote-debugging-server` on the IDE side.

When using `start-client-remote-debugging-server` and `ide-connect-remote-debugging`, `start-client-remote-debugging-server` must be called first.

When using `configure-remote-debugging-spec` and `start-ide-remote-debugging-server`, `start-ide-remote-debugging-server` must be called before the connection is opened by the client. However, by default, `configure-remote-debugging-spec` delays opening the connection until it is needed so can be called first.

2. Check that you are either using the default port numbers, or you have changed them to the same number on both sides.
3. Check that you have the correct hostname in `configure-remote-debugging-spec` or `ide-connect-remote-debugging`.
4. On Android, you need to add the INTERNET permission to the application. The Android example has the line commented out in its Manifest file (`example-file "android/OthelloDemo/AndroidManifest.xml"`).

5. Check that the two machines can connect by TCP (for example, there is no firewall blocking connections).
6. Check that the functions you use return the expected values.
7. Specify the `:log-stream` argument for both sides, and check if anything is written to it.

If you cannot find the problem, then check that the connection works at the TCP level.

- If you run the client as the TCP server, evaluate the following on the client side:

```
(setq *log-stream* <somewhere-that-you-can-see-it>

(comm:start-up-server
 :function #'(lambda (socket)
           (format *log-stream* "Connected from ~a~%" 
                   (comm:get-socket-peer-address socket))
           (finish-output *log-stream*)))
 :service dbg:*default-client-remote-debugging-server-port*)
```

and then on the IDE side evaluate:

```
(comm:open-tcp-stream "<client-hostname>"
                      dbg:*default-client-remote-debugging-server-port*)
```

The call to `open-tcp-stream` should return a stream, and the "Connected from" message should be printed to `*log-stream*` on the client side.

- If you run the IDE as the TCP server, evaluate the following on the IDE side:

```
(comm:start-up-server
 :function #'(lambda (socket)
           (format mp:*background-standard-output*
                  "Connected from ~a~%" 
                  (comm:get-socket-peer-address socket))
           (finish-output mp:*background-standard-output*)))
 :service dbg:*default-ide-remote-debugging-server-port*)
```

and then on the client side evaluate:

```
(comm:open-tcp-stream "<ide-hostname>"
                      dbg:*default-ide-remote-debugging-server-port*)
```

The call to `open-tcp-stream` should return a stream, and the "Connected from" message should be printed to **Output** tab of the Listener or Editor in the IDE.

If you cannot connect as above then you need to fix the configuration of your machines to make it work. If you can connect as above, but the remote debugging does not connect after you did all the checks then contact LispWorks support for help.

### 3.7.4.2 The Inspector does not show slots in a remote object

The most likely explanation for this is that the underlying connection was closed. Check if the remote object prints with "{closed connection}".

## 3.7.5 Advanced usage - multiple connections

### 3.7.5.1 Client side connection management

By default, the connection opened by the client side functions is reused whenever a connection is needed. This is normally all that is required, but sometimes it is useful to have a better control.

The client has a default connection (a global value), and a switch that enables using the default connection (the enabling switch). Both `configure-remote-debugging-spec` and `start-client-remote-debugging-server` have keyword arguments `:setup-default` and `:enable`, which control setting the default connection, and whether to enable using it. The default for both is true. The default connection and switch are used by the APIs that need a connection (mainly when the debugger is entered, but also `remote-inspect` and `start-remote-listener`), so by default the connection that was opened last is used.

The value of the enabling switch can be set globally by `set-remote-debugging-connection` or in a dynamic extent by `with-remote-debugging-connection`. These functions also allow you to specify a specific connection to use, rather than the default. Note that `with-remote-debugging-connection` and `set-remote-debugging-connection` do not affect the default connection, only the enabling switch.

The function `set-default-remote-debugging-connection` can be used to set the default connection.

`start-client-remote-debugging-server` and `configure-remote-debugging-spec` take also a keyword `:open-callback`, which specifies a callback that is called whenever a connection is created. You can use this callback to store the connection somewhere for later use, for example in a call to `set-default-remote-debugging-connection`, `set-remote-debugging-connection` or `with-remote-debugging-connection`.

The value of the `:setup-default` keyword to `configure-remote-debugging-spec` can also be `:delayed`, which means that the connection is not opened immediately, but when it is opened, it is set as the default.

When the debugger is entered, it first checks the value of the enabling switch. If it is set to a connection then that connection is used. If it is set to `t`, then the default connection is used. Otherwise, it checks if a host was configured (globally by `configure-remote-debugging-spec` or in a dynamic extent by `with-remote-debugging-spec`) and tries to open a connection to it. If that succeeds, it decides according to the `:setup-default` and `:enable` arguments whether to set the default connection and the enabling switch, and then use this connection. If `:setup-default` is `nil`, then the connection is closed when the Remote Debugger is closed.

When a connection is closed, all remote object handles in the IDE that were created using it become invalid. For example, if you use `configure-remote-debugging-spec` with `:setup-default nil`, and later the Remote Debugger was raised and you inspected an argument of a function and then closed the Remote Debugger, then the Inspector will fail to access slots in this object. For this reason, it is usually better to have a permanently open default connection, so the Inspector can be still be used after the Remote Debugger has been closed. A single connection is also more efficient, but the effect of this is small.

`start-remote-listener` behaves the same as the debugger when it tries to find a connection.

`remote-inspect` first checks if it can use an existing connection the same way as the debugger. However, if it cannot, it tries to use a connection used previously by an Inspector. If this does not work, it tries the default connection (if any) even if the enabling switch is `nil`, and if all these fail, it opens a connec-

tion using the configured host if any, and remembers it for the next time (unless configured to set this connection as the default). The Inspector behaves differently to the Debugger/Listener is because there is no obvious place where a temporary connection should be closed in the case of the Inspector, compared to the Debugger and Listener where closing the GUI tool is the natural place to close the connection if it is temporary.

In the simplest usage, you will have one connection that is used for everything. The next level of complexity is to have one connection, but control dynamically whether to use it or not, either globally by calls to `set-remote-debugging-connection`, or in a dynamic extent using `with-remote-debugging-connection`.

For more complex usage, you can use the `:open-callback` to record the connections that you have opened, and then use them in `set-default-remote-debugging-connection` or `set-remote-debugging-connection` or `with-remote-debugging-connection` to tell the debugger/listener/inspector which connection to use.

The functions described in “Common (both IDE and client) connection functions” on page 36 can also be used on the client side.

### 3.7.5.2 IDE side connection management

Normally you do not need to manage remote debugging connections on the IDE side, but sometimes it may be useful.

`ide-list-remote-debugging-connections` returns a list of connections.

`ide-find-remote-debugging-connection` can be used to find a connection. This is used by default by the IDE side functions that need a connection (`ide-eval-form-in-remote`, `ide-funcall-in-remote`, `ide-set-remote-symbol-value` and `ide-attach-remote-output-stream`), and the Editor commands.

`ide-set-default-remote-debugging-connection` can be used to set the default connection, which is what the Editor commands use, and affects what `ide-find-remote-debugging-connection` returns.

You can get the connection from a remote object handle by using `remote-object-connection`.

The functions described in “Common (both IDE and client) connection functions” on page 36 can also be used on the IDE side.

### 3.7.5.3 Common (both IDE and client) connection functions

You can close a connection by using `close-remote-debugging-connection`. Closing a connection causes the other side to be closed too. Closing the default connection causes the default to be set to `nil`.

You can use `ensure-remote-debugging-connection` to check if a connection is alive. `ensure-remote-debugging-connection` can be called with any object and returns `nil` for any non-connection object or a connection object that is closed.

You can use `remote-debugging-connection-add-close-cleanup` to add a “cleanup”, which is a callback function that is called when the connection is closed, and `remote-debugging-connection-remove-close-cleanup` to remove a previously added cleanup.

The function `remote-debugging-connection-peer-address` can be used to check what machine is on the other side.

The function `remote-debugging-connection-name` can be used to find the name of a connection.

Each opened connection has a dedicated Lisp process that handles communications through it, which you can see by listing processes using `(mp:ps)` or in the Process Browser tool. The name of the connection appears in the name of the process. You can forcibly close a connection by using `process-terminate` on the process or from the Process Browser.

# 4

---

# The REPL Inspector

LispWorks provides two inspectors. One is for use with the LispWorks IDE, and is described in the *LispWorks IDE User Guide*. The other is the REPL inspector, which uses a stream interface, and can be used on any terminal (in particular within the LispWorks IDE Listener tool). Both inspectors allow you to traverse complex data structures interactively and to destructively modify components of these structures. However, the two inspectors are quite different. No attempt has been made to make their usage compatible and instead each inspector is designed to exploit to the full the particular environment facilities available.

The REPL inspector provides a simple inspector facility which can be used on a stream providing line breaks as the only type of formatting. It is built on top of the `describe` function which is briefly described below and modifies the top level loop in a similar way to the debugger (see Chapter 3, “The Debugger”).

## 4.1 Describe

The function `describe` displays the slots of composite data structures in a manner dependent on the type of the object. The slots are labeled with a name where appropriate, or otherwise with a number.

The example below shows the result of calling `describe` on a simple list.

```

USER 7 > (setq countries '("Chile" "Peru" "Paraguay"
                           "Brazil"))
          ("Chile" "Peru" "Paraguay" "Brazil")

USER 8 > (describe countries)
("Chile" "Peru" "Paraguay" "Brazil") is a CONS
[0] : "Chile"

[1] : "Peru"

[2] : "Paraguay"

[3] : "Brazil"

```

`describe` describes slots recursively up to a limit set by the special variable `*describe-level*`. Note that only arrays, structures and conses are printed recursively. The slots of all other object types are only printed when at the top level of `describe`.

`*describe-level*` has an initial value of 1.

The symbols `*describe-print-level*` and `*describe-print-length*` are similar in effect to `*trace-print-level*` and `*trace-print-length*`. They control, respectively, the depth to which nested objects are printed (initial value 10), and the number of components of an object which are printed (initial value 10).

To customize `describe`, define new methods on the generic function `describe-object`.

## 4.2 Inspect

The function `inspect` is an interactive version of `describe`. It displays objects in a similar way to `describe`. Entering the inspector causes a new level of the top loop to be entered with a special prompt indicating that the inspector has been entered and showing the current inspector level.

In the modified top loop, if you enter a slot name, that slot is inspected and the current object is pushed onto an internal stack of previously inspected objects. The special variables `$`, `$$`, and `$$$` are bound to the top three objects on the inspector stack.

The following keywords are treated specially as commands by the inspector.

Table 4.1 Inspector commands

Command	Meaning
<code>:cv</code>	Display current values of control variables.
<code>:d</code>	Display current object.
<code>:dm</code>	Display more of current object.
<code>:dr</code>	Display rest of current object.
<code>:h</code>	Display help on inspector commands.
<code>:i m</code>	Recursively invoke a new inspector. <i>m</i> is an object to inspect.
<code>:m</code>	Change the inspection mode — see Section 4.3 on page 40.
<code>:q</code>	Quit current inspector.
<code>:s n v</code>	Sets slot <i>n</i> to value <i>v</i> .
<code>:sh</code>	Show inspector stack.
<code>:u int</code>	Undo last inspection. If you supply an optional integer argument, <i>int</i> , then the last <i>int</i> inspections are undone.
<code>:ud</code>	Undo last inspection and redisplay current object.

You can get brief help listing these commands by entering `:?` at the inspector prompt.

The control variables `*inspect-print-level*` and `*inspect-print-length*` are similar to `*describe-print-level*` and `*describe-print-length*` (see above).

`:dm` displays more slots of the current object. If the object has more than `*describe-length*` slots, then the first `*describe-length*` will be printed, followed by an ellipsis and then

`(:dm or :dr for more)`

If you enter the command `:dm` at the prompt it displays the next `*describe-length*` slots, and if you enter `:dr` it displays all the remaining slots. This

only works on the last inspected object, so if you recursively inspect a slot and come back, `:dm` does not do anything useful. Typing `:d` lets you view the object again.

`:ud` is equivalent to typing `:u` followed by `:d`.

### 4.3 Inspection modes

The `:m` command displays and changes the current inspection mode for an inspected value. The session below demonstrates how it works:

```
CL-USER 128 > (inspect "a
string with
newlines in it")

"a
string with
newlines in it" is a SIMPLE-BASE-STRING
0      #\a
1      #\Newline
2      #\s
3      #\t
4      #\r
5      #\i
6      #\n
7      #\g
8      #\Space
9      #\w
10     #\i
11     #\t
12     #\h
13     #\Newline
14     #\n
15     #\e
16     #\w
17     #\l
18     #\i
19     #\n ..... (:dm or :dr for more)

CL-USER 129 : Inspect 1 > :m
* 1. SIMPLE-STRING
  2. LINES
```

The `:m` produces an enumerated list of inspection modes for this value.

The asterisk next to

```
* 1. SIMPLE-STRING
```

means that SIMPLE-STRING is the current inspection mode.

You can change mode by typing :m followed by the name or number of another mode. To change to LINES mode:

```
CL-USER 130 : Inspect 1 > :m 2

" a
string with
newlines in it" is a SIMPLE-BASE-STRING
0      a
1      string with
2      newlines in it
```

### 4.3.1 Hash table inspection modes

There are five hash table inspection modes. They can be accessed in either the LispWorks IDE Inspector tool or the REPL inspector.

A brief introduction to the representation of hash tables is necessary so that you can fully understand what you gain from the new modes.

Internally, a hash table is a structure containing, among other things,

- a big vector
- size and growth information
- accessing functions.

When keys and values are added to the table, sufficiently similar keys are converted into the same index in the vector. When this happens, the similar keys and values are kept together in a chain that hangs off this place in the vector.

The different inspection modes provide views of different pieces of this structure:

<b>HASH-TABLE</b>	This mode is the “normal” view of a hash table; as a table of keys and values. When you inspect an item you inspect the value of the item.
-------------------	--

**STRUCTURE** This mode provides a raw view of the whole hash table structure. When you inspect an item you are inspecting the value of that slot in the hash table structure.

**ENUMERATED-HASH-TABLE**

This mode is a variation of the normal view, where a hash table is viewed simply as a list of lists. When you inspect an item you are inspecting a list containing a key and a value.

**HASH-TABLE-STATISTICS**

This mode shows how long the chains in the hash table are, so that you can tell how efficiently it is being used. For example, if all chains contained fewer than two items the hash table would be being used well.

**HASH-TABLE-HISTOGRAM**

This mode shows the statistical information from **HASH-TABLE-STATISTICS** as a histogram.

Here is an example of hash table inspection.

```
CL-USER 1 > (defvar *hash* (make-hash-table))
*HASH*

CL-USER 2 > (setf (gethash 'lisp *hash*) 'programming
                    (gethash 'java *hash*) 'programming
                    (gethash 'c *hash*) 'programming
                    (gethash 'c++ *hash*) 'programming
                    (gethash 'english *hash*) 'natural
                    (gethash 'german *hash*) 'natural)
NATURAL

CL-USER 3 > (inspect *hash*)

#<EQL Hash Table{6} 21C15D97> is a HASH-TABLE
C++           PROGRAMMING
JAVA          PROGRAMMING
ENGLISH       NATURAL
C              PROGRAMMING
GERMAN        NATURAL
LISP           PROGRAMMING

CL-USER 4 : Inspect 1 > :m
* 1. HASH-TABLE
  2. STRUCTURE
  3. ENUMERATED-HASH-TABLE
  4. HASH-TABLE-STATISTICS
  5. HASH-TABLE-HISTOGRAM
```

STRUCTURE mode displays the raw representation of the hash table:

```
CL-USER 5 : Inspect 1 > :m 2

#<EQL Hash Table{6} 21C15D97> is a HASH-TABLE
KIND                  EQL
SIZE                 37
REHASH-SIZE          2.0
REHASH-THRESHOLD    1.0
THRESHOLD            37
COUNTER              525
NUMBER-ENTRIES       6
TABLE                #(#%((LISP . PROGRAMMING) NIL) NIL NIL
NIL NIL ...)
NO-DESTRUCT-REHASH  NIL
POWER2               NIL
HASH-REM              SYSTEM::DIVIDE-GENERAL
HASH-FN               SYSTEM::EQL-HASHFN
GETHASH-FN            SYSTEM::GETHASH-EQL
PUTHASH-FN            SYSTEM::PUTHASH-EQL
REMHASH-FN            SYSTEM::REMHASH-EQL
GET-TLATTER-FN       SYSTEM::GET-TLATTER-EQL
WEAK-KIND             NIL
USER-STUFF            NIL
MODIFICATION-COUNTER 0
FAST-LOCK-SLOT        0
```

In **ENUMERATED-HASH-TABLE** mode you can recursively inspect keys and values by entering the index. This is especially useful in cases where the key or value is unreadable and so cannot be entered into the REPL:

```
CL-USER 6 : Inspect 1 > :m 3

#<EQL Hash Table{6} 21C15D97> is an Enumerated HASH TABLE
0      (C++ PROGRAMMING)
1      (JAVA PROGRAMMING)
2      (ENGLISH NATURAL)
3      (C PROGRAMMING)
4      (GERMAN NATURAL)
5      (LISP PROGRAMMING)

CL-USER 7 : Inspect 1 > 5

(LISP PROGRAMMING) is a LIST
0      LISP
1      PROGRAMMING

CL-USER 8 : Inspect 2 > :u
```

The **HASH-TABLE-STATISTICS** mode shows that **\*hash\*** has 31 chains, of which 25 are empty and 6 have one entry::

```
CL-USER 9 : Inspect 1 > :m 4

#<EQL Hash Table{6} 21C15D97> is a HASH-TABLE (statistical view)
chain of length 0 :          31
chain of length 1 :          6
```

In **HASH-TABLE-HISTOGRAM** mode the same information is represented as a histogram:

```
CL-USER 10 : Inspect 1 > :m 5

#<EQL Hash Table{6} 21C15D97> is a HASH-TABLE (histogram view)
chain of length 0 :          "*****"
chain of length 1 :          "*****"

CL-USER 11 : Inspect 1 > :q
#<EQL Hash Table{6} 21C15D97>
```



# 5

---

## The Trace Facility

The trace facility is a debugging aid enabling you to follow the execution of particular functions. At any time there are a set of functions (and macros and methods) which are being monitored in this way. The normal behavior when a call is made to one of these functions is for the function's name, arguments and results to be printed out by the system. More generally you can specify that particular forms should be executed before or after entering a function, or that certain calls to the function should cause it to enter the main debugger. Tracing of a function continues even if the function is redefined.

The standard way of arranging for functions to be traced is to call the macro `trace` with the symbols of the functions (or macros or generic functions) concerned. In addition it is possible to restrict tracing to a particular method (rather than a generic function) as described in “Tracing methods” on page 57. The trace facility also handles recursive and nested calls to the functions concerned.

### 5.1 Simple tracing

This section shows you how to perform simple traces.

1. Enter this definition of the factorial function `fac` into the listener:

```
(defun fac (n)
  (if (= n 1) 1
    (* n (fac (- n 1)))))
```

2. Now trace the function by entering the following into the listener.

```
(trace fac)
```

3. Call the function `fac` as follows:

```
(fac 3)
```

The following trace output appears in the listener.

```
0 FAC > ...
  >> N : 3
1 FAC > ...
  >> N : 2
2 FAC > ...
  >> N : 1
2 FAC < ...
  << VALUE-0 : 1
1 FAC < ...
  << VALUE-0 : 2
0 FAC < ...
  << VALUE-0 : 6
```

Upon entry to each traced function call, `trace` prints the following information:

- The level of tracing, that is, the number of recursive entries to `trace`.
- The traced function name.
- The arguments and their values for the current call.

Each line is indented according to the level of tracing for the call.

`>` denotes entry to a function, and `>>` denotes an argument.

Upon exit from each traced function call, `trace` prints the following information:

- The level of tracing.
- The traced function name.
- The returned values for the current call.

< denotes exit from a function, and << denotes a returned value.

Output produced in this way is always sent to a special stream, **\*trace-output\***, which is either associated with the listener, or with background output.

Calling **trace** with no arguments produces a list of all the functions currently being traced. In order to cease tracing a function the macro **untrace** should be called with the function name. All tracing can be removed by calling **untrace** with no arguments.

```
CL-USER 5 > (untrace fac)
(FAC)

CL-USER 6 > (fac 4)
24

CL-USER 7 >
```

## 5.2 Tracing options

There are a number of options available when using the trace facilities, which allow you both to restrict or expand upon the information printed during a trace. For instance, you can restrict tracing of a function to a particular process, or specify additional actions to be taken on function call entry and exit.

Note that the options and values available only apply to a particular traced function. Each traced function has its own, independent, set of options.

This section describes the options that are available. Each option can be set as described in the next subsection.

### 5.2.1 Evaluating forms on entry to and exit from a traced function

<b>:before</b>	<i>Trace keyword</i>
----------------	----------------------

**:before** *list-of-forms*

If non-nil, the list of forms is evaluated on entry to the function being traced. The forms are evaluated and the results printed after the arguments to the function.

Here is an example of its use. `*traced-arglist*` is bound to the list of arguments given to the function being traced. In this example, it is used to accumulate a list of all the arguments to `fac` across all iterations.

1. In the listener, initialize the variable `args-in-reverse` as follows:

```
(setq args-in-reverse ())
```

2. For the `fac` function used earlier, set the value of `:before` as follows:

```
(trace (fac :before ((push (car *traced-arglist*) args-in-reverse))))
```

3. In the listener, evaluate the following form:

```
(fac 3)
```

After evaluating this form, `args-in-reverse` has the value `(1 2 3)`, that is, it lists the arguments which `fac` was called with, in reverse order.

<code>:after</code>	<i>Trace keyword</i>
---------------------	----------------------

`:after list-of-forms`

If non-nil, this option evaluates a list of forms upon return from the function to be traced. The forms are evaluated and the results printed after the results of a call to the function.

This option is used in exactly the same way as `:before`. For instance, using the example for `:before` as a basis, create a list called `results-in-reverse`, and set the value of `:after` so that `(car *traced-results*)` is pushed onto this list. After calling `fac`, `results-in-reverse` contains the results returned from `fac`, in reverse order.

Note also that `*traced-arglist*` is still bound.

### 5.2.2 Evaluating forms without printing results

<code>:eval-before</code>	<i>Trace keyword</i>
---------------------------	----------------------

`:eval-before list-of-forms`

This option allows you to supply a list of forms for evaluation upon entering the traced function. The forms are evaluated after printing out the arguments to the function, but unlike `:before` their results are not printed.

**:eval-after***Trace keyword*`:eval-after` *list-of-forms*

This option allows you to supply a list of forms for evaluation upon leaving the traced function. The forms are evaluated after printing out the results of the function call, but unlike `:after` their results are not printed.

### 5.2.3 Using the debugger when tracing

**:break***Trace keyword*`:break` *form*

If *form* evaluates to non-nil, the debugger is entered directly from `trace`. If it returns `nil`, tracing continues as normal. This option lets you force entry to the debugger by supplying a *form* as simple as `t`.

Upon entry to the traced function, the standard trace information is printed, any supplied `:before` forms are executed, and then *form* is evaluated.

**:break-on-exit***Trace keyword*`:break-on-exit` *form*

Like `:break`, this option allows you to enter the debugger from `trace`. It differs in that the debugger is entered *after* the function call is complete.

Upon exit from the traced function, the standard trace information is printed, and then *form* is evaluated. Finally, any supplied `:after` forms are executed.

**:backtrace** *Trace keyword*

**:backtrace *backtrace***

Generates a backtrace on each call to the traced function. *backtrace* can be any of the following values:

**:quick** Like the `:bq` debugger command.

**t** Like the `:b` debugger command.

**:verbose** Like the `:b :verbose` debugger command.

**:bug-form** Like the `:bug-form` debugger command.

## 5.2.4 Entering stepping mode

**:step** *Trace keyword*

**:step *form***

When non-nil, this option puts the trace facility into stepper mode, where interpreted code is printed one step of execution at a time.

## 5.2.5 Configuring function entry and exit information

**:entrycond** *Trace keyword*

**:entrycond *form***

This option controls the printing of information on entry to a traced function. *form* is evaluated upon entry to the function, and information is printed if and only if *form* evaluates to `t`. This allows you to turn off printing of function entry information by supplying a *form* of `nil`, as in the example below.

**:exitcond** *Trace keyword*

**:exitcond *form***

This option controls the printing of information on exit from a traced function. *form* is evaluated upon exit from the function, and, like

`:entrycond`, information is printed if and only if *form* evaluates to a non-nil value. This allows you to turn off printing of function exit information by supplying a *form* of `nil`.

An example of using `:exitcond` and `:entrycond` is shown below:

1. For the `fac` function, set the values of `:entrycond` and `:exitcond` as follows.

```
(trace (fac :entrycond (evenp (car *traced-arglist*))
                           :exitcond (oddp (car *traced-arglist*))))
```

Information is only printed on entry to `fac` if the argument passed to `fac` is even. Conversely, information is only printed on exit from `fac` if the argument passed to `fac` is odd.

2. Enter the following call to `<Code>fac</Code>` in a listener:

```
CL-USER 24 > (fac 10)
```

The tracing information printed is as follows:

```
0 FAC > ...
  >> N : 10
2 FAC > ...
  >> N : 8
4 FAC > ...
  >> N : 6
6 FAC > ...
  >> N : 4
8 FAC > ...
  >> N : 2
9 FAC < ...
  << VALUE-0 : 1
7 FAC < ...
  << VALUE-0 : 6
5 FAC < ...
  << VALUE-0 : 120
3 FAC < ...
  << VALUE-0 : 5040
1 FAC < ...
  << VALUE-0 : 362880
```

### 5.2.6 Directing trace output

**:trace-output** *Trace keyword*

**:trace-output *stream***

This option allows you to direct trace output to a stream other than the listener in which the original function call was made. By using this you can arrange to dispatch traced output from different functions to different places.

Consider the following example:

1. In the listener, create a file stream as follows:

```
CL-USER 1 > (setq str (open "trace.txt" :direction :output))
Warning: Setting unbound variable STR
#<STREAM::LATIN-1-FILE-STREAM C:\temp\trace.txt>
```

2. Set the value of the **:trace-output** option for the function **fac** to **str**.
3. Call the **fac** function, and then close the file stream as follows:

```
CL-USER 138 > (fac 8)
40320

CL-USER 139 > (close str)
T
```

Inspect the file **trace.txt** in order to see the trace output for the call of **(fac 8)**.

### 5.2.7 Restricting tracing

**:process** *Trace keyword*

**:process *process***

This lets you restrict tracing of a function to a particular process. If *process* evaluates to **t**, then the function is traced from within all processes (this is the default). Otherwise, the function is only traced from within the process that *process* evaluates to.

**:when***Trace keyword***:when *form***

This lets you invoke the tracing facilities on a traced function selectively. Before each call to the function, *form* is evaluated. If *form* evaluates to `nil`, no tracing is done. The contents of `*traced-arglist*` can be examined by *form* to find the arguments given to `trace`.

## 5.2.8 Storing the memory allocation made during a function call

**:allocation***Trace keyword***:allocation *form***

If *form* is non-`nil`, this prints the memory allocation, in bytes, made during a function call. The symbol that *form* evaluates to is used to accumulate the amount of memory allocated between entering and exiting the traced function.

Note that this symbol continues to be used as an accumulator on subsequent calls to the traced function; the value is compounded, rather than over-written.

Consider the example below:

1. For the `fac` function, set the value of `:allocation` to `$$fac-alloc`.
2. In the listener, call `fac`, and then evaluate `$$fac-alloc`.

```
CL-USER 152 > $$fac-alloc
744
```

## 5.2.9 Tracing functions from inside other functions

**:inside***Trace keyword***:inside *list-of-functions***

The functions given in the argument to `:inside` should reference the traced function in their implementation. The traced function is then only

traced in calls to any function in the list of functions, rather than in direct calls to itself.

For example:

1. Define the function `fac2`, which calls `fac`, as follows:

```
(defun fac2 (x)
  (fac x))
```

2. For the `fac` function, set the value of `:inside` to `fac2`:

```
(trace (fac :inside fac2))
```

3. Call `fac`, and notice that no tracing information is produced.

```
CL-USER 2 > (fac 3)
6
```

4. Call `fac2`, and notice the tracing information.

Evaluate `(fac2 3)`, and notice the tracing information.

```
0 FAC > ...
  >> N : 3
1 FAC > ...
  >> N : 2
2 FAC > ...
  >> N : 1
2 FAC < ...
  << VALUE-0 : 1
1 FAC < ...
  << VALUE-0 : 2
0 FAC < ...
  << VALUE-0 : 6
```

## 5.3 Example

The following example illustrates how `trace` may be used as a debugging tool. Suppose that you have defined a function `f`, and intend its first argument to be a non-negative number. You can trap calls to `f` where this is not true, providing an entry into the main debugger in these cases. It is then possible for you to investigate how the problem arose.

To do this, you specify a `:break` option for `f` using `trace`. If the form following this option evaluates to a non-nil value upon calling the function, then the

debugger is entered. In order to inspect the first argument to the function `f`, you have access to the variable `*traced-arglist*`. This variable is bound to a list of the arguments with which the function was called, so the first member of the list corresponds to the first argument of `f` when tracing `f`.

```
CL-USER 1 > (defun f (a1 a2) (+ (sqrt a1) a2))
F

CL-USER 2 > (trace (f :break (< (car *traced-arglist*) 0)))
(F)

CL-USER 3 > (f 9.0 3)
0 F > ...
  >> A1 : 9.0
  >> A2 : 3
0 F < ...
  << VALUE-0 : 6.0
6.0

CL-USER 4 > (f -16.0 3)
0 F > ...
  >> A1 : -16.0
  >> A2 : 3

Break on entry to F with *TRACED-ARGLIST* (-16.0 3).
1 (continue) Return from break.
2 Continue with trace removed.
3 Continue traced with break removed.
4 Continue and break when this function returns.
5 (abort) Return to level 0.
6 Return to top loop level 0.

Type :b for backtrace or :c <option number> to proceed.
Type :bug-form "<subject>" for a bug report template or :? for
other options.

CL-USER 5 : 1 >
```

## 5.4 Tracing methods

You can also trace methods (primary and auxiliary) within a generic function. The following example shows how to specify any qualifiers and specializers.

1. Type the following methods into the listener:

```
(defmethod foo (x)
  (print 'there))

(defmethod foo :before ((x integer))
  (print 'hello))
```

2. Next, trace only the second of these methods by typing the following definition spec.

```
(trace (method foo :before (integer)))
```

3. Test that the trace has worked by calling the methods in the listener:

```
CL-USER 226 > (foo 'x)
```

```
THERE
THERE
```

```
CL-USER 227 > (foo 4)
0 (METHOD FOO :BEFORE (INTEGER)) > (4)
```

```
HELLO
0 (METHOD FOO :BEFORE (INTEGER)) < (HELLO)
```

```
THERE
THERE
```

```
CL-USER 228 >
```

## 5.5 Tracing subfunctions

Subfunctions are functions that are defined inside the body of other functions rather than by top level definers like `defun`, `defmethod`, etc. To trace such a subfunction, call `trace` with a "subfunction dspec" in one of these forms:

- (`subfunction sub-name parent-dspec`)
- (`flet sub-name parent-dspec`)
- (`labels sub-name parent-dspec`)

See “Subfunction dspecs” on page 85 for details. All of the keywords that `trace` takes have the same effect for subfunction tracing.

The behavior when tracing a subfunction is somewhat different from tracing other function.

- `trace` modifies the parent of the subfunction such that future execution of the code that creates the subfunction will create it traced.
- A subsequent call to `trace` with the same dspec re-modifies the parent, and also causes any of the subfunctions that were already created traced to change their tracing behavior (as defined by the keywords to `trace`) to the behavior specified by the latest call to `trace`.
- `untrace` with the same dspec returns the parent function to its original state and switches off tracing for the subfunctions that were created traced.
- A call to `trace` with the same dspec after `untrace` modifies the parent as in the first point above, but has no effect on any subfunction that was created by the parent before the call to `untrace`.

Tracing of subfunction works only for compiled functions.

### 5.5.1 Notes on subfunction names

Anonymous lambdas are named by the compiler using integers.

You can find the dspec of a given subfunction by calling `object-dspec` on the subfunction. You can also construct it from the printed representation of the subfunction, which contains the sub-name and the parent-dspec.

A subfunction can be given an name using a `hcl:lambda-name` declaration (see `declare`, page 651). If this is of the form `(subfunction sub-name)`, then the dspec of the subfunction will contain both *sub-name* and the correct parent-dspec. However, if it has any other form, then dspec will be that name and you will need to know the parent-dspec in order to construct the subfunction dspec.

## 5.6 Trace variables

**\*max-trace-indent\***

The maximum indentation used during output from `trace`.

**\*trace-indent-width\***

The additional amount by which tracing output is indented upon entering a deeper level of nesting.

**\*trace-level\***

The current depth of tracing.

**cl:\*trace-output\***

The stream to which tracing sends its output by default.

**\*traced-arglist\***

The variable that holds the arguments given to the traced function.

**\*traced-results\***

The variable that holds the results from the traced function.

The following four variables allow you to control the style of tracing output separately from normal printing:

**\*trace-print-circle\***

The value to which **\*print-circle\*** is bound during output from **trace**.

**\*trace-print-length\***

The value to which **\*print-length\*** is bound during output from **trace**.

**\*trace-print-level\***

The value to which **\*print-level\*** is bound during output from **trace**.

**\*trace-print-pretty\***

The value to which **\*print-pretty\*** is bound during output from **trace**.

## 5.7 Troubleshooting tracing

This section describes some of the common problems seen when tracing, with suggestions to overcome these.

### 5.7.1 Excessive output

In general it is not useful to trace `c1:length` and other base-level functions unconditionally because they are called too frequently by LispWorks itself.

It may be useful to trace these functions in a limited fashion, using the `trace` options `:inside` or `:when`.

### 5.7.2 Missing output

There are two common reasons for not seeing calls you expect in trace output.

#### 5.7.2.1 Compiled code may not call the functions you expect

There are many other optimizations built-in to the LispWorks compiler, which affect code generated according to the compiler qualities in effect at compile-time. For example if the compiler was set to inline structure accessors, then tracing structure accessors in code compiled with that setting will produce no output.

While debugging, you could re-compile the code at higher safety or run it interpreted, to obtain the trace output.

#### 5.7.2.2 trace works on function names, not function objects

`trace` works by tracing function names, not function objects.

Therefore tracing function objects, for example by

```
(trace #'foo)
```

will not yield any trace output. Instead you need to do

```
(trace foo)
```

Also, if the symbol `foo` is traced, then code which invokes `foo` by

```
(funcall (symbol-function 'foo) ...)
```

or equivalently

```
(funcall #'foo ...)
```

will not produce any trace output.

The correct approach is to use `(funcall 'foo ...)` instead of `(funcall #'foo ...)`.

# 6

---

## The Advice Facility

The advice facility provides a mechanism for altering the behavior of existing functions. As a simple application of this, you may supplement the original function definition by supplying additional actions to be performed before or after the function is called. Alternatively, you may replace the function with a new piece of code that has access to the original definition, but which is free to ignore it altogether and to process the arguments to the function and return the results from the function in any way you decide. The advice facility allows you to alter the behavior of functions in a very flexible manner, and may be used to engineer anything from a minor addition of a message, to a major modification of the interface to a function, to a complete change in the behavior of a function. This facility can be helpful when debugging, or when experimenting with new versions of functions, or when you wish to locally change some functionality without affecting the original definition.

**Note:** It can be dangerous to put advice on system functions or functions used at low-level by the system. In general, advising a basic Common Lisp function (that is, a simple function for manipulating simple objects such as `reverse`) is dangerous, because the implementation may use it.

## 6.1 Defining advice

Each change that is required should be specified using the `defadvice` macro. This defines a new body of code to be used when the function is called; this piece of code is called a piece of advice. Consider the following example:

```
(defadvice
  (capi:prompt-for-file pff-1 :before)
  (message &key &allow-other-keys)
  (format t "~&Prompting for file with message ~S~%" message))
```

Here `defadvice` is given the name of the function you want to alter, a name for the piece of advice, and the keyword `:before` to indicate that you want the code carried out before `capi:prompt-for-file` is called. The rest of the call to `defadvice` specifies the additional behavior required, and consists of the lambda list for the new piece of advice and its body (the lambda list may specify keyword parameters and so forth). The advice facility arranges that `pff-1` is invoked whenever `capi:prompt-for-file` is called, and that directly after this the original definition of `capi:prompt-for-file` is called.

After executing this advice definition, demonstrate it by selecting the menu command **File > Open** in the LispWorks IDE. The message appears in the **Output** tab.

Pieces of advice may be given to be executed after the call by specifying `:after` instead of `:before` in the call to `defadvice`. So if you wished to add further code to be performed after `capi:prompt-for-file` you could also define:

```
(defadvice
  (capi:prompt-for-file pff-2 :after)
  (message &rest args)
  (format t
    "~&The other arguments to prompt-for-file were: ~S~%" args))
```

Note that `pff-2` also receives the arguments to `capi:prompt-for-file`, which are reported by the body.

Note also that `defadvice` works on function names, not function objects, like `trace`. See “trace works on function names, not function objects” on page 61 for details.

## 6.2 Combining the advice

We have already seen how a before and an after piece of advice may be combined, and this section describes the general algorithm. There are three types of advice: *before*, *after* and *around*. These resemble before, after and around methods in CLOS. There may be several pieces of each type of advice present for a particular function.

The first step in working out how the combination is done is to order the pieces of advice. All the around advice comes first, then all the before advice, then the original definition, and lastly the after advice. The order within each of the around, before and after sections defaults to the order in which the pieces of advice were defined (that is most recent first). See `defadvice`, page 1100 for details of how to control the ordering of advice within each section.

The remainder of this section discusses what happens when a function that has advice is called.

### 6.2.1 :before and :after advice

First we deal with the case when there is no around advice present. Here each of the pieces of before advice are called in turn, with the same arguments that were given to the function, next the original definition is called with these arguments, and finally each of the pieces of after advice is called in reverse order with the same arguments (so that by default the most recently added piece of after advice is invoked last). The results returned by the function call are the values produced by the last piece of after advice to be called (if there is one), or by the original definition (if there is no after advice).

Note that none of these bits of code should destructively modify the arguments that they receive. Adding a piece of before advice thus provides a simple way of specifying some additional action to be performed before the original definition, and before any older bits of before advice. Adding a piece of after advice allows you to specify extra actions to be performed after the original definition, and after any older bits of after advice. The advice facility automatically links together these bits of advice with the original function definition.

### 6.2.2 :around advice

Next we shall discuss the use of around advice, which provides you with greater control than do before and after advice. Let us suppose that a function that has some around advice is called. The arguments to the function are passed to the code associated with the first piece of around advice in the ordering, and the values returned by that piece of advice are the results of the function. There is no requirement for the advice to invoke any other pieces of advice, nor to call the original definition of the function.

However the code for any piece of around advice has access to the next member of the ordering, which it may invoke any number of times by calling `call-next-advice`. So it is possible for each piece of around advice to call its successor in the ordering if this is desired, and then the bits of around advice are called in turn in a similar fashion to our earlier description for before and after advice. However in the case of around advice the decision whether or not to call the next piece of advice is directly under your control, and you are free to modify the arguments received by the piece of advice, and to choose the arguments to be given to the next piece of advice if it is called.

If the last piece of around advice in the ordering calls `call-next-advice`, then it invokes the combination of before and after advice and the original definition that was discussed earlier. That is, the arguments to the call are given in the sequence described above to each of the before pieces of advice, then to the original definition and then to the after pieces of advice. The call to `call-next-advice` returns with the values produced by the last of these subsidiary calls, and the around advice may use these values in any way.

## 6.3 Removing advice

The macro `delete-advice` (or the function `remove-advice`) may be used to remove a named piece of advice. Since several pieces of advice may be attached to a single functional definition, the name must be supplied to indicate which one is to be removed.

```
CL-USER 40 > (delete-advice capi:prompt-for-file pff-1)
NIL
```

```
CL-USER 41 > (delete-advice capi:prompt-for-file pff-2)
NIL
```

## 6.4 Advice for macros and methods

As well as attaching advice to ordinary functions, it may also be attached to macros and methods.

In the case of a macro, advice is linked to the macro's expansion function, and so any before or after advice receives a copy of the arguments given to this expansion function (normally the macro call form and an environment). A simple example:

```
CL-USER 45 > (defmacro twice (b) `(+ ,b ,b))
TWICE

CL-USER 46 > (defadvice
  (twice before-twice :before)
  (call-form env)
  (format t
    "~~%Twice with environment ~A and call-form ~A"
    env call-form))
NIL

CL-USER 47 > (twice 3)
Twice with environment NIL and call-form (TWICE 3)
6
```

Note that the advice is invoked when the macro's expansion function is used. So if the macro is present within a function that is being compiled, then the advice is invoked during compilation of that function (and not when that function is finally used).

In the case of a method, the call to `defadvice` must also specify precisely to which method the advice belongs. A generic function may have several methods, so the call to `defadvice` includes a list of classes. This must correspond exactly to the parameter specializers of one of the methods for that generic function, and it is to that method that the advice is attached. For example:

```

CL-USER 45 > (progn
  (defclass animal ()
    (genus habitat description
      (food-type :accessor eats)
      (happiness :accessor how-happy)
      (eaten :accessor eaten :initform nil)))
  (defclass cat (animal)
    ((food-type :initform 'fish)))
  (defclass elephant (animal)
    (memory (food-type :initform 'hay)))
  (defmethod feed ((animal animal))
    (let ((food (eats animal)))
      (push food (eaten animal))
      (format t "~%Feeding ~A with ~A" animal
        food)))
  (defmethod feed ((animal cat))
    (let ((food (eats animal)))
      (push food (eaten animal))
      (push 'milk (eaten animal))
      (format t "~%Feeding cat ~A with ~A and ~A"
        animal food 'milk)))
  (defvar *cat* (make-instance 'cat))
  (defvar *nellie* (make-instance 'elephant)))
*PELLIE*

CL-USER 46 > (feed *cat*)
Feeding cat #<CAT 6f35d4> with FISH and MILK
NIL

CL-USER 47 > (feed *nellie*)
Feeding #<ELEPHANT 71e7bc> with HAY
NIL

CL-USER 48 > (defadvice
  ((method feed (animal))
   after-feed :after)
  (animal)
  (format t "~%-A has eaten ~A"
    animal (eaten animal)))
NIL
CL-USER 49 > (defadvice
  ((method feed (cat))
   before-feed :before)
  (animal)
  (format t "~%Stroking ~A" animal)
  (setf (how-happy animal) 'high))
NIL

```

```

CL-USER 50 > (feed *cat*)
Stroking #<CAT 6f35d4>
Feeding cat #<CAT 6f35d4> with FISH and MILK
NIL

CL-USER 51 > (feed *nellie*)
Feeding #<ELEPHANT 71eb7c> with HAY
#<ELEPHANT 71eb7c> has eaten (HAY HAY)

```

## 6.5 Advising subfunctions

Subfunctions are functions that are defined inside the body of other functions rather than by top level defining forms like `defun`, `defmethod`, etc. To advise such a subfunction, call `defadvice` with a "subfunction dspec" of the form:

- `(subfunction sub-name parent-dspec)`
- `(flet sub-name parent-dspec)`
- `(labels sub-name parent-dspec)`

See “Subfunction dspecs” on page 85 for details. The rest of the `defadvice` form has the same effect as when advising ordinary functions.

The behavior when advising a subfunction is somewhat different from advising other functions.

- `defadvice` modifies the parent of the subfunction such that future execution of the code that creates the subfunction will create it advised.
- A subsequent call to `defadvice` with the same dspec and name re-modifies the parent, and also causes any of the subfunctions that were already created advised to change their "advice" behavior (as defined by the `defadvice` form) to the behavior specified by the latest call to `defadvice`.
- `remove-advice` with the same dspec and name returns the parent function to its original state, and switches off the "advice" for the subfunctions that were created "advised".
- Using `defadvice` again with the same dspec and name after `remove-advice` modifies the parent as in the first point above, but has no affect

on any subfunction that was created by the parent before the call to `remove-advice`.

Advising of subfunction works only for compiled code.

### 6.5.1 Notes on subfunction names

Anonymous lambdas are named by the compiler using integers.

You can find the dspec of a given subfunction by calling `object-dspec` on the subfunction. You can also construct it from the printed representation of the subfunction, which contains the sub-name and the parent-dspec.

A subfunction can be given an name using a `hcl:lambda-name` declaration (see `declare`, page 651). If this is of the form `(subfunction sub-name)`, then the dspec of the subfunction will contain both *sub-name* and the correct parent-dspec. However, if it has any other form, then dspec will be that name and you will need to know the parent-dspec in order to construct the subfunction dspec.

## 6.6 Examples

So far you have only seen examples of before and after pieces of advice. This section contains some further examples. Suppose that you define a function `alpha` that squares a number, and then decide that you intended to return the reciprocal of the square instead. You might proceed as follows.

```
CL-USER 30 > (defun alpha (x) (* x x))
ALPHA

CL-USER 31 > (defadvice
                 (alpha reciprocal :around)
                 (num)
                 (/ (call-next-advice num)))
NIL

CL-USER 32 > (alpha -5)
1/25
```

First you change `alpha` to return the reciprocal of the square. Do this by defining an around method to take the reciprocal of the result produced by the next piece of advice (which initially is the original definition). Now suppose that

you later decide that you would like `alpha` to return the sum of the squares of the reciprocals in a certain range. You can achieve this by adding an extra layer of around advice. This must iterate over the range required, summing the results obtained by the calls to the next piece of advice (which currently yields the reciprocal of the square of its argument).

```
CL-USER 36 > (defadvice
  (alpha sum-over-range :around)
  (start end)
  (loop for i from start upto end
        summing (call-next-advice i)))
NIL

CL-USER 37 > (alpha 2 5)
1669/3600
```

Note that `alpha` now behaves as a function requiring two arguments; the outer piece of around advice determines the external interface to the function, and uses the inner pieces of advice as it needs - in this case invoking the inner advice a variable number of times depending on the range specified. The use of the words “outer” and “inner” corresponds to earlier and later pieces of around advice in the ordering discussed above, but is more descriptive of their behavior.

You now realize that taking the reciprocal of zero gives an error. You decide that you wish to generate an error if `alpha` is called in such a way as to cause this, but that you want to generate the error yourself. You also decide to add a warning message for negative arguments. As you want these actions to be performed as the last (that is innermost) in the chain of around advice, you specify this in the call to `defadvice` by giving it a `:where` keyword with value `:end`.

```

CL-USER 41 > (defadvice
                  (alpha zero-or-negative
                      :around :where :end)
                  (x)
                  (unless (plusp x)
                      (format t
                          "~%**Warning: alpha is being called with ~A"
                          x))
                  (if (zerop x)
                      (error "Alpha cannot be called with zero")
                      (call-next-advice x)))
NIL

CL-USER 42 > (alpha -5 -2)

**Warning: alpha is being called with -5
**Warning: alpha is being called with -4
**Warning: alpha is being called with -3
**Warning: alpha is being called with -2
1669/3600

CL-USER 43 > (alpha 0 3)

**Warning: alpha is being called with 0
Error: alpha cannot be called with zero
 1 (abort) return to level 0.
 2 return to top loop level 0

Type :c followed by a number to proceed

CL-USER 44 : 1 > :a

```

Finally you decide to alter `alpha` yet again, this time to produce approximations to  $\pi$ .  $\pi^2/6$  is the sum of the reciprocals of the squares of all the positive integers. So you can generate an approximation to  $\pi$  using the sum of the reciprocals of the squares of the integers from one to some limit. (In fact this is not an efficient way of calculating  $\pi$ , but it could be of interest.)

```

CL-USER 51 > (defadvice
                  (alpha pi-approximation :around)
                  (limit)
                  (sqrt
                      (* 6
                          (call-next-advice 1.0 limit))))
NIL

```

Next, try calling the following in turn:

```
(alpha 10.0)
(alpha 100.0)
(alpha 1000.0)
pi
```

Lastly, here is a simple example showing a use of advice with an `&rest` lambda list:

```
(defun foo (a b c)
  (print (list a b c)))

(defadvice (foo and-rest-advice :around) (&rest args)
  (format t "advice called with args ~S" args)
  (apply #'call-next-advice args))
```

## 6.7 Advice functions and macros

The main functions used for advice are introduced below. See the reference pages for full details.

The main macro used to define new pieces of advice is `defadvice`

Pieces of around advice should use `call-next-advice` to invoke the next piece of advice. As explained earlier this either calls the next piece of around advice (if one exists), or calls the combination of before advice, the original definition, and after advice. It may only be called from within the body of the around advice.

To remove a piece of advice, use the macro `delete-advice` or the function `remove-advice`.

## *6 The Advice Facility*

# 7

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# Dspecs: Tools for Handling Definitions

The dspec system is the machinery underlying the way definitions are named in LispWorks. It supports program development by tracking the locations of definitions, and is also used in tracing and advising functions.

Dspecs are not expected to work in runtimes delivered at a delivery level greater than 0.

This chapter explains the concepts underlying dspecs and their use in tracking locations of definitions. For full details of the programming interface, see Chapter 36, “The DSPEC Package”.

## 7.1 Dspecs

Definition specifications, or *dspecs*, are a systematic way of naming definitions. The dspec system includes all kinds of definitions provided in LispWorks, and can be extended to include definers that you add.

Most named definitions are global, but local functions can have names, and some of the operations described here can be applied to them as well.

Here are three examples of dspecs:

```
car  
(setf car)
```

```
(defclass standard-object)
```

A dspec is simply a name: you can operate on it even if the thing named does not currently exist.

## 7.2 Forms of dspecs

A dspec is one of:

- A symbol
- A `setf` function name
- A list starting with a symbol naming the class of definition (`method` or `defstruct` for example).

A symbol which is used as a dspec always names a function or a macro.

`(setf foo)` is a name for a `setf` function.

**Note:** `nil` is not a legal dspec, because it cannot have a function definition. Therefore when a dspec API returns `nil`, this should be interpreted in the usual way as "not found" or "not applicable".

### 7.2.1 Canonical dspecs

Internally, dspecs are handled in the canonical form:

```
(dspec-class primary-name . qualifiers)
```

where *dspec-class* is the canonical name of the class, and *qualifiers* is a proper list. *primary-name* is typically a symbol, but can be a list (in the case of a `setf` function) or a string (in the case of a package). The equality for canonical dspecs is `equal`.

As an example the general form of a `defmethod` dspec is:

```
(defmethod name qualifiers (specializer*))
```

<b>name</b>	<b>:</b>	<b>=</b>	<b>symbol</b>	<b> </b>	<b>(setf symbol)</b>
<b>qualifiers</b>	<b>:</b>	<b>=</b>	<b>qualifier</b>	<b> </b>	<b>(qualifier qualifier*)</b>
<b>qualifier</b>	<b>:</b>	<b>=</b>	<b>symbol</b>		
<b>specializer</b>	<b>:</b>	<b>=</b>	<b>symbol</b>	<b> </b>	<b>(eql object)</b>

Functions in the dspec API accept non-canonical dspecs. All dspec functions, except `dspec:prettify-dspec`, `find-dspec-locations`, `name-definition-locations`, `dspec-definition-locations` and `find-name-locations` return canonical dspecs.

## 7.3 Dspec namespaces

Dspec classes are the namespaces for dspecs. Class names are often the same as the name of the defining form, though documentation types as defined for `documentation` are also used. See “Details of built-in dspec classes and aliases” on page 82 for a list of the classes.

### 7.3.1 Dspec classes

Dspec classes provide a set of handlers, to allow uniform handling of different types of definitions by other parts of the system, such as the editor and various browsers.

The most important handlers are `dspec-defined-p` and `dspec-undefiner` for testing if a dspec is currently defined and for undefining a dspec.

New dspec classes are defined using `define-dspec-class`.

Dspec classes can be subclassed. The top-level classes correspond to distinct global namespaces (such as `variable` for variables and constants and `function` for functions and macros), and at each level, all the subclasses are distinct from each other (but they do not have to form a complete partition of the superclass). See “Details of built-in dspec classes and aliases” on page 82 for the full hierarchy of system-provided classes.

You are allowed to define new top-level classes and subclass them, but you cannot add new subclasses to a system-provided class. However, see “Dspec aliases” on page 80 for how to add new ways of making existing definitions.

#### 7.3.1.1 Complete example of a top-level dspec class

Define a `saved-value` object which has a name and a value:

```
(defstruct saved-value
  name
  value)
```

The objects are defined using `def-saved-value` and stored on the plist of their name:

```
(defmacro def-saved-value (name value)
  `(dspec:def (def-saved-value ,name)
    (when (record-definition `(def-saved-value ',name)
                               (dspec:location))
      (setf (get ',name 'saved-value)
            (make-saved-value :name ',name
                              :value ,value)))
    ',name)))
```

Define a function to retrieve the `saved-value` object:

```
(defun find-saved-value (name)
  (get name 'saved-value))
```

Define a macro to access a `saved-value` object:

```
(defmacro saved-value (name)
  `(saved-value-value (find-saved-value ',name)))
```

Define a dspec class for `def-saved-value` dspecs:

```
(dspec:define-dspec-class def-saved-value nil
  "Defined saved values"
  :definedp
  #'(lambda (name)
      ;; Find any object that def-saved-value recorded
      (not (null (find-saved-value name))))
  :undefinedp
  #'(lambda (dspec)
      ;; Remove what def-saved-value recorded
      `(remprop ,(dspec:dspec-name dspec) 'saved-value))
  :object-dspec
  #'(lambda (obj)
      ;; Given a saved-value object, we can reconstruct its dspec
      (and (saved-value-p obj)
           `(def-saved-value ,(saved-value-name obj)))))
```

For completeness, define a form parser that generates dspecs from forms:

```
(dspec:define-form-parser
  (def-saved-value
    (:parser dspec:single-form-form-parser)))
```

**Note:** this form parser for `def-saved-value` is not strictly necessary, because the system provides an implicit form parser which recognizes definitions beginning with "def".

### 7.3.1.2 Example of subclassing

This example is based on that in “Complete example of a top-level dspec class” on page 77.

Define a `computed-saved-value` object has a function to compute the value the first time:

```
(defstruct (computed-saved-value (:include saved-value))
  function)
```

`saved-value` objects are defined using `def-computed-saved-value` and stored on the plist of their name:

```
(defmacro def-computed-saved-value (name function)
  `(dspec:def (def-computed-saved-value ,name)
    (when (record-definition `,(def-computed-saved-value ',name)
      ,(dspec:location))
      (setf (get ',name 'saved-value)
        (make-computed-saved-value :name ',name
          :function ,function)))
    ',name)))
```

Define a function to compute a `computed-saved-value`:

```
(defun ensure-saved-value-computed (name)
  (let ((saved-value (find-saved-value name)))
    (or (saved-value-value saved-value)
        (setf (saved-value-value saved-value)
          (funcall
            (computed-saved-value-function saved-value))))))
```

Define a macro to access a `computed-saved-value`:

```
(defmacro computed-saved-value (name)
  `(ensure-saved-value-computed ',name))
```

Define a dspec class for `def-computed-saved-value` dspecs:

```
(dspec:define-dspec-class def-computed-saved-value def-saved-
value
  "Defined computed saved values"
  :definedp
  #'(lambda (name)
      ;; Find any object that def-computed-saved-value recorded
      (computed-saved-value-p (find-saved-value name)))
  ;; The :undefiner is inherited from the superspace.
  :object-dspec
  #'(lambda (obj)
      ;; Given a computed-saved-value object, we can reconstruct
      its dspec
      (and (computed-saved-value-p obj)
           `(def-computed-saved-value ,(saved-value-name obj)))))
```

For completeness, define a form parser that generates dspecs from forms:

```
(dspec:define-form-parser
  (def-computed-saved-value
    (:parser dspec:single-form-form-parser)))
```

**Note:** this form parser for `def-computed-saved-value` is not strictly necessary, because the implicit form parser will recognize definitions beginning with "def".

### 7.3.2 Dspec aliases

You can add new ways of making existing definitions and use the dspec system to track these definitions. This is what happens when your defining form expands into a system-provided form. The macro `define-dspec-alias` is used to inform the dspec system of this.

For example if your definer is:

```
(defmacro my-defun ((name &rest args) &body body)
  `(defun ,name ,args ,@body))
```

then you would define the form of dspecs for `my-defun` definitions like this:

```
(dspec:define-dspec-alias my-defun (name)
  `(defun ,name))
```

**Note:** in general you should not include the lambda list in the dspec, because it is not needed to locate the definition later.

**Note:** to make source location work you will also need a `define-form-parser` definition for `my-defun`. This is illustrated in “Using pre-defined form parsers” on page 91.

## 7.4 Types of relations between definitions

### 7.4.1 Functionally equivalent definers

When one definition form simply macroexpands into another, or otherwise has an identical effect as far as the dspec system is concerned, the dspec system should consider them variant forms of the same class.

Use `define-dspec-alias` to convert one definer to the other during canonicalization. A pre-defined example of this in LispWorks is `defparameter` and `defvar`. These cannot be distinguished (other than in the source code), so `defparameter` has been defined as a dspec alias for `defvar`. However, `defvar` and `defconstant` are distinct kinds of variable, since we can easily tell which type of definition is in effect by calling the function `constantp`. To define their dspecs, LispWorks creates a dspec class called `variable` and uses it as the superspace argument when defining the `defvar` and `defconstant` dspec classes.

As an explicit example, suppose you have a defining macro

```
(defmacro parameterdef (value name)
  `(defparameter ,name ,value))
```

then

```
(dspec:define-dspec-alias parameterdef (value name)
  `(defparameter ,name))
```

would be a suitable appropriate alias definition. This `define-dspec-alias` form defines the dspec.

`define-dspec-alias` is like `defmacro` for dspecs, so it could be used to describe complicated conversions, as long as it can be done purely statically and totally in terms of existing dspecs. However, nothing more complicated than `defparameter` has been found necessary.

### 7.4.2 Grouping subdefinitions together

Some definition forms are macros that expand into a group of other definitions, for example `defstruct`. When the form is associated with a dspec class, the subdefinitions can be automatically recorded as being subforms of the new definition, by use of the `def` macro.

This means that the dspec system knows that the subdefinitions were inside the main definition (indeed, inside this particular form). Therefore

- Location queries can retrieve this information.
- The source location commands in the LispWorks IDE, when passed a subdefinition, know to search for the main definition given in the `def`.

**Note:** to make source location work you will also need a `define-form-parser` definition for the macro that expands into the `def`.

**Note:** `def` defines a relation between two particular definitions, for example `(defstruct foo)` and `(defun make-foo)`, not between the two dspec classes.

### 7.4.3 Distributed definitions

Some definitions are additions to another class of definition, for example methods are additions to generic functions. We call these *distributed definitions*, consisting of "parts" and "the aggregate".

The primary name of a part gives the primary name of the aggregate it is a part of, and the qualifiers distinguish it from the other parts of the same aggregate. Only a part dspec may have qualifiers.

## 7.5 Details of built-in dspec classes and aliases

This section shows the dspec classes, subclasses and aliases provided by Lisp-Works. Subclasses are indented. Following the list of dspec classes are notes about some of these classes.

The system-defined dspec classes are:

```

COMPILER-MACRO (alias DEFINE-COMPILER-MACRO)
EDITOR:DEFCOMMAND (alias EDITOR:DEFINE-COMMAND-SYNONYM)
DEFINE-ACTION
DEFINE-ACTION-LIST
WIN32:DEFINE-DDE-CLIENT
WIN32:DEFINE-DDE-DISPATCH-TOPIC
DSPEC:DEFINE-DSPEC-CLASS (aliases DSPEC:DEFINE-SUBCLASS-DSPEC-CLASS,
DSPEC:DEFINE-FUNCTION-DSPEC-CLASS)
DSPEC:DEFINE-DSPEC-ALIAS
EDITOR:DEFINE-EDITOR-VARIABLE (alias EDITOR:DEFINE-EDITOR-MODE-VARIABLE)
FLI:DEFINE-FOREIGN-CALLABLE
FLI:DEFINE-FOREIGN-TYPE (alias FLI:DEFINE-FOREIGN-CONVERTER)
DSPEC:DEFINE-FORM-PARSER
CAPI:DEFINE-MENU
DEFSETF (aliases DEFINE-SETF-EXPANDER, DEFINE-SETF-METHOD)
DEFSYSTEM
FUNCTION
  DEFGENERIC
  DEFMACRO (alias DEFINE-MODIFY-MACRO)
  DEFUN (alias SYSTEM:DEFUN-AND-INLINE)
    FLI:DEFINE-FOREIGN-VARIABLE
    FLI:DEFINE-FOREIGN-FUNCTION (alias FLI:DEFINE-FOREIGN-FUNCALLABLE)
  METHOD (alias DEFMETHOD)
  METHOD-COMBINATION (alias DEFINE-METHOD-COMBINATION)
  PACKAGE (alias DEFPACKAGE)
  STRUCTURE (alias DEFSTRUCT)
TYPE
  DEFCLASS
    CAPI:DEFINE-INTERFACE
    CAPI:DEFINE-LAYOUT
    DEFINE-CONDITION
    STRUCTURE-CLASS
  DEFTYPE
VARIABLE
  DEFINE-SYMBOL-MACRO
  DEFCONSTANT
  DEFVAR (aliases DEFGLOBAL-PARAMETER, DEFGLOBAL-VARIABLE,
  DEFPARAMETER)

```

Further dspec classes are defined by modules such as `com` (on Microsoft Windows), `kw` and `sql`.

The canonical form of a symbol dspec is (`function symbol`) and the canonical form of a setf function name dspec is (`function (setf symbol)`).

### 7.5.1 Function dspecs

A function-dspec is a dspec that names a specific function. You can use a function-dspec when you need to specify a function by name, for example in `trace`, `defadvice`, and `set-up-profiler`.

A function-dspec can be either a symbol, a list of the form `(setf symbol)`, or any dspec with a class that is a "function" class, that is `function` or any of the classes listed above under `function`. It can also be a method dspec as described in "CLOS dspec classes" on page 84 or a subfunction dspec as described in "Subfunction dspecs" on page 85.

### 7.5.2 CLOS dspec classes

`defgeneric` and `method` can handle `standard-generic-function` and `standard-method`.

The canonical form of a `defgeneric` dspec is `(defgeneric generic-function-name)`.

The canonical dspec of a `method` is:

```
(method function-name [method-qualifier] (parameter-specializer-name*))
```

Where *function-name*, *method-qualifier* and *parameter-specializer-name* match the ones in the `defmethod` form.

Each *parameter-specializer-name* must match the corresponding specializer for all the required parameters of the method. If a parameter is not specialized in the `defmethod` form then its *parameter-specializer-name* needs to be given as `t`.

For example, a method that is defined by:

```
(defmethod a-method ((arg1 cons) arg2 &optional arg3) ...)
```

has a dspec:

```
(method a-method (cons t))
```

and a method defined like this:

```
(defmethod initialize-instance :after ((a my-class)
                                         &key key1 key2)
  ...)
```

has a dspec:

```
(method initialize-instance :after (my-class))
```

### 7.5.3 Part Classes

`method` is a part class for `defgeneric`.

`compiler-macro` is a part class for `function`.

### 7.5.4 Foreign callable dspecs

For `fli:define-foreign-callable` the canonical name is the foreign name, with any machine-specific prefixes omitted.

## 7.6 Subfunction dspecs

For some purposes, most usefully `trace` and `defadvice`, LispWorks allows dspecs that do not name a global definition, but a local function. These are of the form:

```
(subfunction sub-name parent-dspec)
```

where *parent-dspec* is another dspec (possibly a subfunction dspec itself). For `flet` and `labels`, it is also possible to use the form:

```
(flet sub-name parent-dspec)
```

An alias for `(subfunction (flet sub-name) parent-dspec)`.

or:

```
(labels sub-name parent-dspec)
```

An alias for `(subfunction (labels sub-name) parent-dspec)`.

*sub-name* is the name of the subfunction inside the parent, which by default is determined as follows:

- For subfunctions defined by `flet` and `labels`, the name is a two element list of the form `(flet function-name)` or `(labels function-name)`,

where *function-name* is the function name in the `flet/labels` definition.

- For anonymous lambdas, the compiler names the subfunctions within each parent function by small, increasing integers starting from 1.

You can override the default name by using the LispWorks-specific `hcl:lambda-name` declaration (see `declare`). Note that you should use the form

```
(declare (lambda-name (subfunction sub-name))
```

to get a name that is useful for debugging. If you do not use `subfunction`, then the debugger cannot find the source for function.

Notes:

- The *sub-name* of the subfunction is not used by the dspec system to search its databases, so can be anything.
- Source level debugging does not use the *sub-name* of the subfunction, but does need to be able to find the definition of *parent-dspec*.
- `trace` and `defadvice` search for the function by comparing (using `equal`) the subfunction name in the dspec to the name of each subfunction in the parent function.
- A subfunction dspec can be canonicalized and prettified or passed as an argument to `dspec-definition-locations` (which will find where parent is defined).
- Additionally, pseudo-dspecs like this are allowed for top-level forms:

```
(top-level-form (location tlf))
```

*location* is an atomic location (not containing `:inside`) and *tlf* identifies the top-level form within that location. These are used as parent dspecs in subfunction dspecs and `:inside` locations. These dspecs can be canonicalized and prettified, and can be returned as dspecs from the location finders.

## 7.7 Tracking definitions

The dspec system is used to keep track of global definitions in many ways, and global definition macros usually tell the dspec system when the definition changes.

The main purpose of the system is to keep track of where the definition was located, but it also allows fine-tuned control of redefinitions.

### 7.7.1 Locations

Locations are mainly something the dspec system just stores and retrieves. :inside locations are used to describe definitions located as subforms of other definitions.

:inside locations are usually not explicitly specified, but arise as a result of having two nested definitions, both of which use the `def` and `location` macros to handle the name and location info.

The types of locations and their meanings are:

A pathname      A definition existed in the file named or an editor buffer with that name.

The keyword :listener

A definition was executed interactively in the listener or an editor buffer not associated with a file.

The keyword :unknown

A definition was found in the image (these are entered when a location query does not find any information already in the database).

The keyword :implicit

A definition for a part was recorded, but no information exists for the aggregate.

### 7.7.2 Recording definitions and redefinition checking

The location information is entered into the database when the definition is executed, by the defining function calling `record-definition`.

`record-definition` performs various checks, and returns true or false depending on whether the definition was allowed or not. In particular, it checks whether the same name has already been defined in a different location and if so a warning or error can be signaled. See `record-definition`, page 817 for details.

### 7.7.2.1 Use of record-definition

You should not usually call `record-definition`, since all the system-provided definers call it.

However, for new classes of definition which you add with `define-dspec-class`, you should call `record-definition` for dspecs in their new classes, as shown in “Complete example of a top-level dspec class” on page 77.

### 7.7.2.2 Protecting packages

LispWorks has a mechanism for protecting packages against defining any of their external symbols. By default, all the LispWorks implementation packages are protected. This is configurable by the variables `*packages-for-warn-on-redefinition*` and `*handle-warn-on-redefinition*`.

The protection is useful because it is relatively easy to redefine an external symbol by mistake, and it leads to undefined behavior which is difficult to debug. However, in some circumstances you may want to force such definition. In this case, you can rebind either of `*packages-for-warn-on-redefinition*` or `*handle-warn-on-redefinition*` around the definition to avoid the error.

You can also protect your packages by adding their names to the global value of `*packages-for-warn-on-redefinition*`.

### 7.7.3 Source level debugging and stepping

With suitable compilation options (see `toggle-source-debugging`), the LispWorks debugger will automatically identify the exact subform in the source code for each stack frame. In addition, the Stepper tool in the LispWorks IDE can step subforms in the source code.

This also works for a subform that occurs within a macro expansion, provided that the subform is `eq` to the original subform in the call to the macro. In the rare case where a macro copied a subform, making it non-`eq`, you can use the `replacement-source-form` macro to indicate which original subform should be identified as the source code for the new form.

## 7.8 Finding locations

There are two ways of retrieving location information for definitions in the running LispWorks image:

- query for a `dspec` using `dspec-definition-locations`, or
- query for a *name* in a given set of namespaces using `name-definition-locations`

The difference is that name queries will find the locations of all the part definitions as well as the definition named, whereas `dspec` queries will only find the locations for the definition named (there might be many if it has been redefined).

To provide for sub-definitions hidden in another definition, such as `defstruct` accessors, all location queries produce a list of pairs of `dspecs` and locations, each pair naming a definition within the corresponding location that contains the definition looked for. So a query for an accessor called `foobar` might produce the pair:

```
((defstruct foo) #P"/usr/users/hacker/hacks/hack.lisp")
```

## 7.9 Users of location information

To find location information for definitions made in the running image or recorded in a tags database or a tags file:

- query for a `dspec` using `find-dspec-locations`, or
- query for a *name* in a given set of namespaces using `find-name-locations`

The extent of the search is controlled by the value of the variable `*active-finders*`.

For example, to obtain the locations of the definitions of `foo` across all dspec namespaces, call

```
(dspec:find-name-locations dspec:*dspec-classes* 'foo)
```

Another example of the use of `find-name-locations` is the LispWorks Editor tool's Find Definitions tab.

### 7.9.1 Finding definitions in the LispWorks editor

Returning to our example `parameterdef` definer

```
(defmacro parameterdef (value name)
  `(defparameter ,name ,value))
```

1. Load a file `foo.lisp` containing

```
(parameterdef 42 *foo*)
```

2. Now use **Expression > Find Source** on the symbol `*foo*`. Notice that LispWorks knows which file the definition is in, but cannot find the defining top level form.
3. Also notice that the Definitions tab of the Editor tool does not display the definition of `*foo*`. This is because the Editor does not recognize `parameterdef` as a definer. When the LispWorks editor looks at the definitions in a buffer, it needs to know the dspecs that each defining form will generate when evaluated. You can tell the editor how to parse a defining form to generate the dspec by using `define-form-parser`.
4. Now evaluate these forms to associate a parser with `parameterdef` and inform the dspec system that `parameterdef` is another way of naming a `defparameter` dspec:

```
(dspec:define-form-parser parameterdef (value name)
  `(parameterdef ,name))
```

```
(dspec:define-dspec-alias parameterdef (name)
  `(defparameter ,name))
```

5. Now use **Expression > Find Source** on the symbol `*foo*` again. Notice that the source of the definition of `*foo*` is displayed correctly in the text tab of the Editor tool, and that the Definitions tab displays the definition as

```
(parameterdef *foo*)
```

### 7.9.2 Using pre-defined form parsers

LispWorks provides form parsers `name-only-form-parser`, `single-form-form-parser` and `single-form-with-options-form-parser`. You can use `single-form-with-options-form-parser` as the parser for `my-defun` definitions (see “Dspec aliases” on page 80), like this:

```
(dspec:define-form-parser (my-defun
                           (:parser dspec:single-form-with-options-form-parser)))
```

This allows the Editor to locate definitions like:

```
(my-defun (foo x y)
          (+ x y))
```

You can identify the form parser defined for a dspec class using `get-form-parser`.

### 7.9.3 The editor’s implicit form parser

When testing your form parsers bear in mind that the LispWorks editor has an implicit form parser, independent of explicit parsers defined in the dspec system. It tries to parse a dspec from a top level form which is of length 2 or more and whose car has symbol name beginning with "DEF". That is:

```
(defxyz name forms)
```

gets parsed as

```
(defxyz name)
```

which may be a dspec (and thus provides a match for the source location commands). This mechanism operates only when there's no explicit parser defined for `defxyz`.

The editor’s implicit form parser is useful because it matches a common simple case. However it does not work for the `parameterdef` example, because that definer’s symbol name does not begin with "DEF".

### 7.9.4 Reusing form parsers

The form parser established above was specifically for `parameterdef` forms. However if you have other definers of similar syntax - in this example, definers for which the name is the second subform - then you can define a form parser which can be associated with each of them, as follows:

```
(dspec:define-form-parser (name-second (:anonymous t))
                           (value name)
                           `,(name-second ,name))
```

Note that the `name-second` variable is evaluated in the body of the parser. Supposing you have another defining macro `constantdef`:

```
(defmacro constantdef (value name)
                      `(defconstant ,name ,value))
```

then you can associate the same parser with both this and `parameterdef`:

```
(dspec:define-form-parser (parameterdef
                           (:parser name-second-form-parser)))

(dspec:define-form-parser (constantdef
                           (:parser name-second-form-parser)))
```

### 7.9.5 Example: defcondition

Suppose you have a macro based on `define-condition`:

```
(defmacro defcondition (&rest args)
                      `(define-condition ,@args))
```

When the following form is evaluated, the system records the dspec (`define-condition foo`):

```
(defcondition foo () ())
```

Two setups are needed to allow the editor to locate such a defining form.

Firstly, this tells the system how to parse (`defcondition ...`) toplevel forms:

```
(dspec:define-form-parser
  (defcondition
    (:alias define-condition)))
```

So now:

```
(dspec:parse-form-dspec '(defcondition foo () ()))
=>
(defcondition foo)
```

Secondly, this tells the system that (defcondition foo) is an alias for (define-condition foo).

With this, the editor would report "Cannot find (DEFINE-CONDITION FOO) in ...".

```
(dspec:define-dspec-alias defcondition (name)
  `(define-condition ,name))
```

So now this definition can be located:

```
(defcondition foo () ())
```

just as if it were:

```
(define-condition foo () ())
```

### 7.9.6 Example: my-defmethod

Suppose you have a method definer `my-defmethod`:

```
(defmacro my-defmethod ((name &key doc)
  lambda-list
  &body body)
  `(defmethod ,name ,lambda-list ,@body))
```

Unlike function dspecs, method dspecs need to include the specialized argument types as well as the function name, so the alias and the parser both need to be more complex.

This causes the dspec to include the argument types:

```
(dspec:define-dspec-alias my-defmethod (name &rest options)
  `(defmethod ,name ,@options))
```

The dspec parser for method lambda lists is complicated, but you can invoke the `defmethod` parser in your `my-defmethod` parser, like this:

```
(dspec:define-form-parser my-defmethod (name-stuff lambda-list)
  `(.my-defmethod ,(cdr (dspec:parse-form-dspec
    `(defmethod ,(car name-stuff)
      ,lambda-list))))
```

Now this definition can be located:

```
(my-defmethod (bar :doc "bar documentation") (x y)
  (foo x y))
```

just as if it were:

```
(defmethod bar (x y)
  (foo x y))
```

# 8

---

## Action Lists

Action-lists are a unified approach to various different mechanisms for running initializations, or “hook” functions at various points during the life of the system. They provide central gathering points for applications to trigger on system-wide events such as start-up, disk-save, and so on.

An action-list is a tagged list of data, to be executed (in some sense) in sequence whenever the circumstance identified by its tag occurs. It is expected that whatever code detects or causes the circumstance will take care of running the action-list.

An execution-function can be specified for the action-list when it is created. Otherwise, the default behavior is to treat the data of each action as a callable and apply it to any additional arguments specified at execution time. At its simplest, an action-list emulates (`map nil 'funcall`).

Names of action-lists and action-items are general lisp objects, compared with `equalp`. This allows strings and other objects to be used as unique identifiers.

Actions can be specified to depend on other actions; when defining an action-item, you can say that it must be before or after other action-items using the `:before` and `:after` keywords. Aside from that, actions are assumed to have no dependencies, and no order of execution should be counted on for the actions in a list.

You can (and are encouraged to) specify a documentation string for action-lists or action-items.

In addition you can create action-lists that are not registered globally. This allows applications to have disembodied action lists for their own internal purposes. The other action-list functions allow an action-list to be passed in instead of a name, to accommodate this.

## 8.1 Defining action lists and actions

Action lists are defined using the `define-action-list` macro, and are undefined using the `undefine-action-list`. It is also possible to make unnamed, unregistered lists using `make-unregistered-action-list`.

When defining an action-list, the user may provide an associated execution-function. When executing the action-list, this user-defined execution-function is used instead of the default execution-function, to map over and “execute” the action-list's action-items. The macro `with-action-list-mapping` provides facilities to map over action-items (that is, their corresponding “data”). In addition, the macro `with-action-list-mapping` provides a simple mechanism to trap errors and print warnings while executing each action-item.

Actions are added to an action list using `define-action`, and are removed using `undefine-action`.

## 8.2 Exception handling variables

Three global variables control the handling of exceptions in action list and action item operations.

The variable `*handle-existing-action-list*` controls the behavior of `define-action-list` when the action list already exists. It allows you to control independently both:

- whether you are notified, and
- whether the action list gets redefined

The variable `*handle-existing-action-in-action-list*` controls the behavior of `define-action` when the action already exists in the given action-list. It allows you to control independently both:

- whether you are notified, and
- whether the action item gets redefined

The variable `*handle-missing-action-list*` specifies behavior when one of `undefine-action-list`, `print-actions`, `execute-actions`, `define-action` and `undefine-action` is called on a missing action-list. By default, an error is signaled, but you can make it warn or ignore instead.

The variable `*handle-missing-action-in-action-list*` specifies behavior when you attempt to undefine a missing action. By default, a warning is signaled, but you can make it signal error, or ignore, instead.

## 8.3 Other variables

The variable `*default-action-list-sort-time*` specifies when actions in action-lists are sorted. By default actions are sorted at the time of execution of the action list, but you can cause them to be sorted at action definition time instead.

See `define-action-list` for an explanation of ordering specifiers.

## 8.4 Diagnostic utilities

Two diagnostic functions are provided:

- `print-actions` prints out the actions on a specified action list
- `print-action-lists` prints a list of all the defined action lists

## 8.5 Examples

This example illustrates “typical” use of action lists. The `define-action` forms might be scattered across several files (`mail-utilities.lisp`, `caf-define.lisp`, and so on). Each of the functions, such as `read-mail`, `dont-panic`, and so on, take one argument: `hassled-p`.

```
(in-package "CL-USER")
```

```

(define-action-list "On arrival at office"
  :documentation "Things to do in the morning"
  :dummy-actions '("Look busy")
  :default-order '(:before "Look busy"))

(define-action "On arrival at office" "Read mail" 'read-mail)

(define-action "On arrival at office" "Greet co-workers"
  'say-hello)

(define-action "On arrival at office" "Drink much coffee"
  'wake-up:after "Locate coffee machine")

(define-action "On arrival at office" "Locate coffee machine"
  'dont-panic)

(defun my-morning (hassled-p Monday-p)
  (execute-actions ("On arrival at office"
    :ignore-errors-p Monday-p)
    hassled-p)
  <rest of my-morning code goes here>
)

```

This example illustrates use of execution-functions and post-processing

```
(in-package "CL-USER")
```

Here are the implementation details, which are hidden from the “user”.

```

(defstruct (thing (:constructor make-thing (name number)))
  name
  number)

(defvar *things*
  (make-unregistered-action-list :sort-time :define-action
    :execution-function 'act-on-things))

(defun do-things (function &optional post-process)
  (execute-actions (*things* :post-process post-process)
    function))

(defun act-on-things (things other-args-list &key post-process)
  (with-action-list-mapping
    (things ignore thing post-process)
    (destructuring-bind
      (function) other-args-list
      (funcall function thing))))

```

The interface is given below. The internals of the mapping mechanism are hidden.

```
(defmacro define-thing (name number)
  (with-unique-names (thing)
    `(let ((,thing (make-thing ,name ,number)))
       (define-action *things* ',name ,thing)))))

(defmacro undefine-thing (name)
  `(~(undefined-action *things* ,name) ,))

(defun find-thing (name)
  (do-things #'(lambda (thing)
                  (and (equal name (thing-name thing))
                       thing))
              :or))

(defun add-things ()
  (reduce '+ (do-things 'thing-number :collect)))
```

## 8.6 Standard Action Lists

The following action lists are defined in LispWorks as shipped:

**"When starting image"** - Actions to be executed upon image startup.

**"Confirm when quitting image"** - Actions to be executed before the image quits. Every action must return non-nil as its first value, otherwise the quit will be aborted once the actions are complete.

**"When quitting image"** - Actions to be executed when the image quits, after success of the "Confirm when quitting image" actions.

**"Initialize LispWorks Tools"** - Things to do when the LispWorks IDE starts on a screen. You may customize your environment startup by defining actions on it.

**"Delivery Actions"** - Actions to be executed when doing delivery. Actions on this list are executed in a 'normal' environment. See the *Delivery User Guide* for an example action item.

**"Save Session Before"** - Actions executed before saving a session. See `save-current-session` for details.

**"Save Session After"** - Actions executed after saving a session and redisplaying all the windows. These actions are executed both in the saving image and in the saved image when restarted. See `save-current-session` for details.



# 9

---

## The Compiler

The compiler translates Lisp forms and source files into binary code for the host machine. A compiled Lisp function, for instance, is a sequence of machine instructions that directly execute the actions the evaluator would perform in interpreting an application of the original source lambda expression. Where possible the behaviors of compiled and interpreted versions of the same Lisp function are identical. Unfortunately the definition of the Common Lisp language results in certain unavoidable exceptions to this rule. The compiler, for instance, must macroexpand the source before translating it; any side effects of macro-expansion happen only once, at compile time.

By using declarations, you can advise the compiler of the types of variables local to a function or shared across an application. For example, numeric operations on a variable declared as a `single-float` can be compiled as direct floating-point operations, without the need to check the type at execution time. You can also control the relative emphasis the compiler places on efficiency (speed and space), safety (type checking) and support for debugging. By default the compiler produces code that performs all the necessary type checking and includes code to recover from errors. It is especially important that the type declarations be correct when compiling with a safety level less than 3 (see later in this chapter for more details).

When compiling a Lisp source file, the compiler produces its output in a format that is much faster to load than textual Lisp source — the “fasl” or “fast-

load” form. Fasl files contain arbitrary Common Lisp objects in a pre-digested form. They are loaded without needing to use the expensive `read` function. A series of “fasl-loader” routines built into LispWorks interpret the contents of fasl files, building the appropriate objects and structures in such a way that objects that were `eq` before fasl-dumping are created `eq` when fasl-loaded.

Fasl files are given pathname extensions that reflect the target processor they were compiled for; as the fasl files contain processor specific instruction sequences it is essential that the loader be able to distinguish between files compiled for different targets. These pathname extensions always end in “fasl”. See `compile-file` for details of all the possible fasl file extensions.

## 9.1 Compiling a function

The function `compile` takes a symbol as its first argument, and an interpreted function definition (a lambda expression) as its second, optional, argument. It compiles the definition and installs the resultant code as the symbol-function of the symbol (unless the symbol was `nil`). If the definition is omitted then the current symbol-function of the symbol is used. Below are some examples:

```
CL-USER 3 > (compile (defun fred (a b)
                               (dotimes (n a) (funcall b))))
; FRED
FRED
NIL
NIL

CL-USER 4 > (funcall (compile nil '(lambda (n)
                                         (* n n))) 7)
; NIL
49

CL-USER 5 > (compile 'ident-fun '(lambda (x) x))
; IDENT-FUN
IDENT-FUN
NIL
NIL
```

## 9.2 Compiling a source file

The function `compile-file` takes a pathname as its argument and compiles all the forms in the file, producing a corresponding fasl file (with pathname derived from the source pathname). Any side effects in the source file are only felt once the compiled file is subsequently loaded. Many proclamations, for example, are not visible at compile time. The special form `eval-when` can be used to force such side effects to take effect at the time of compilation, rather than loading.

## 9.3 Compiling a form

To compile an arbitrary form *form* (as opposed to a function), call

```
(compile form)
```

This compiles *form* as if by `compile-file` but without any file related processing and does it in-memory, so it has also the same effect as loading. This has a similar effect to compiling a definition in the LispWorks Editor tool, except that there is no source recording.

Using `compile` this way is especially useful if you need to dynamically define something that is normally defined by a top level or, for example `kw: defrule`.

## 9.4 How the compiler works

Conceptually the compiler can be viewed as performing a series of separate passes.

- In the first pass the source code is macro expanded in the appropriate macro environment.
- A series of source to source optimizing transformations are performed to simplify the source tree. Type declarations are used to select specialized, efficient versions of low level functions.
- A graph is generated from the source tree. The structure of the graph reflects the flow of control in the tree. The nodes of the graph contain blocks of intermediate code for an abstract machine with byte addressing and an infinite set of registers. Register allocation is performed

based on data flow analysis and machine specific rules concerning live ranges across code fragments.

- The blocks of intermediate code are translated into a single linear sequence of target machine code through a process of template matching.
- Finally the relative branch instructions are “fixed up” to point to the correct locations in the code sequence.

The compiler is in fact much more complex than this model might suggest. Machine specific optimizations, for example, can be included in any of the passes. The distinction between passes is also not as simple as that listed above. However, this description is sufficient to allow the programmer to make optimal use of the compiler.

## 9.5 Compiler control

There are ways to control the nature of compiled code via the `declare` special form and `proclaim` function. See “Declare, proclaim, and declaim” on page 109 for fuller discussion of these two forms.

In particular there are a set of optimize qualities which take integral values from 0 to 3. These control the trade-offs between size, speed, retention of debug information, optimizations and safety (that is, type checks) in the resulting code, and also compilation time. For example:

```
(proclaim '(optimize (speed 3) (safety 0) (debug 0)))
```

tells the compiler to concentrate on code speed rather than anything else, and

```
(proclaim '(optimize (safety 3)))
```

ensures that the compiler never takes liberties with Lisp semantics and produces code that checks for every kind of error that can be signaled.

The important declarations to the compiler are type declarations and optimize declarations. To declare that the type of the value of a variable can be relied upon to be unchanging (and hence allow the compiler to omit various checks in the code), say:

```
(declare (type the-type variable * ))
```

Optimize declarations have various qualities, and these take values from 0 to 3. The names are `safety`, `fixnum-safety`, `float`, `sys:interruptable`, `debug`, `speed`, `compilation-speed`, and `space`.

Most of the qualities default to 1 (but `safety` and `fixnum-safety` default to 3 and `interruptable` defaults to 0). You can either associate an optimize quality with a new value (with local lexical scope if in `declare`, and global scope if `proclaim`), or just give it by itself, which implies the value 3 (taken to mean “maximum” in some loose sense).

Thus you ensure code is at maximum safety by:

```
(proclaim '(optimize (safety 3)))
```

or

```
(proclaim '(optimize safety))
```

and reduce debugging information to a minimum by

```
(proclaim '(optimize (debug 0)))
```

Normally code is interruptible, but when aiming for maximum speed and minimum safety and debug information code is not interruptible unless you ensure it thus:

```
(proclaim '(optimize (debug 0) (safety 0) (speed 3)
                     interruptable))
```

The levels of `safety` have the following implications:

- 0 implies no type checking upon reading or writing from defstructs, arrays and objects in general, nor any checking of array index bounds.
- 1 implies no type checking upon reading from defstructs, arrays and objects in general, nor any checking of array index bounds when reading. However, array index bounds are checked when writing.
- 2 implies type checking when writing, but not when reading. Other than this the compiler generates generally safe code, but allows `type` and `fixnum-safety` declarations to take effect. Array index bounds are checked for both reading and writing.
- 3 (default) implies complete type and bounds checking, and disallows `fixnum-safety` and `type` declarations from taking any effect.

The levels of `fixnum-safety` have the following implications:

- 0 implies no type checking of arguments to numeric operations, which are assumed to be fixnums. Also the result is assumed, without checking, to not overflow - this level means single machine instructions can be generated for most common integer operations, but risks generating values that may confuse the garbage collector.
- 1 implies that numeric operations do not check their argument types (assumed fixnum), but do signal an error if the result would have been out of range.
- 2 implies that numeric operations signal an error if their arguments are non-fixnum, and also check for overflow.
- 3 (default) implies complete conformance to the semantics of Common Lisp numbers, so that types other than integers are handled in compiled code.

Additionally if the level of `float` (really this should be called “float-safety”) is 0 then the compiler reduces allocation during float calculations.

The effects of combining these qualities is summarized below:

Table 9.1 Combining debug and safety levels in the compiler

Keyword settings	Operations
<code>safety=0</code>	Array access optimizations
<code>debug&gt;0</code>	Dumps symbol names for arglist
<code>debug&gt;=2</code>	Ensure debugger knows values of args (and variables when source level debugging is on) and can find the exact subform in the Editor.
<code>debug&lt;1</code>	Does not generate any debug info at all
<code>debug=3</code>	Avoids <code>make-instance</code> and <code>find-class</code> optimizations
<code>debug=3</code>	Avoids <code>gethash</code> and <code>puthash</code> optimizations
<code>debug=3</code>	Avoids <code>ldb</code> and <code>dpb</code> optimizations

Table 9.1 Combining debug and safety levels in the compiler

Keyword settings	Operations
<code>debug=3</code>	Avoids an optimization to <code>last</code>
<code>safety&gt;1</code>	Be careful when multiple value counts are wrong
<code>safety&lt;1</code>	Do not check array indices during write
<code>safety&lt;2</code>	Do not check array indices during read
<code>speed&gt;space</code>	Inline map functions (unless <code>debug&gt;2</code> )
<code>debug&lt;=2</code>	Optimize (merge) tail calls
<code>debug&lt;2 and safety&lt;2</code>	Self calls
<code>safety&gt;=2</code>	Check get special
<code>safety&lt;2</code>	Do not check types during write
<code>safety&lt;3</code>	Do not check types during read
<code>safety&gt;=1</code>	Check structure access
<code>safety&lt;=1</code>	Inline structure readers, with no type check
<code>safety=0</code>	Inline structure writers, with no type check
<code>safety&gt;1</code>	Check number of args
<code>safety&gt;=1 or interruptible&gt;0</code>	Check stack overflow
<code>safety&gt;1</code>	Ensures the thing being funcalled is a function
<code>safety&lt;3 and fixnum-safety=2</code>	Fixnum-only arithmetic with errors for non fixnum arguments.
<code>safety&lt;3 and fixnum-safety=1</code>	No fixnum overflow checks
<code>safety&lt;3 and fixnum-safety=0</code>	No fixnum arithmetic checks at all
<code>safety&gt;2</code>	<code>char=</code> checks for arguments of type <code>character</code>
<code>safety&gt;=2</code>	Ensures symbols in <code>progv</code>

Table 9.1 Combining debug and safety levels in the compiler

Keyword settings	Operations
<code>debug=3</code>	Avoids “ad hoc” predicate type transforms
<code>compilation-speed=3</code>	Reuse virtual registers in very large functions
<code>debug=3 and safety=3</code>	( <code>declare (type foo x)</code> ) and ( <code>the foo x</code> ) ensure a type check
<code>float=0</code>	Optimize floating point calculations

The other optimize qualities are: `speed` — the attention to fast code, `space` — the degree of compactness, `compilation-speed` — speed of compilation, `interruptable` — whether code must be interruptible when unsafe.

Note that if you compile code with a low level of safety, you may get segmentation violations if the code is incorrect (for example, if type checking is turned off and you supply incorrect types). You can check this by interpreting the code rather than compiling it.

### 9.5.1 Examples of compiler control

The following function, compiled with safety = 2, does not check the type of its argument because it merely reads:

```
(defun foo (x)
  (declare (optimize (safety 2)))
  (car x))
```

However the following function, also compiled with safety = 2, does check the type of its argument because it writes:

```
(defun set-foo (x y)
  (declare (optimize (safety 2)))
  (setf (car x) y))
```

As another example, interpreted code and code compiled at a low safety does not check type declarations. To make LispWorks check declarations, you need to compile your code after doing:

```
(declaim (optimize (safety 3) (debug 3)))
```

This last example shows how to copy efficiently bytes from a typed-aref vector (see `make-typed-aref-vector`) to an (`unsigned-byte 8`) array. `type` and `safety` declarations cause the compiler to inline the code that deals specifically with (`unsigned-byte 8`). This code was developed after an application was found to have a bottleneck in the original version of this function:

```
(defun copy-typed-aref-vector-to-byte-vector
  (byte-vector typed-vector length)
  (declare (optimize (safety 0))
           (type (simple-array (unsigned-byte 8) 1) byte-vector)
           (fixnum length))
  (dotimes (index length)
    (declare (type fixnum index))
    (setf (aref byte-vector index)
          (sys:typed-aref '(unsigned-byte 8)
                          typed-vector index))))
```

## 9.6 Declare, proclaim, and declaim

The special form `declare` is used to:

- declare Lisp variables as “special”, which affects the semantics of the appropriate bindings of the variables, or
- help the system (in reality the compiler) run your Lisp code faster, or
- make the code run with more sophisticated debugging options, or
- help you optimize your code

`declare` behaves computationally as if it is not present (other than to affect the semantics), and is only allowed in certain contexts, such as after the variable list in a `let`, `do`, `defun` and so on. Consult the syntax definition of each special form to see if it accepts `declare` forms.

For the details, including some LispWorks extensions to Common Lisp, see the reference entry for `declare`.

The function `proclaim` parses declarations in a specified list and then puts their semantics and advice into global effect. This can be useful when compiling a file for speedy execution, since a proclamation such as:

```
(proclaim '(optimize (speed 3) (space 0) (debug 0)))
```

causes the rest of the file to be compiled with these optimization levels in effect. (A lengthier way to do this is to make appropriate declarations in every function in the file.) Below are some more examples:

```
(proclaim '(special *fred*))  
(proclaim '(type single-float x y z))  
(proclaim '(optimize (safety 0) (speed 3)))
```

Do not forget to quote the argument list if it is a constant list. This form:

```
(proclaim (special x))
```

attempts to call function `special`.

`declaim` is a macro equivalent to `proclaim`.

### 9.6.1 Naming conventions

Exercise caution if you `declare` or `proclaim` variables to be special without regard to the naming convention that surrounds their names with asterisks.

## 9.7 Optimizing your code

Careful use of the compiler optimize qualities described above or special declarations may significantly improve the performance of your code. However it is not recommended that you simply experiment with the effect of adding declarations. It is more productive to work systematically:

1. Use the Profiler, described in Chapter 12, “The Profiler”, to analyze your application’s performance and identify bottlenecks, then
2. Consider whether re-writing of parts of your source code would improve efficiency at the bottlenecks, and
3. Use `:explain` declarations to make the compiler generate optimization hints, and
4. (In SMP LispWorks) use `analysing-special-variables-usage` to report on symbols proclaimed special, and
5. Consider adding suitable declarations as described in this chapter to improve efficiency at the bottlenecks.

The most important tool for speeding up programs is the Profiler. You use the profiler to find the bottlenecks in the program, and then optimize these bottlenecks by helping the compiler to produce better code.

The remainder of this section describes some specific ways to produce efficient compiled code with LispWorks.

### 9.7.1 Compiler optimization hints

You can make the compiler print messages which will help you to optimize your code. You add suitable `:explain` declarations, recompile the code, and check the output.

The full syntax of the `:explain` declaration is documented in the reference entry for `declare`.

Various keywords allows you to see information about compiler transformations depending on type information, allocation of floats and bignums, floating point variables, function calls, argument types and so on. Here is a simple example:

```
(defun foo (arg)
  (declare (:explain :variables) (optimize (float 0)))
  (let* ((double-arg (coerce arg 'double-float))
         (next (+ double-arg 1d0))
         (other (* double-arg 1/2)))
    (values next other)))
;;- Variables with non-floating point types:
;;- ARG OTHER
;;- Variables with floating point types:
;;- DOUBLE-ARG NEXT
```

**Note:** the LispWorks IDE allows you to distinguish compiler optimization hints from the other output of compilation, and also helps you to locate quickly the source of each hint. For more information see the chapter “The Output Browser” in the *LispWorks IDE User Guide*.

### 9.7.2 Fast integer arithmetic

You can arrange for compiled code to perform optimal raw 32-bit arithmetic, and additionally in 64-bit LispWorks, optimal raw 64-bit arithmetic.

For all the details, see “Fast 32-bit arithmetic” on page 472 and “Fast 64-bit arithmetic” on page 474.

### 9.7.3 Floating point optimization

The declaration `float` allows generation of more efficient code using float numbers. It reduces allocation during float calculations. It is best used with safety 0. That is, you declare `(optimize (float 0) (safety 0))` as in this example:

```
(progn
  (setf a
        (make-array 1000
                   :initial-element 1D0
                   :element-type 'double-float))
  nil ; to avoid printing the large array
  )

(compile
  (defun test (a)
    (declare (optimize (speed 3) (safety 0) (float 0)))
    (declare (type (simple-array double-float (1000))
                  a))
    (let ((sum 0D0))
      (declare (type double-float sum))
      (dotimes (i 1000)
        (incf sum (the double-float (aref a i))))
      sum))

  (time (test a))
=>
Timing the evaluation of (TEST A)

  user time      =      0.000
  system time    =      0.000
  Elapsed time  =  0:00:00
  Allocation    = 16 bytes standard / 0 bytes conses
  0 Page faults
```

**Note:** In some cases, the operations cannot be fully optimized with `float 0`, which can cause the compiled code to be larger because the unboxing and boxing of floats will be inline.

### 9.7.4 Tail call optimization

In 64-bit LispWorks and on x86 platforms the compiler optimizes tail calls unless

1. The compiler optimize quality `debug` is 3, or
2. There is something with dynamic scope on the stack, such as a special binding, a catch or `c1:dynamic-extent` allocation (so it is not really a tail call)

On all other platforms the compiler optimizes tail calls unless 1.) or 2.) above apply, or

3. The call has more than 4 arguments and this is more than the number of fixed (not `&optional`/`&rest`/`&key`) parameters in the calling function.
4. The call has more than 4 arguments and the calling function has `&rest`/`&key` parameters.

### 9.7.5 Usage of special variables

The declaration `c1:special` specifies that a variable is special, that is it does not have lexical scope. This covers two cases: if the variable is bound in the dynamic environment (for example by `let` or `let*`), then the value of that binding is used; otherwise the value in the global environment is used, if any. An error is signaled in safe code if there is no value in either environment.

When `setq` is used with a variable, the value in the dynamic environment is modified if the variable is bound in the dynamic environment, otherwise the value in the global environment is modified. Dynamic variables can have a different value in each thread because each thread has its own dynamic environment. The global environment is shared between all threads.

In SMP LispWorks access to special variables (excluding constants) is a little slower than in non-SMP LispWorks. It can be made to run faster by declarations of the symbol, normally by using `proclaim` or `declare`.

The speedup will be pretty small overall in most cases, because access to specials is usually a small part of a program. However, if the Profiler identifies some piece of code as a bottleneck, you will want to optimize it, and your optimizations may include proclamation of some variable as global or dynamic.

The three declarations described in this section are extensions to Common Lisp. All declare the symbol to be `cl:special`, along with other information. These three declarations are mutually exclusive between themselves and `cl:special`. That is, declaring a symbol with any of these declarations eliminates the other declaration:

- `hcl:special-global` declares that the symbol is never bound in the dynamic environment.

In SMP LispWorks the compiler signals error if it detects that a symbol declared as `hcl:special-global` will be bound in the dynamic environment, and at run time it also signals an error.

In non-SMP LispWorks the compiler gives an error, but there is no run time check. The run time behavior is the same as `cl:special`, with all accesses to the symbol in low safety.

`hcl:special-global` is very useful, and because of the checks it is reasonably safe. It is useful not only for speed, but also to guard against unintentionally binding variables that should not be bound.

See also `defglobal-parameter`.

- `hcl:special-dynamic` declares that the symbol is always bound in the dynamic environment when it is accessed.

In high safety code accessing the symbol when it is not bound in the dynamic environment signals an error. In low safety code it may result in unpredictable behavior.

In non-SMP LispWorks the only effect of this declaration is to make all access to the variable low safety.

`hcl:special-dynamic` is useful, but because it can lead to unpredictable behavior you need to ensure that you test your program in high safety when you use it.

- `hcl:special-fast-access` declares that a symbol should be "fast access".

The semantics of the declaration is the same as `c1:special`, except that access to the variable is low safety. In addition, the compiler compiles access to the symbol in a way that speeds up the access, but also introduces a tiny reduction in the speed of the whole system. The balance between these effects is not obvious.

It is not obvious where `hcl:special-fast-access` is useful. If you can ensure that the symbol is always bound or never bound then `hcl:special-dynamic` or `hcl:special-global` are certainly better.

### 9.7.5.1 Finding symbols to declare

The macro `analysing-special-variables-usage` can be used to find symbols that may be proclaimed global, which can improve performance. `analysing-special-variables-usage` also helps to identify inconsistencies in the code.

### 9.7.5.2 Coalesce multiple special bindings

If a set of specials are always bound at the same time, it is better to store the values in a single structure object and bind one special variable to that object, to reduce the overall number of special bindings.

## 9.7.6 Stack allocation of objects with dynamic extent

`(declare dynamic-extent)` will optimize these calls so that they allocate in the stack, in all cases:

- `&rest` lists
- `flet` functions and `labels` functions
- `(cons x y)`
- `(list ...)`
- `(list* ...)`
- `(copy-list x)`
- `(make-list x)`
- `(vector ...)`

(**declare dynamic-extent**) will also optimize these specific calls:

- (**make-array n**)
- (**make-array n :initial-element x**) without any other arguments
- (**make-foo ...**) where **make-foo** is an inline structure constructor.  
The default constructor is declared inline automatically when none of the **defstruct** slot initforms are calls to functions.
- (**make-string n :element-type 'base-char**)
- (**(system:make-typed-aref-vector n)**)

### 9.7.7 Inlining foreign slot access

Given a structure definition

```
(fli:define-c-struct foo-struct
  (a :int)
  (b :int))
```

you can inline access to a slot by declaring **fli:foreign-slot-value** inline and supplying the *object-type*:

```
(defun foo-a (struct)
  (declare (inline fli:foreign-slot-value))
  (fli:foreign-slot-value struct 'a :object-type 'foo-struct))
```

### 9.7.8 Built-in optimization of remove-duplicates and delete-duplicates

LispWorks optimizes **cl:remove-duplicates** and **cl:delete-duplicates** for lists when the *test* or *test-not* is one of a small set of known functions. These functions are currently **cl:eq**, **cl:equal**, **cl:equalp**, **cl:=**, **cl:string=**, **cl:string-equal**, **cl:char=** and **cl:char-equal**.

## 9.8 Compiler parameters affecting LispWorks

There are six compiler parameters that control the generation of information used by various LispWorks utilities, such as the debugger, and also by various editor commands, such as **Show Paths From**. By default, these parameters are all **t**, which allows you to use all the features of these utilities, at the expense of increasing compilation times.

These variables are initially set to `t` (in the LispWorks file `config/a-dot-lispworks.lisp`). To speed up compilation times, you should set these variables to `nil`. The variables can be controlled as a group by using the function `toggle-source-debugging`.

It is also possible to compile your code with counters or flags such that you can see which parts of your program have actually executed at run time, as described in Chapter 10, “Code Coverage”.



# 10

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# Code Coverage

Code Coverage in LispWorks allows you to compile your code with code execution counters, which then record when each piece of code is executed, and then display which parts of the program were executed and how frequently. Alternatively you can compile your code with a binary flag to record simply whether each piece was executed or not.

## 10.1 Using Code Coverage

Using Code Coverage involves four steps, described in this section:

1. Compiling the code to record code coverage information.
2. Loading the code.
3. Exercising the code.
4. Displaying the results.

Optionally, you can get a copy of the results and manipulate these before displaying them, as described in “Manipulating code coverage data” on page 121.

### 10.1.1 Compiling the code to record code coverage information

Switch on generation of Code Coverage by either calling `generate-code-coverage` (which switches it globally), or using the macro `with-code-coverage-generation` (which switches it on only within the dynamic scope of the macro). Then compile your file(s) by calling `compile-file`. Alternatively you can use something that calls `compile-file` such as `compile-system`, menu command **File > Compile...** or the editor command **Compile File**.

Code Coverage works only when compiling into binary files, rather than into memory (which is what some editor commands such as `Compile Buffer` do).

When `compile-file` is called with code coverage generation, it generates code that keeps track of execution and contains some extra data. This results in slightly slower code and larger binary files that use more memory when loaded.

### 10.1.2 Loading the code

Load your compiled files as usual by calling `c1:load`. Alternatively you can use something that calls `c1:load` such as `load-system`, menu command **File > Load...** or the editor command **Load File**.

When a file that was compiled with code coverage generation is loaded, it automatically adds itself to the internal `code-coverage-data` structure (over-writing existing data), and from that point any access to this structure (see below) will include information about the code in this file. Executing code that was compiled with code coverage generation always updates the internal `code-coverage-data` structure (it is not switchable).

### 10.1.3 Exercising the code

Decide what you want to check, and run the entry points.

Code Coverage measures which parts of the program were executed, so you need to decide what you want to check and call the entry points. In a graphical application, you need to display the main window and interact with it.

### 10.1.4 Displaying the results

There are two ways to view the results:

- as HTML files in a web browser, or
- with the Editor and Code Coverage Browser tools in the LispWorks IDE.

HTML display is done by calling `code-coverage-data-generate-coloring-html`, which in general generates one HTML file per source file in the `code-coverage-data`, and also an index HTML file with hyperlinks to all of them. Editor display is done by the function `editor-color-code-coverage`, which takes the name of a source file and creates a new editor buffer with the source colored according to the code coverage. Both functions take various keywords to control what they actually do. By default, both of them use the internal `code-coverage-data` structure, but can also use a manipulated `code-coverage-data`. See `code-coverage-data-generate-coloring-html` and `editor-color-code-coverage` for full details.

## 10.2 Manipulating code coverage data

Optionally you can manipulate `code-coverage-data` before displaying it, using the functions described in this section.

The `code-coverage-data` structure contains information about some set of files. Except for the internal `code-coverage-data`, this information does not change. The internal `code-coverage-data` object is updated whenever code that was compiled with code coverage runs. Also, when a binary file that was compiled with code coverage is loaded it adds itself to the internal `code-coverage-data` (overwriting any existing data associated with that file). Most of the functions for manipulating `code-coverage-data` can operate on the internal `code-coverage-data` structure by passing `t` as the data argument. See the specific functions for details.

The interface to code coverage data allows you to:

- Copy `code-coverage-data`, save it into a file, and load a `code-coverage-data` from a file.

These functions are `copy-code-coverage-data`, `copy-current-code-coverage`, `merge-code-coverage-data`, `filter-code-coverage-data`, `save-code-coverage-data`, `save-current-code-coverage` and `load-code-coverage-data`.

- Add or subtract two `code-coverage-data` structures. This means add or subtract all the corresponding counters from the two structures. This is allowed only if all the files that are in both structures are from the same compilation.

For example, you may subtract the data of one test from another to see how they differ in the way they use their code.

These functions are `add-code-coverage-data`, `destructive-add-code-coverage-data`, `subtract-code-coverage-data`, `destructive-subtract-code-coverage-data`, `reverse-subtract-code-coverage-data` and `destructive-reverse-subtract-code-coverage-data`.

- Clear the internal `code-coverage-data` (this means eliminating the files from it) or reset it (this means setting the counters to 0), or setting to another `code-coverage-data`.

These functions are `clear-code-coverage`, `reset-code-coverage` and `restore-code-coverage-data`.

- Set an internal snapshot, and later compare with it.

These functions are `set-code-coverage-snapshot`, `get-code-coverage-delta` and `reset-code-coverage-snapshot`.

- Generate statistics about the contents of the code coverage, by `code-coverage-data-generate-statistics`.

### 10.3 Preventing code generation for some forms

You can use the macros `error-situation-forms` and `without-code-coverage` to prevent generation of code coverage inside their body. For example, explicit calls to `c1:error` that are not expected to happen can be marked not to be counted. The system uses these in macros that call `c1:error` such as `c1:etypecase` and `c1:assert`.

## 10.4 Code coverage and multithreading

By default, code compiled with code coverage uses non-atomic counters, which means that if the code runs in multiple threads it will occasionally drop a count. As the count is mostly used as heuristics this is usually not a problem (it will never drop all the counts, so you will not get 0 counts when there should be more than 0).

To record an exact count you can compile with `atomic-p t` (see `generate-code-coverage` and `with-code-coverage-generation`). Atomic incrementing may make the program run much more slowly, which is the reason that it is not the default behavior.

The `code-coverage-data` manipulation functions are thread-safe, and will not corrupt data or cause errors when running in parallel. However they are not atomic, so modifying the same structure in parallel will create inconsistent data. Reading the internal data while code with counters is executing may also generate an inconsistent data.

## 10.5 Counting overflow

The code coverage counters are 32-bit signed values (signed to allow negative values, which you can get when subtracting). Long tests can overflow in their frequently-called functions. That means that for these functions the counter is not that useful anymore. Also, you can end up on exactly 0, which looks as if the code was not executed. For heuristics that seems not to be a problem.

To avoid these problems with counter overflow, you can compile with a binary flag (initial value 0) instead of the counter. The flag switches to 1 when the code is called (see `generate-code-coverage` and `with-code-coverage-generation`). This loses the counting, but also generates smaller and faster code and uses less memory.

## 10.6 Memory usage and code speed

Collecting code coverage information makes the code larger and slower, but still workable. Compiling with binary flags results in code that is faster and smaller than code compiled with counters (see `generate-code-coverage` and `with-code-coverage-generation`) and it also reduces the size of the

data that `code-coverage-data` needs to keep. On the other hand you lose the counters, but if you do not need the counters it may be useful.

## 10.7 Understanding the code coverage output

In general there are five colors that are used to color the source code. Below these are named by the keyword argument to `code-coverage-set-html-background-colors` that changes them for the HTML coloring, and the default color is shown in parentheses:

*fully-covered* (Green)

Forms where every part was covered, that is all of the source subforms were executed.

*partially-covered* (GreenYellow)

Forms that are partially covered in a visible way, that is some of the source subforms were not executed.

*hidden-partial* (Orange)

Forms that are partially covered in a non-visible way, that is all the source subforms were executed, but some of them were expanded to forms that were not completely executed.

*uncovered* (Pink)

Uncovered forms, that is forms that were never executed.

*eliminated* (DeepPink)

Forms that were completely eliminated by the compiler.

Note that by default only *hidden-partial*, *uncovered* and *eliminated* are shown, so all colored forms indicate something that was not covered. However, inside a *hidden-partial* form the *fully-covered* subforms are always colored, regardless of the setting of *fully-covered*.

When counters are displayed, they have their own background color *counters* (MediumAquamarine), except for negative counters that use color *counters-negative* (Gold). In addition the colors *error* (Red) and *warn* (Yellow) are used when adding error or warning messages.

### 10.7.1 Eliminated forms

The compiler eliminates forms that it determines are not needed. These include:

- Forms that have no side effects and whose result is not used.
- Forms that will never be reached.

To deduce that code does not have side effects, the compiler needs to know that the function calls in it have no side effects. The only function calls that the compiler knows to be free of side effects are either system functions or automatically defined functions such as structure accessors.

Unreachable code can happen explicitly but it can also happen implicitly, when the compiler eliminates it. The commonest case is when the compiler uses type inference to infer what a predicate will return. For example, suppose you have this definition:

```
(defun my-func (arg)
  (let ((sum (+ arg 10)))
    (if (consp sum)
        (car sum)
        (* sum 7))))
```

Since `sum` is a result of the call to `+` it must be a number and therefore cannot be a cons. Hence the compiler can infer that the `consp` call will always return `nil`, replace the call to `consp` by `nil`, eliminate the call to `car`, and go straight to the `*` call. In the coloring, the call to `car` will be shown as *eliminated*, while the `if` form will be shown as *fully-covered*. That is a little counter-intuitive, because the `if` and the `consp` are not actually in the compiled code, but they were effectively evaluated by the compiler at compile time.

### 10.7.2 Displaying counters

By default, code coloring adds counters, indicating how many times a point in the code has been executed. Note that counts may also be negative, when the code coverage data that is displayed is the difference between datas (as generated by functions like `subtract-code-coverage-data`). When a count is 0 the counter is not displayed.

By default, if the counter for a subform is the same as the counter of the parent form, the counter for that subform is not displayed. Thus when you see a sub-

form without a counter, it means it was executed the same number of times as its parent. The counter is displayed even if it is the same in situations when the code coverage status of the forms is different, for example if the parent is *partially-covered* but the subform is *fully-covered*.

It is possible to force all counters to be displayed, by passing `:show-counters :all` to `code-coverage-data-generate-coloring-html` and the other displaying functions. Note that the compiler does not generate counters for forms that it can deduce will be always executed the same number of times as the parent, so for these it will never display counters.

### 10.7.3 Function forms where the function is not actually called

Entering a function form does not necessarily call the function, because during evaluation of the arguments there may be an exit out of the form. This exit can be local or non-local, and in general the compiler cannot tell whether it will happen or not, though it can be sure that it will not happen for specific cases like local variable references and self-evaluating forms. Therefore the compiler adds a counter just before the function is called. It is not obvious how to display this counter, and when it is 0 what part of the form has not been executed.

The current coloring regards the function name as the part of the form that is "being evaluated" when the function is actually called. Therefore it inserts the counter before the function name, and if it is 0 it colors the function name in the *uncovered* color. That means that in some cases you have a counter before the opening parenthesis that counts the times that the form was entered, and a counter after the opening parenthesis that counts the times that the function was called. Since the coloring normally skips counters that are inside a form where they have the same count as the counter of the form, you will see both numbers only when they are different.

### 10.7.4 Partially hidden

Partially hidden forms are forms where all the source code as shown was executed, but some macro expansion of it contains a conditional where one of the branches was not executed. Thus there is not any specific form to color as uncovered, but some part of the actual code was not executed. These forms are colored by a special color *hidden-partial*, which is Orange by default.

For example, if you have this code:

```
(defmacro did-it-p ()
  '(if *done* nil t))

(defun go-next-p ()
  (did-it-p))
```

and whenever `go-next-p` is called `*done*` is true, then the false branch of the `if` form was not executed, but inside the definition of `go-next-p` there is no source that was not executed. Thus the form `(did-it-p)` is partially hidden.

Partially hidden forms can have subforms that are fully covered. These forms are colored by the color *fully-covered* even if fully covered forms are not colored otherwise (the default behavior), to clarify that they were fully covered.

## 10.8 Coloring code that has changed

The code coverage data does not keep the source code. Instead, it keeps a reference to the code that the reader saw (when called from `compile-file`).

When it adds colors, it re-reads the source file. That means it needs the original source file for coloring. If the source file was modified, it adds a warning in the beginning of the file, but tries to color it anyway.

If what the reader sees has not changed (that is the only changes involve only comments and whitespace) the coloring will work properly. Changes to what the reader sees, however, will confuse the coloring. In general, subforms that are modified are miscolored, but code outside the modified subform colors properly. For a top level form, if you modify it, this form will not color properly, but all the other forms will color properly. If you remove or add a top level form, all the following forms will not color properly. Note that this applies even if you do something like adding (or removing) a `progn` around some forms, which although it does not affect the compiler does cause the reader to see different forms.

Thus if you modify your code, the coloring becomes less reliable. In most cases this is not a big problem, but in many cases it is probably better to copy your source tree and compile the copy with code coverage, so you can continue to modify the source while reviewing the code coverage output.



# 11

---

# Memory Management

This chapter introduces some basic ideas of memory management, and then discusses the LispWorks memory management system in more detail. The chapter also introduces the functions and macros needed to control memory management. Full details of all the symbols mentioned here are given in Chapter 38, “The HCL Package” and Chapter 49, “The SYSTEM Package”.

## 11.1 Introduction

Automatic memory management is one of the most significant features of a Lisp system. Whenever an object, such as a cons cell, is required to hold an aggregate of values, the system calls the appropriate function to create a new object and fill it with the intended values. The programmer need not be concerned with the low level allocation and management of memory as the Lisp system provides this functionality automatically.

When an object is no longer required (that is, it has become “garbage”), the system must automatically reclaim (“collect”) the space it occupies and reallocate the space to a new object. Whenever the space for new objects is exhausted, a “garbage collector” (GC) is run to determine (by a process of elimination) all the existing objects that are still required by the running program. Any other objects still in the image are necessarily garbage, and the space they occupy can be reclaimed.

For a description of how LispWorks uses the address space of different Operating Systems, and factors affecting the maximum image size, see “Address Space and Image Size” on page 458.

Garbage collection with a naive algorithm is extremely inefficient.

The LispWorks GC works in unison with the memory allocator to arrange allocated objects in a series of “generations”. Each generation contains objects of a particular age. In practice most Lisp data objects are only required for a very short period of time. That is, they are ephemeral. The LispWorks GC concentrates its efforts on repeatedly scanning the most recent generation. Such a scan requires only a fraction of a second and reclaims most of the space allocated since the last collection. Any object in the most recent generation that survives a number of such collections is promoted to the next youngest generation. Eventually this older generation becomes full, and only then is it collected. The generations are numbered from 0 upwards, so that generation 0 is the youngest.

The remainder of this chapter describes the LispWorks GC in more detail. The implementation and the programmatic interface differ between 32-bit and 64-bit LispWorks.

## 11.2 Guidance for control of the memory management system

### 11.2.1 General guidance

The memory management is designed with the intention that the programmer will have to do very little or nothing about it. In general, we believe that the design is quite successful, and in most cases you do not have to do anything. The main exception to this is dealing with long-lived data in long-lived processes in 32-bit LispWorks.

Before doing anything about memory management, you should be familiar with the function `room`, and use it frequently. There is no point at all in trying to tune the memory management without knowing the sizes of your application, as output by `room`.

The data and code in the LispWorks image can be categorized according to how long they live, as follows:

1. Short-lived data
2. Long-lived data
3. Permanent data

Note that the distinction is not in the data itself, but in the existence of pointers to it.

In general, you rarely need to worry about short-lived data, and have to worry about permanent data only if you have a large amount of it. In short-lived applications you do not need to worry about long-lived data either, so there is a good chance that you do not have to worry about memory management at all.

In long-lived applications, you certainly need to consider long-lived data in 32-bit LispWorks, and maybe in 64-bit LispWorks.

### 11.2.2 Short-lived data

Normally you should not do anything about handling of short-lived data, because the default settings are good enough for almost all situations. Sometimes you may hit a situation where the settings are not good ("pathological case"). However, it would normally require a deep understanding of the memory management system to deal with such a situation, and we will in general consider this as a bug and try to fix it. Therefore if you find such situation you should report it to Lisp Support, following the guidelines at [www.lisp-works.com/support/bug-report.html](http://www.lisp-works.com/support/bug-report.html).

Problems with short-lived data normally just reduce the performance of some part of your application. Normally the best solution is to optimize the code to do less work, including allocating less.

To do that, first find the bottlenecks in your application by using `profile` (and `start-profiling` and `stop-profiling`). `time` and `extended-time` can then be used to determine how long specific operations take, how much they allocate and, for long operations, how long they spend in garbage collection. Use this information to decide what to try to optimize.

### 11.2.3 Long-lived data

Long-lived data is data that lives long enough to be promoted to the highest generation to which promotion occurs automatically (the "blocking generation"), but later becomes garbage. The blocking generation is 2 in 32-bit LispWorks and (by default) 3 in 64-bit LispWorks.

You can check which generation individual objects are in (by `generation-number`), but normally you want to know the total amount of data in various generations. The function `room` is used for that. In general, it is useful to call

```
(room)
```

and sometimes also

```
(room t)
```

periodically (every 5 minutes) and log the output. In servers, such logs are essential. From this output you can see how the sizes of the various generations change over time.

If the output shows that the blocking generation grows too much, even though permanent data is not added, you will need to do something about it. In 64-bit LispWorks there is a good chance that you do not have to do anything. In 32-bit LispWorks long-lived processes (for example servers) probably need to do something.

The main thing you will do is calling `(gc-generation t)`. This garbage collects the blocking generation. You should check the state of the memory after calling it by calling `room` again. If the amount of allocated data (as opposed to total size) did not reduce, you may have a memory leak that causes accumulation of permanent data that does not die.

If `gc-generation` does free data (that is, the allocation reduces significantly), you probably need to add calls to it to your application.

**Compatibility note:** In 32-bit LispWorks version 5.1 and earlier, the documented way to collect generation 2 is to call `(mark-and-sweep 2)`. `(gc-generation t)` does what `(mark-and-sweep 2)` does, plus some additional operations that improve the performance of allocation. It also has the advantage that it is the same call that is used in 64-bit LispWorks. We recommend always using `gc-generation`.

To decide when to call `gc-generation`, you need to consider the following:

1. You need to prevent excessive growth of the process.
2. You want to avoid calling `gc-generation` when the application needs to respond quickly.
3. The call will be more effective if it is done between chunks of work than in the middle of a chunk of work.

We now discuss these considerations in detail:

1. You can follow the overall size of the process by looking at the output of `(room nil)`, or programmatically by using the result of `room-values`. The definition of "excessive growth" depends on the machine that you are running on and what the server actually does. Normally you want to avoid the need for paging, so you should try to keep the size of the image below the size of real memory that it can use. For 32-bit LispWorks on modern machines that have a lot of memory, the limit will be the amount of address space the machine has. In addition, garbage collecting a larger image takes more time. In a typical 32-bit application, 100-200 MB would be the target, though it can be larger. In a 64-bit application the limit is the size of the real memory.
2. `(gc-generation t)` can take a significant amount of time. 32-bit LispWorks on a modern machine can collect 100-200 MB in less than a second if it does not page. If it pages, or has a slower CPU, it takes more time. The 64-bit GC is generally faster and better, as long as it does not page, but since you normally deal with much more data in 64-bit images, there may be significant delays in 64-bit LispWorks. If such delays are a problem for your application, you should try to call `gc-generation` at times when it is less of a problem. Use `time` to find out how long `gc-generation` takes in various situations.
3. If you can identify places where there are no active chunks of work, you can try to place calls to `gc-generation` in these places. For servers, this is likely to be much less important than the two considerations above, but for an application that computes results using large amounts of data, this may be a significant consideration.

In 32-bit LispWorks, by default, generation 2 (which is the "blocking generation") is not collected automatically, because such collection may take a

significant amount of time, so most programmers need to control when it actually happens. You can change this by using `collect-generation-2`, but usually you need better control, and do a collection of generation 2 when it is appropriate. Therefore if your application generates long-lived data, you need to add calls to `gc-generation`.

Even if you find that your application does not generate long-lived data (that is, generation 2 does not grow), it is probably a good idea to keep checking, in case some circumstances do cause it to generate long-lived data.

In 64-bit LispWorks by default generation 3 (the "blocking generation") is collected automatically, so there is a good chance that you do not have to do anything. However, you may want to call `gc-generation` explicitly when you know it is a good time to do it. You may also want to block automatic calls if they take too long: use `set-blocking-gen-num` to do that. If generation 3 becomes very big (Gigabytes), you may also consider using `marking-gc` instead of `gc-generation`.

Once you set up `gc-generation` calls, you may still see the image growing even though the allocation does not grow that much. That is normally the result of fragmentation. In 32-bit LispWorks you can use `check-fragmentation` to check for fragmentation, and `try-move-in-generation` to prevent it if needed. See "Controlling Fragmentation" on page 144 for a discussion.

In 64-bit LispWorks you have a problem with fragmentation only if you use `marking-gc`. `marking-gc` has keyword arguments that can be used to reduce fragmentation, and there is a good chance that using these will be enough to avoid serious fragmentation. `gc-generation` can be used occasionally to eliminate all fragmentation. Check for fragmentation by using `gen-num-segments-fragmentation-state`.

#### 11.2.4 Permanent data

Permanently-living data will typically be the actual code of the application, and maybe also data that never goes away.

Because the data never goes away, it is best to put it outside normal garbage collection, which means promoting it to the highest generation. This is done by `clean-down`, which is called automatically (by default) when saving an image (whether by `save-image` or `deliver`). In most cases that is the right

time to do it, so normally you do not need to call `clean-down` explicitly. In some situations you may want to call it yourself, and sometimes you want to avoid the call when saving an image with a lot of non-permanent data. To control the automatic call, see `save-image` and `deliver`.

There are several things that need to be considered when using `clean-down`:

1. If the permanent data is only a small amount compared to the long-lived data, it is not obvious that `clean-down` is needed, specially if you use a saved (or delivered) image where the code and maybe some data was already promoted.
2. `clean-down` promotes all the data that is live (that is, pointed to from some other live object) in the image when it is called. If the image contains data that is live, but later becomes garbage, it will be promoted and hence not collected until another call to `clean-down`, which will make the image unnecessarily larger. Since this data is not being accessed, the effect on performance is small, but if there is a lot of it the effect may be significant.
3. `clean-down` needs extra memory to operate, especially in 64-bit LispWorks. For very large 64-bit LispWorks images `clean-down` may fail due to running out of swap memory.
4. `clean-down` takes a significant amount of time. If it does not cause paging, it should take seconds, but if it needs to page it may take much longer. You therefore should avoid calling it when you need the application to respond reasonably quickly.

## 11.3 Memory Management in 32-bit LispWorks

This section describes the garbage collector (GC) in 32-bit LispWorks 7.1.

In LispWorks for UNIX and LispWorks for Macintosh, the implementation is not significantly different to that in LispWorks 4.x, LispWorks 5.x or LispWorks 6.x.

In LispWorks for Windows and LispWorks for Linux, the implementation has changed since LispWorks 4.x and you may notice performance improvements relative to those versions.

### 11.3.1 Generations

In memory, a generation consists of a chain of segments. Each segment is a contiguous block of memory, beginning with a header and followed by the allocation area.

The first generation normally consists of two segments: the first segment is relatively small, and is where most of the allocation takes place. The second segment is called the big-chunk area, and is used for allocating large objects and when overflow occurs (see below for a discussion of overflow).

The second generation (generation 1) is an intermediate generation, for objects that have been promoted from generation 0 (typically for objects that live for some minutes).

Long-lived objects are eventually promoted to generation 2. Note that generation 2 is not scanned automatically. Therefore these objects will not be reclaimed (even if they are not referenced) until an explicit call to a GC function (for example `gc-generation` on `t`, or `clean-down`) or when the image is saved. Normally, objects are not promoted from generation 2 to generation 3, except when the image is saved.

Generation 3 normally contains only objects that existed at startup time, that is those were saved in the image. Normally it is not scanned at all, except when an image is saved.

Note that the division between the generations is a result of the promotion mechanism, and is not a property of a piece of code itself. A piece of system software code that is loaded in the system (for example, a patch) is treated the same as any other code. The garbage collection code is explicitly loaded in the static area using the function `switch-static-allocation`.

### 11.3.2 Allocation of objects

Normal allocation is done from a buffer, called the small objects buffer. The GC maintains a pointer to the beginning and end of the buffer, and allocates from it by moving one of the boundaries. When the buffer becomes too small the GC finds another free block and makes that the buffer.

In non-SMP LispWorks there is only one global small objects buffer. In SMP LispWorks, each process may have its own "local" small objects buffer (in

addition to the global one). The system decides dynamically which process should have a local buffer and which not. In general processes that do any significant amount of work have a local buffer, and most of their allocation would be from local buffers.

When there is an overflow the small object buffer is allocated in the big-chunk area, and then a bigger buffer is allocated (see below).

### 11.3.2.1 Allocation of static objects

Objects that cannot be moved are allocated in special segments, called static segments. These can be in any generation, but are in generation 2 by default.

Such objects include:

- Code that must not move during garbage collection, in particular the code and data of the GC itself
- Arrays created by `make-array` with `allocation :static`. This is the preferred way to allocate a static array.
- Objects allocated explicitly in the static area, by `in-static-area` or by use of `switch-static-allocation`.
- Foreign code loaded from a non-shared library via `link-load:read-foreign-modules`. This applies to LispWorks for SPARC Solaris only.

Because static objects are not allowed to move, the static segments are not allowed to move. This implies that if there is a static segment in a high address the image size cannot be reduced below this size. Applications that use a lot of static area normally allocate additional static segments, and thus grow without being able to shrink again. This can be prevented by enlarging the initial static segment, which is in a low address. Use the function `enlarge-static` to increase the size of the initial static segment. (Use `(room t)` to find its current size.)

### 11.3.2.2 Allocation in different generations

Objects that are known to have long life can be allocated directly in a higher generation, by using `allocation-in-gen-num` and `set-default-generation`. Note that both these functions have a global effect, that is any object

allocated after a call to `set-default-generation` or within the body of `allocation-in-gen-num` is allocated in the specified generation, unless it is explicitly allocated in a different generation. Therefore careless use of these functions may lead to allocation of ephemeral garbage in high generations, which is very inefficient. Conversely, if a long-lasting object is allocated to a low generation, it has to survive several garbage collections before being automatically promoted to the next generation.

The best way to control the allocation generation for an array is to call `make-array` with `allocation :long-lived` or a number.

See also “Allocation of interned symbols and packages” on page 164 and “Allocation of stacks” on page 164.

### 11.3.3 GC operations

Mark and sweep is the basic operation of reclaiming memory, and it is done in two stages:

<i>Mark</i>	All objects that are alive in the generation being garbage collected and in younger generations are marked as alive. (Alive means pointed to by some other live object.)
<i>Sweep</i>	All unmarked objects in the generations being garbage collected are added to the free blocks, and all marked objects are unmarked.

A mark and sweep operation is always on all the generations from 0 to a specific number.

A mark and sweep operation can be caused explicitly by calling `gc-generation`.

Promotion is the process of moving objects from one generation to the next generation. An object is marked for promotion after surviving a specific number of mark and sweep operations, but may be promoted before that. The number of survivals is specific to each segment.

Promotion does not free objects.

### 11.3.4 Garbage collection strategy

When the GC runs out of memory, it has to find more memory. Normally (that is, when allocating in generation 0) the first operation is a mark and sweep. Before performing the mark and sweep, the GC compares the amount of memory allocated since the previous mark and sweep with the `:minimum-for-sweep` value, which is set by `set-gc-parameters`. If the amount allocated is less than `:minimum-for-sweep` the GC does not do a mark and sweep, but causes an overflow (described below). This prevents an excessive number of mark and sweep operations in periods when the program allocates a large amount of data which stays alive.

If more than `:minimum-for-sweep` has been allocated, a mark and sweep operation takes place. After this operation the GC checks that the segment it was trying to allocate to has more free space than the minimum free space for this segment. If the remaining free space is less than `minimum-free-space`, the GC tries to create more free space by promoting objects from the segment.

Before promoting, the GC performs two checks. First, it checks that there are enough objects marked for promotion to justify a promotion operation. The minimum free space for a segment is set by `set-minimum-free-space`, and can be shown by `(room t)`.

Second, the GC checks that there is enough free space in the next generation to accommodate the promoted objects. If there is insufficient space, the GC tries to free some, either by a mark and sweep on the next generation, promoting the next generation, or by enlarging the generation.

The minimum amount of space for promotion is the value `minimum-for-promote`, which is set by `set-gc-parameters`.

If there is insufficient space, and there are not enough objects marked for promotion, the GC increases the size of the image, by overflow, as described below.

On Motif only, note that the GC monitor window does not indicate a mark and sweep of generation 0, as this operation takes a small amount of time (it would take longer to change the display of the window). The GC monitor window appears only in the Motif IDE.

### 11.3.5 Memory layout

#### 11.3.5.1 Linux

On Linux, the default initial heap is mapped at address `#x20000000` (0.5 GB). LispWorks then tries to locate the location of dynamic libraries, and marks a region around these libraries that should not be used (by default 64 MB from the bottom). In most cases this suffices to avoid clashes.

Problems can arise if the memory at `#x20000000` or above is already used by another part of the software. If that memory gets used before LispWorks is mapped, LispWorks must be relocated elsewhere, typically to a higher address, as described in “Startup relocation of 32-bit LispWorks” on page 460.

If the memory above LispWorks gets used by other parts of the software after LispWorks was mapped, it may be possible to avoid the problem by reserving some memory above LispWorks by supplying *ReserveSize*.

The location of dynamic libraries differs between Linux configurations, and that needs to be taken into account. For most cases, including the cases where the libraries are mapped at `#x40000000` or somewhere above `#x28000000`, the mechanism for detecting libraries works and no action is required.

In principle LispWorks (32-bit) for Linux can grow up to some distance below `#xBF000000` (almost 2.5 GB), though this depends on the OS kernel allowing this size.

**Note:** In LispWorks 5.0 and previous, we told some customers to relocate above the libraries, for example at `#x50000000` or `#x48000000`, but this should not be needed in LispWorks 7.1.

#### 11.3.5.2 FreeBSD

By default, LispWorks is mapped at `#x30000000`.

Problems may arise if something uses memory above `#x30000000`. If this memory is used before LispWorks is mapped, LispWorks must be relocated elsewhere, typically to a higher address, as described in “Startup relocation of 32-bit LispWorks” on page 460.

If the memory above LispWorks gets used by other parts of the software after LispWorks was mapped, it may be possible to avoid the problem by reserving some memory above LispWorks by using *ReserveSize*.

Normally the dynamic libraries are mapped at #x28000000, and therefore LispWorks can grow without a problem.

In principle LispWorks can grow up to some distance below #xc0000000 (almost 2.25 GB), though this depends on the OS kernel allowing this size and how many threads you have running.

### 11.3.5.3 x86/x64 Solaris

The default initial heap is mapped at address #x10000000 (0.25 GB).

LispWorks then tries to locate the location of dynamic libraries, and marks a region around these libraries that should not be used (by default 64 MB from the bottom). In most cases this suffices to avoid clashes.

Problems can arise if the memory at #x10000000 or above is already used by another part of the software. If that memory gets used before LispWorks is mapped, LispWorks must be relocated elsewhere, typically to a higher address, as described in “Startup relocation of 32-bit LispWorks” on page 460

If the memory above LispWorks gets used by other parts of the software after LispWorks was mapped, it may be possible to avoid the problem by reserving some memory above LispWorks by supplying *ReserveSize*.

### 11.3.5.4 Windows and Macintosh

LispWorks (32-bit) for Windows and LispWorks (32-bit) for Macintosh both map by default at #x20000000. Since these platforms support reservation, normally you will not need to do anything special about this.

Problems may however arise if LispWorks operates in conjunction with non-relocatable software which insists on using addresses at #x20000000 or some distance above, in which case you will need to relocate LispWorks, as described in “Startup relocation of 32-bit LispWorks” on page 460.

LispWorks (32-bit) for Windows can in principle grow up to some distance below #x80000000 (almost 1.5 GB) but there is always the possibility that

some DLL will be mapped in this region. On startup, it reserves 0.5 GB above its location, so that much is guaranteed.

LispWorks (32-bit) for Macintosh can grow to around 2.7 GB. You can relocate it only on the Intel architecture.

### 11.3.5.5 AIX

The image is mapped at `#x31000000`.

The 16 MB (= `#x1000000`) above `#x30000000` allows it to grow down a little, which is used for static objects. In most cases it does not use this memory. The heap can grow up from `#x31000000` to `#xd0000000`, where the libraries are mapped.

LispWorks also maps some memory at `#xe0000000`, which is a read-only area containing code and some strings.

Foreign data (malloc and stacks) is in the normal AIX place, the 256 MB between `#x20000000` and `#x30000000`.

The heap is relocatable as described in “Startup relocation of 32-bit Lisp-Works” on page 460. However, to actually allow a larger area for foreign data, you also need to enable large address-space as far as AIX is concerned. This can done either at the time LispWorks is invoked by the environment variable `LDR_CNTRL` with `maxdata`, or statically on the LispWorks executable by using `ldedit` with `-bmaxdata`. For details see the entry for "Large program Support" in the AIX documentation (search for "Large program Support" at [www.ibm.com](http://www.ibm.com)).

When relocating it generally advisable to leave several megabytes between the heap and the top of the foreign data, in case LispWorks needs more static area. However, this is not essential, because in most of cases LispWorks will not need it, and it can allocate static areas higher.

### 11.3.6 Approaching the memory limit

If your program allocates a lot you may reach the limit of memory that Lisp-Works can use. The limit depends on the architecture as described in “Memory layout” on page 140.

When LispWorks actually reaches the limit it will fail to communicate with the user due to allocation errors. To avoid this situation, LispWorks informs the user earlier that it is approaching the limit of memory. It first checks whether you set the approaching memory callback (by `set-approaching-memory-limit-callback`), and if there is a callback calls it. If there is no callback or the callback returns, LispWorks signals an error of type `approaching-memory-limit` (which is a subclass of `c1:storage-condition`).

The function `memory-growth-margin` can be used to see how much LispWorks "believes" that it can grow.

The callback can be used to effectively ignore the condition, but this is a bad idea in general, because it will probably lead to an error later when LispWorks actually reaches the limit, and then it may crash in a bad way. To be safe, the callback should either cleanup and exit, or free a substantial amount of memory. You can reasonably continue only if a crash is not going to cause a serious damage.

### 11.3.7 Overflow

If the amount allocated from the previous mark and sweep operation is less than `:minimum-for-sweep`, the GC does not perform a mark and sweep. Instead it allocates a small-objects buffer in the big-chunk area (the second segment in the first generation). The minimum and maximum sizes of this buffer are specified by `:minimum-overflow` and `:maximum-overflow`, which can be set by `set-gc-parameters`. If the GC fails to find a buffer of this size, it looks for a smaller buffer, and if that fails it enlarges the big-chunk area (and the process size) by the amount needed to allocate a buffer of the size of the currently allocated area in generation 0, up to a maximum amount specified by `:maximum-overflow`.

### 11.3.8 Behavior of generation 1

When objects are promoted from generation 0 to 1, and there is not enough space in generation 1, the GC tries to free space in generation 1. The first step is to check whether sufficient space can be freed by promoting the objects marked for promotion. If this is the case the GC promotes these objects from generation 1 to generation 2. (In practice, this rarely happens.) If this check fails the GC marks and sweeps generation 1. If not enough space is freed by

this mark and sweep, than either all the objects in generation 1 are promoted, or generation 1 is expanded. This is controlled by `expand-generation-1`, which specifies whether expansion or promotion takes place.

If generation 1 is expanded, the amount it tries to expand by is the value `:new-generation-size` (set by `set-gc-parameters`) in words (that is, multiples of 4 bytes), or the amount of free space needed, whichever is bigger. If `:new-generation-size` is 0, it is not expanded. In this case part of the objects marked for promotion are not promoted.

### 11.3.9 Behavior of generation 2

Normally generation 2 is not garbage collected. If the system runs out of space in this generation, it expands it, using the value of `:new-generation-size` multiplied by two. Garbage collection of generation 2 can be caused by calling the function `collect-generation-2` with appropriate argument.

### 11.3.10 Forcing expansion

If you know that a given generation will need to grow, you can save the GC the work by calling `enlarge-generation` to expand the generation in advance.

### 11.3.11 Controlling Fragmentation

Some applications periodically free (that is, stop using) a substantial amount of data that lived for long enough to reach generation 2 (use `room` or `room-values` and `generation-number` to follow the behavior of objects). In this case, `gc-generation` should be called on generation 2, to collect these data and re-use the memory. Repeated cycles like this may cause fragmentation, which will slow down promotion into generation 2. This manifests itself in significant pauses, typically of a few seconds. `try-move-in-generation` or `try-compact-in-generation` can be used to reduce the fragmentation, and hence to reduce the pauses. Because these functions themselves take some time, they should be called when such a pause is acceptable.

'Moving' a segment means moving objects out of the segment to another segment, leaving the segment empty. This reduces the fragmentation in the generation, and it is normally much faster than compact. Therefore in almost all

cases, `try-move-in-generation` is better than `try-compact-in-generation`.

The actual decision to use these functions will be typically based on the results of `check-fragmentation`. For example, the following function checks whether there is more than 10 MB free area in generation 2 in blocks of 4096 bytes or larger (`tlb`, third return value of `check-fragmentation`). If there is not, and the free area in generation 2 (`tf`) is more than four times the free area in large blocks, it calls `try-move-in-generation`. Because `try-move-in-generation` gets a *time-threshold* of 0, it returns after moving at most one segment. (It will not move any segments if none of them looks fragmented.)

```
(defun call-memory-functions()
  (gc-generation t)           ; first collect all dead objects
  (multiple-value-bind (tf tsb tlb)
    (check-fragmentation 2) ; check the fragmentation
    (when (and (> 10000000 tlb)
               (> (ash tf -2) tlb))
      (try-move-in-generation 2 0))))
```

A function such as this can be called at times when a pause of a few seconds is acceptable, and it will keep the memory of generation 2 less fragmented.

It is not possible to give definitive guidance here on how to use `try-move-in-generation` or `try-compact-in-generation`, because it depends on the way the application uses memory. In general, these functions will always improve the behavior of the application. Therefore the main problem is to identify points in the execution of the application where they can be called without causing unacceptably long pauses.

### 11.3.12 Summary of garbage collection symbols

The remainder of this chapter summarizes which functions are useful in which circumstances. See also “Common Memory Management Features” on page 163. For full details of these functions, see their reference entries.

#### 11.3.12.1 Determining memory usage

To determine memory usage (useful when benchmarking), use the functions `room`, `total-allocation` and `find-object-size`. The function `room-values` is suitable for programmatic use: it returns the values that `room` prints.

In 32-bit LispWorks, `memory-growth-margin` returns the amount by which the Lisp heap can grow, if `set-maximum-memory` has been called.

### 11.3.12.2 Allocating in specific generations

Arrays can be allocated static or in a higher generation using the *allocation* argument in `make-array`.

To control the allocation of other objects to generations, use `allocation-in-gen-num`, `get-default-generation`, `set-default-generation` and `*symbol-alloc-gen-num*`.

### 11.3.12.3 Controlling a specific generation

To control the behavior of a specific generation, use `clean-generation-0`, `collect-generation-2`, `collect-highest-generation`, `expand-generation-1` and `set-minimum-free-space`.

### 11.3.12.4 Controlling the garbage collector

The functions that are most likely to be useful for controlling the GC are `room`, `check-fragmentation`, `gc-generation` and `try-move-in-generation`.

Other potentially useful functions and macros are `avoid-gc`, `get-gc-parameters`, `gc-if-needed`, `enlarge-generation`, `normal-gc`, `set-gc-parameters`, `with-heavy-allocation` and `try-compact-in-generation`.

## 11.4 Memory Management in 64-bit LispWorks

This section describes the garbage collector (GC) in 64-bit LispWorks.

### 11.4.1 General organization of memory

The memory in 64-bit LispWorks is arranged in segments, which belong to generations. Unlike 32-bit LispWorks, segments are sparsely allocated in memory, that is they are not contiguous.

Each segment has an allocation type, which defines the type of objects that the segment contains. The system creates and destroys segments as needed. A generation may or may not contain a segment for a specific allocation type,

and a generation may contain more than one segment for any particular allocation type. Segments may change in size.

You can see the allocation for each allocation type in the output of:

```
(room)
```

Additionally you can see the segments of each generation in the output of:

```
(room t)
```

After the total allocation in each generation, this prints the allocation type for each segment followed by the hexadecimal address range for allocating objects.

You can also use

```
(room :full)
```

which does not produce segments information, but prints allocated amounts by allocation types.

### 11.4.2 Segments and Allocation Types

Some GC interface functions take an allocation type as an argument, which is one of the keywords below. There are two categories of allocation type.

The main allocation types, which can be used as the *what* argument to the function `apply-with-allocation-in-gen-num`, are:

<code>:cons</code>	The segment contains only conses.
<code>:symbol</code>	The segment contains only symbols (and does not include symbol names or any of the other properties of symbols).
<code>:function</code>	The segment contains only function objects.
<code>:non-pointer</code>	The segment contains only objects that do not contain pointers (strings, specialized numeric arrays, double-floats).

**:other** The segment contain other objects, that is any object that contain pointers, and is not a symbol, cons or a function.

The derived allocation types are:

**:mixed** The segment contains a mixture of **:other**, **:function** and **:symbol**, but not **:cons** or **:non-pointer**.

**:cons-static**

The segment contains cons objects that are static.

**:non-pointer-static**

The segment contains objects that do not contain pointers and are static (currently stacks are also allocated in these segments).

**:mixed-static** The segment contains a mixture like **:mixed**, but static.

**:weak** The segment contains weak objects (arrays, and internals of weak hash tables).

**:other-big** The segment contains a single very large simple vector. The vector is static.

**:non-pointer-big**

The segment contains a single very large non-pointer object (a string or a specialized numeric array). The vector is static.

Segments of allocation type **:other-big** or **:non-pointer-big** can be as large as required to hold their object.

For all other allocation types, the size of each single segment is restricted. The implementation limit is currently 256 MB, and you can specify a smaller limit using **set-maximum-segment-size**.

### 11.4.3 Garbage Collection Operations

In 64-bit LispWorks there are two methods of garbage collection: *copy* (the default for all non-static objects) and *mark and sweep* (also referred to simply as *mark*) for static objects and under user control.

The two methods can be mixed within the same garbage collection operation and generation, but a segment is collected using only one of mark or copy in a given operation.

When a segment is collected using the copying method, the objects within it can either be copied to another segment in the same generation or can be copied to a segment in a higher generation. The latter case is called promotion.

The automatic garbage collection copies with promotion until the objects reach the blocking generation, which is collected in a specific way as described in “Generation Management” on page 149.

#### 11.4.4 Generation Management

In general, higher generations contain objects that live longer and are therefore much less likely to die. Each garbage collection only collects the generations up to some number, and never reclaims the objects in higher generations.

Objects move between generations by being promoted. For most allocation types, this means that the GC copies the objects from a segment in one generation to a segment in a higher generation. For allocation types `:other-big` and `:non-pointer-big`, the objects are not actually copied when they are promoted; but instead the whole segment is re-attached to the higher generation. The automatic garbage collection promotes objects until they reach the blocking generation.

In the default configuration, there are 8 generations, numbered from 0 to 7. Generation 7 is used to keep objects that survived saving the image. Generations 4, 5 and 6 are not used. Generation 3 is the blocking generation, where long-lived objects accumulate. Generations 0, 1, and 2 are ephemeral, and objects that survive a garbage collection in each of these generations are promoted to the next generation.

#### 11.4.5 Tuning the garbage collector

The GC settings are tuned for typical cases, so in general you do not need to change them. If you are considering tuning the GC, contact Lisp Support.

The main tools for seeing how the GC behaves are the macro `extended-time` and periodical calls to `room`.

In the output of `(room)` (or the more verbose `(room t)`), the allocation in each generation is presented according to the allocation type, which may be useful to decide on possible tuning.

`(extended-time forms)` outputs the time spent in garbage collection, whether automatic or called explicitly. The time is shown according to the maximum generation number that was collected and to whether it was a standard garbage collection (automatic and calls to `gc-generation`) or a marking garbage collection (calls to `marking-gc`).

In addition to `room` and `extended-time`, there are also the functions `count-gen-num-allocation`, `gen-num-segments-fragmentation-state`, and `set-automatic-gc-callback`. These function can be used to collect information about automatic garbage collection operations.

The profiler can also help determine whether the settings can be improved for your application. See Chapter 12, “The Profiler” for details of that.

#### 11.4.5.1 Interface for tuning the GC

The main interfaces are those which control the blocking generation.

For generations lower than the blocking generation, objects that survive are promoted, and the system does not automatically promote objects to higher generations. Thus if the application generates long-lived objects, they will accumulate in the blocking generation.

The behavior when the blocking generation grows is controlled by `set-blocking-gen-num` and `set-gen-num-gc-threshold`. It may also be useful to set the maximum segment size with `set-maximum-segment-size`.

Explicit garbage collection can be done by calling `gc-generation` and `marking-gc`. Since repeated use of `marking-gc` will cause a lot of fragmentation, the arguments `what-to-copy` and `max-size-to-copy` can be used to specify that part of the data should be collected by copying.

`gc-generation` can also be used to promote objects to a higher generation than the blocking generation.

It is normally less important to tune the ephemeral segments, that is the segments below the blocking generation. Functions that may be useful include

`set-default-segment-size`, `set-spare-keeping-policy` and `set-delay-promotion`.

## 11.5 The Mobile GC

The Mobile GC is a 64-bit GC that is written to run on 64-bit iOS (in the future it may be used on other platforms, for example 64-bit Android). When Lisp-Works is delivered for 64-bit iOS, the "saved image" (the code in the object file that delivery creates) switches automatically to use the Mobile GC. Thus you are always using the Mobile GC when running on 64-bit iOS, and you are not required to do anything about it.

The default parameters of the Mobile GC are intended to be useful for most applications and in many cases you do not need to do anything to tune the Mobile GC.

### 11.5.1 Mobile GC changes to common functions and macros

This section describes changes to the behavior of GC-related functions and macros when using the Mobile GC compared to the ordinary 64-bit GC. For most applications, `room`, and maybe `gc-generation`, are the only interesting functions. Specific functions for the Mobile GC are not discussed in this section.

#### mobile-gc-p

Returns true when running the Mobile GC.

#### room

The output of `room` is different for the Mobile GC. The last line (and the entire output of `(room nil)`) is the same, but the more detailed output is different. Without any argument, or if the argument is `:default`, Lisp-Works outputs the allocated and free sizes according to these types:

Cons            `cons` object only.

Other            All other objects, except static objects and large objects (> 1 MB).

Static	Static objects.
Large	Large objects (> 1 MB). Note: this threshold may change in the future, but it is fixed in the current version.

The Cons and Other segments are divided according to their generation and there may also some permanent segments (as a result of a call to `make-current-allocation-permanent`, `make-object-permanent` or `make-permanent-simple-vector`).

In addition, LispWorks also holds some reserved segments that are used during GC, and `room` prints the size of these too.

The output of `(room t)` also includes the segments for each type. For each segment, it prints the start and end addresses (in hex), the allocated area, and whether there is a free "hole" in the middle of it. For the Large and Static segments, it also prints the generation number of each segment. Permanent Static and Large segments have generation number 3.

See “Mobile GC technical details” on page 154 for more technical details.

### gc-generation

When the `gen-num` argument is a number, it must be 0, 1 or 2. The value `t` (and `:blocking-gen-num`) is interpreted as 2.

Generation 0 is always promoted, but the `:promote` keyword affects generation 1 and, if non-nil, promotes even if promotion was blocked by `set-promote-generation-1`.

The keyword `:coalesce` is interpreted as in the ordinary 64-bit GC. The keyword `:block` is ignored.

### marking-gc

Calls `gc-generation` with the `gen-num` argument. It is not useful in the Mobile GC.

### clean-down

Performs the same GC as `(gc-generation t)`.

**reduce-memory**

The *full* argument can be also be :**aggressive**, 0 1 or 2.

**count-gen-num-allocation**

The *gen-num* argument can be 0, 1, 2 or 3 (3 means permanent).

**in-static-area**

This does not affect allocation of conses (which are never static in the Mobile GC).

**apply-with-allocation-in-gen-num**

The *gen-num* argument must be 0, 1 or 2.

**sweep-all-objects**

Does not sweep **cons** objects in the Mobile GC.

**sweep-gen-num-objects**

Does not sweep **cons** objects in the Mobile GC.

The following functions do nothing in the Mobile GC, and the values that they return are not meaningful:

```
set-delay-promotion
set-maximum-segment-size
set-default-segment-size
set-gen-num-gc-threshold
set-blocking-gen-num
gen-num-segments-fragmentation-state
set-spare-keeping-policy
```

### 11.5.2 Mobile GC technical details

This section describes the Mobile GC in more detail. For most purposes, you do not need to understand the technical details of the Mobile GC, because it is used automatically and it should just work. You may want to know more if you want to fully understand the output of `room` (especially when called with T), and if you want to optimize memory usage (and maybe performance) of the application. In general, you should first use `time` or `extended-time` and `room` or `room-values` to understand the behavior of your application before trying to optimize it.

The ordinary 64-bit GC is "sparse", which means it leaves unused addresses between memory that it has allocated, and it also relies on being able to map memory at specific addresses. The result is a very efficient GC. However, on 64-bit iOS the range of addresses that is available (the address space) is very small compared to other 64-bit architectures (as determined experimentally because Apple do not document it), and also there is no documented interface for mapping at specific addresses. Therefore the ordinary 64-bit GC cannot work on 64-bit iOS, which is the reason for introducing the Mobile GC. The Mobile GC is less efficient than the ordinary 64-bit GC, but the only interface that it requires from the underlying OS for memory handling is `malloc` and `free`.

An additional issue specific to iOS is that iOS does not allow execution of machine code that is created dynamically, and the memory region where the code resides is read-only. Therefore the Mobile GC does not support compilation of code in memory at run time. Moreover, functions can contain data that can be modified so this needs to be separated from the code, which is not the case in the ordinary 64-bit memory model. To support this, the images that are used to deliver on iOS are different from the desktop images, though the difference is only in the memory layout of function objects, and from the programmer's point of view they behave the same. These images differ from the ordinary 64-bit images in that function objects and code are separated, and that function objects are allocated in the same segments as symbols (that is the allocation type `:symbol`). The code is allocated in objects with allocation type `:function`. See "Segments and Allocation Types" on page 147 for more details about allocation types. The names of these images and how to use them are described in "Delivering for iOS" on page 241.

The separation of code and use of the Mobile GC solves two different problems, which in principle could be solved separately. On 64-bit iOS, we have to solve both problems, and therefore the separation of code and the switch to the Mobile GC are done together.

### 11.5.2.1 Objects alive at delivery time

During delivery for 64-bit iOS, the code is separated out into its own block of memory (the "code block"). Then all of the other objects are put together in a block of memory, which is called the "data block". The data block is divided between non-pointer objects, weak objects and all other objects. The objects in the data block are never GCed, but the GC follows pointers from them to objects allocated at run time. Delivery creates an object file containing the code block and the data block, which is then linked with the rest of the app.

You cannot obtain a pointer to any object in the code block.

`generation-number` returns 3 for objects in the data block.

### 11.5.2.2 Objects allocated at run time

The Mobile GC has 4 different allocation types (note that these do not match the allocation types of the ordinary 64-bit GC described in “Segments and Allocation Types” on page 147):

Cons	<code>cons</code> objects
Static	Static objects
Large	Very large objects
Other	All other objects.

The Mobile GC does not allow allocation of static conses. Weak objects are allocated as Other or Large.

The different allocation types are allocated in separate segments, where a segment is a contiguous block of memory. Each allocation type has a variable number of segments, which are printed by `(room t)`. Each non-permanent segment belongs to a specific generation, which can be 0, 1 or 2. The permanent segments, which are created by `make-current-allocation-permanent`,

have generation number 3, even though there is not really a generation 3 (the GC does not collect them).

Like in the ordinary GC, allocation of static objects makes life more difficult for the GC (so it reduces the efficiency of LispWorks), and should be avoided.

Objects that are larger than a threshold (currently 1 MB, but this may change) are allocated in segments with the Large allocation type and are also static.

The vast majority of allocation happens in segments with the Cons and Other allocation types, which are together called "ordinary allocation". The segments for ordinary allocation are all of size 8 MB, including any overhead. For Cons segments, the overhead is larger because conses do not have headers.

The Mobile GC mixes marking and copying techniques. Copying has the advantage of eliminating fragmentation and is also more efficient for typical applications where most allocation is very short lived. On the other hand, it requires spare memory to be available during the GC. Marking creates fragmentation and is slower when most of the objects are freed immediately, but it does not require extra memory. Thus the Mobile GC tries to use copying when possible (that is when it can get enough memory from the operating system), and otherwise uses marking GC. The two methods may be mixed in the same GC operation.

For copying, LispWorks uses reserved segments, which it obtains from the operating system as needed. At the end of the GC, it returns any segments that are no longer needed to the operating system, except for some segments that it keeps in reserve. The amount of reserved memory that it keeps is dynamic, and by default grows as the amount of allocation grows. By default, as long as the amount of memory in ordinary segments is less than 48 MB, LispWorks tries to keep enough reserved segments to copy everything in generation 0 and 1 without asking the operating system for more memory. see [`set-reserved-memory-policy`](#) for details.

The copying GC might promote objects, which means copying them to the next generation. Generation 0 objects that are copied are always promoted (that is copied to generation 1). For Generation 1 objects, it is more complex:

For automatic GC:

`set-promote-generation-1` can be used to block any promotion from generation 1.

If promotion is not blocked (the default), then objects that have already survived a GC of generation 1 are promoted (copied to generation 2) and objects that are new to generation 1 remain in generation 1 (default setting) or are promoted depending on the setting by `set-split-promotion`.

For explicitly invoked GC by a call to `gc-generation`

The keywords `:promote` and `:coalesce` control whether objects from generation 1 are promoted or not. Generation 2 objects are always copied into generation 2.

Blocking promotion from generation 1 can be used to prevent GCs of generation 2, as discussed in “Preventing/reducing GC of generation 2” on page 159.

### 11.5.2.3 Special considerations for the Mobile GC

Because memory is more limited on mobile platforms, the Mobile GC is tuned to collect its highest generation (2) more often compared to the corresponding operation in the ordinary GC (which is a GC of generation 3). Such a GC may take enough time (in the order of a second) and be frequent enough to annoy users. If that happens then you need to try to tune your application, as described in “Preventing/reducing GC of generation 2” on page 159, and you can also try to reduce the amount that your application allocates.

Very large objects (> 1 MB) that do not contain pointers are handled especially efficiently by the Mobile GC. For example, if your program handles a million small strings of 10-15 characters, then you can save memory and maybe even speed up your program by storing them all in a very large string, and use fixnums to specify the bounds of the small strings within the large string instead of using pointers to the small strings. This saves memory and makes the reduces the work that the GC needs to do even if only half of the large string is actually used. Note also that when you finish with it, you can free a very large

object and return its memory to the operating system without doing a GC by calling `release-object-and-nullify`.

When a very large object that may contain pointers (for example a large `simple-vector`) is examined by the GC, it needs to go through all of those pointers. This is wasted work unless either it is long-lived and is rarely seen by the GC, or it is almost full of useful pointers, or if you make it permanent. Objects in general can be made permanent by `make-current-allocation-permanent`, which is discussed in “Preventing/reducing GC of generation 2” on page 159, but very large objects, which are allocated in their own segment, can also be made permanent individually by `make-object-permanent` or `make-permanent-simple-vector`. If most of the elements in a `simple-vector` are not pointers to objects that can be GCed, this substantially improves the performance of LispWorks.

Large objects which are allocated in their own segments can be explicitly freed (releasing the memory they use) by calling `release-object-and-nullify`. That releases the memory without a GC (so it is fast), and works on such objects even if they are permanent.

### 11.5.3 Tuning memory management in the Mobile GC

#### 11.5.3.1 Response to low memory

Mobile platforms typically inform applications when memory availability becomes low. On Android this is done by the `onTrimMemory` or `onLowMemory` methods and on iOS by the `didReceiveMemoryWarning` method. It is probably a good idea to respond to these methods, but it is not essential.

In your implementation of these methods, you should release any system resources that can be released without loss and also try to reduce the memory used by Lisp data. Since the GC sometimes temporarily requires more memory during an operation, it may be a bad idea to do a GC once you get the warning. The function `reduce-memory` is provided to reduce memory usage without requiring more memory temporarily. Note that `gc-generation` can do a much better job than `reduce-memory` in general, but it may require more memory temporarily.

Calling `reduce-memory` with argument `nil` (the default) just releases any reserved memory that LispWorks has kept. It is fast and probably always a good idea. However, with argument `nil`, `reduce-memory` does not perform any GC operation, which in principle could release more memory. Because a GC takes time, it is not obvious whether it worth the trouble.

Calling `reduce-memory` with 0 or 1 causes a GC of generation 0 or 1, which is probably fast enough (unless promotion of generation 1 is blocked and generation 1 grows), but will not typically release much memory.

Calling `reduce-memory` with 2 (or, equivalently, T), or even `:aggressive`, can release much more memory, but takes more time, depending on the size of generation 2. Unless it is likely to release a large amount, it is probably not worth it. Thus, unless you know that generation 2 contains a lot of dead objects, you should only call `reduce-memory` with `nil`, or maybe 0 or 1.

If you call `reduce-memory` with a non-nil argument, you should first clear any caches that you have kept, so their contents can be GCed.

To be able to reduce memory usage, `reduce-memory` needs reserved memory to perform a copying GC. Since `reduce-memory` never obtains more memory from the operating system, its effectiveness depends on the amount of reserved memory that it has when it is called. Moreover, any call to `reduce-memory` frees all of the reserved memory (once the GC has occurred if the argument is non-nil), so calling `reduce-memory` with non-nil shortly after a previous call with NIL is not going to be effective.

To see how much effect `reduce-memory` had on the memory, you can look at the output of `room` (last line with any argument you give it), or the result of `room-values`. To see how much time it takes, use the `time` macro or `get-internal-real-time`.

### 11.5.3.2 Preventing/reducing GC of generation 2

GC of generations 0 and 1 should normally be fast enough that you do not need to worry about them. GC of generation 2, however, typically takes enough time to be noticeable, and if generation 2 is large (> 100 MB) can take more than a second. Thus you normally want to avoid GC of generation 2.

In a "nicely behaved" application, which we believe is true for most applications, generation 2 never needs to be collected. This is based on the assumption that the application's memory usage is bounded and predictable.

tion that a nicely behaved application starts with some initialization that allocates long-lived objects, but then enters a "work" phase, where it allocates only short lived objects, which die before they reach generation 2.

Even if there is some "generation leak", that is objects being promoted from generation 1 to 2 that die not long afterwards, the leak may be slow enough that it is not a problem. For example, if your application "leaks" on average 1 kB each second, it would take close to 3 hours of operation to leak 10 MB, which is still too small to worry about (the default minimum size of generation 2 before a GC is 64 MB). So you can usually ignore this kind of leakage and hope that any occasional delay of a second or two after running the application for many hours is not too annoying for the user (though if it only a "generation leak", you can do better by blocking promotion). If you have a leakage of 100 kB per second, the delay would happen every few minutes, which may be too annoying.

To find if your applications leaks to generation 2, you should periodically log the size of either the whole application or of generation 2. The output of `room` is the most useful thing to log, but you can also use `room-values` or `count-gen-num-allocation`. If the application does leak to generation 2, you should determine if it is a real memory leak, which means that the application accumulates live objects, or just a generation leak, which means that objects live long enough to reach generation 2 and then die. To determine that, call `(gc-generation T)` (or, equivalently, `(clean-down)`), continue using the application for a while and then call it again. If the leak is just a "generation leak", then the size of generation 2 after `(gc-generation t)` should stay (more or less) the same. If it grows, then you have a real memory leak.

If your application is "nicely behaved", generation 2, and hence the whole application, will initially grow, typically by few 10's of megabytes, and then will stay more or less fixed. The size of the whole application will always fluctuate, because generation 0 and 1 fluctuate, but generation 2 should be stable or grow slowly. If this is the case, you probably do not need to do anything further to control memory usage.

If generation 2 does grow, LispWorks will occasionally do a GC of generation 2, which takes a noticeable time (maybe a few seconds if generation 2 is few 100's of megabytes). If the leak is a real memory leak, it will also cause the application to grow indefinitely.

If the leak is a real memory leak, then the GC cannot do anything about it. One possibility is to make the application run for a limited time, for example by monitoring the size and quitting when it reaches some threshold. If quitting and restarting is possible without much loss, that may be a good solution. Most of applications probably want to avoid that though, in which case you will need to figure out what keeps objects alive and fix it. The functions `sweep-all-objects`, `sweep-gen-num-objects` and `mobile-gc-sweep-objects` can be used to check what kind of objects have accumulated. However, whatever keeps the objects is something in your application, and you will have to find it.

If the leak is only a "generation leak", then there are several ways to deal with it:

- Block promotion from generation 1 to 2 by calling `set-promote-generation-1` with `nil`.

Once you have made this call, the automatic GC will never promote to generation 2 (explicit invocation of the GC ignores this setting). This is useful in situations where the "leaking" objects are live long enough to be promoted to generation 2, or the memory they use is small, so generation 1 does not grow too much. If there are many objects that live longer, then generation 1 will grow, and hence the GC of generation 1 will become slow. You should check if generation 1 grows, but it is probably OK if it remains at 20-30 megabytes allocated after a GC. You can try timing a GC of generation 1 by `(time (gc-generation 1))`.

Note that you can switch promotion on and off as needed, so if you can identify phases in your application when allocation is not long-lived and phases when some is long-lived, then you can switch promotion on and off as appropriate.

- Prevent GC in generation 2 by calling `set-generation-2-gc-options`. Once you have called `set-generation-2-gc-options` with `:minimal-size-for-gc t`, LispWorks will not automatically GC generation 2. It is then your responsibility to GC generation 2 at the appropriate time by calling `(gc-generation 2)`.

As above, one of the options is to never GC generation 2, and just quit when the application reaches some size. Otherwise, you will need to identify appropriate points in time to perform the GC.

In an interactive application, you can have a "cleanup" option somewhere that invokes the GC, so the user can invoke it. You probably also want some indicator when the application has grown and needs a "cleanup".

For an interactive application, it may be useful to do a GC when the application becomes backgrounded, but it is not obviously so. The method that is called by the operating system to indicate that the application has been backgrounded must return in a short time, so you probably need to invoke the GC from another thread. Also the operating system may not give much CPU to the application while it is in the background, and may even terminate background applications that take CPU. For example, the "App Programming Guide for iOS" says: "Apps that spend too much time executing in the background can be throttled back by the system or terminated." A GC of a 100-200 megabyte application should not take enough time to cause termination, but it depends both on the underlying system (hardware and OS) and the current state of it, so it is not that predictable. You certainly need to store anything that needs to be stored before doing a GC while in the background.

As long as memory is not constrained, the time it takes to GC generation 2 correlates to the amount alive after the GC rather than before the GC (because it uses copying, so does not touch dead objects). Therefore, if you have points in time in the execution when you know your application uses less memory then these are good points for doing a GC. That would be the case if your application builds a large data structure for a task (allocation of > 10 megabytes), and all this data becomes free when the task finishes. In this situation, it may be useful to perform a GC in the end of the task.

- Tuning the GC of generation 2 by `set-generation-2-gc-options`.

By calling `set-generation-2-gc-options` you can tune the frequency of GC of generation 2. You can either aim for infrequent GCs, which may be long but hopefully rare enough not to be too annoying, or aim for frequent GCs which are fast enough that they do not bother the user.

When the amount that is alive after a GC is almost always much less than the amount alive before, which is quite common, you can tell that to the GC by `set-expected-allocation-in-generation-2-after-`

`gc`. This can significantly improve how well the GC copes when it fails to get as much memory as it asks for from the operating system. See `set-expected-allocation-in-generation-2-after-gc` for details.

- Making the long-lived objects permanent by using `make-current-allocation-permanent`.

The function `make-current-allocation-permanent` causes all the currently allocated objects to be made permanent, which means that the GC will not scan or free them in future (but it will still follow pointers from them). That is useful in the typical situation where the application starts with some initialization that creates long-lived objects. Using `make-current-allocation-permanent` at the end of the initialization makes all these objects permanent, and therefore reduces the time for GC of generation 2. If new objects in generation 2 after initialization are only the result of "generation leak" then the effect on time can be quite large.

## 11.6 Common Memory Management Features

This section summarizes Memory Management functionality common to all LispWorks 7.1 implementations.

### 11.6.1 Timing the garbage collector

The macro `extended-time` is useful when timing the Garbage Collector (GC).

Use `start-gc-timing`, `stop-gc-timing` and `get-gc-timing` to time GC operations.

### 11.6.2 Reducing image size

To reduce the size of the whole image, use `clean-down`.

In 32-bit LispWorks, you can use `(clean-down)` or the less aggressive `(clean-down nil)` to reduce the image size when the image is much larger than the amount that is allocated. In 64-bit LispWorks there is no need to do that.

`(clean-down t)` promotes to generation 3 and tries to reduce the image size, while `(clean-down nil)` promotes only to generation 2 and does not reduce

the image size. Experience suggests that the latter is actually more useful in most circumstances.

In some circumstances it is important to avoid enlarging the size of the image even temporarily. The common situation is when the operating system signals low memory. In this situation you should use `reduce-memory` instead of `clean-down`.

### 11.6.3 Allocation of interned symbols and packages

Interned symbols (and their symbol names), and packages, are treated in a special way, because they are assumed to have a long life. They are allocated in the generation specified by the variable `*symbol-alloc-gen-num*`, which has the initial value 2 in 32-bit LispWorks and 3 in 64-bit LispWorks.

Symbols created with `make-symbol` or `gensym` start out in generation 0.

Symbols will be garbage collected if they are no longer accessible (regardless of property lists) but note that in 32-bit LispWorks, if the symbols are in generation 2 then you might need to invoke `gc-generation` explicitly to collect them in a timely manner.

### 11.6.4 Allocation of stacks

Stacks are allocated directly in generation 2 because they are relatively expensive to promote. Therefore creating many processes will cause generation 2 to grow, even if these processes are short-lived.

The variable `*default-stack-group-list-length*` controls the number of stacks that are cached for reuse. Increase its value if your application repeatedly makes and discards more than 10 processes.

### 11.6.5 Mapping across all objects

To call a function on all objects in the image, use `sweep-all-objects`.

### 11.6.6 Special actions

You may want to perform special actions when certain types of object are garbage collected, using the functions `add-special-free-action`, `flag-spe-`

`cial-free-action`, `flag-not-special-free-action` and `remove-special-free-action`.

For example, when an open file stream is garbage collected, the file descriptor must be closed. This operation is performed as a special action.

### 11.6.7 Garbage collection of foreign objects

Users of the Foreign Language Interface may want to specify the allocation of static arrays. The recommended way to do this is to call `make-array` with `:allocation :static`. See for example `:lisp-array` in the *LispWorks Foreign Language Interface User Guide and Reference Manual*.

### 11.6.8 Freeing of objects by the GC

Weak arrays and weak hash tables can be used to allow the GC to free objects.

Relevant functions are `make-hash-table`, `set-hash-table-weak`, `set-array-weak`, `make-array` and `copy-to-weak-simple-vector`.

For a description of weak vectors see `set-array-weak`, page 1012.

### 11.6.9 Assisting the garbage collector

This section describes techniques that may improve the performance of your application by reducing the GC's workload.

#### 11.6.9.1 Breaking pointers from older objects

This is a technique that can be useful when older objects regularly point to newer objects in a lower generation. In such a case, when the lower generation (only) is collected these newer objects will be promoted even if the older objects are not live. All of these objects will not get collected until the higher generation is collected.

This is a general issue with generational garbage collection and, if it causes poor performance in your application, can be addressed along these lines. It is not necessarily a problem in every case where older objects point to newer objects.

For example, suppose you are popping items from a queue represented as a list of conses (or other structures), then you can set the "next" slot of each popped item to `nil`.

In the code below, if the `queue-head` cons is promoted to generation  $n$ , then all the other conses will also be promoted to generation  $n$  eventually, until generation  $n$  is collected. This happens even after calls to `pop-queue` have removed these conses from the queue.

```
(defstruct queue head tail)

(defun push-queue (item queue)
  (let ((new (cons item nil)))
    (if (queue-head queue)
        (setf (cdr (queue-tail queue)) new)
        (setf (queue-head queue) new))
    (setf (queue-tail queue) new)))

(defun pop-queue (queue)
  (pop (queue-head queue)))
```

The fix is to make `pop-queue` set the "next" slot (in this case the `cdr`) of the discarded `queue-head` cons to `nil`, so that it no longer points from an older object to a newer object. For example:

```
(defun pop-queue (queue)
  (when-let (head (queue-head queue))
    (setf (queue-head queue) (shiftf (cdr head) nil))
    (car head)))
```

# 12

---

## The Profiler

The LispWorks profiler provides a way of empirically monitoring execution characteristics of Lisp programs. The data obtained can help to improve the efficiency of a Lisp program by highlighting those procedures which are commonly used or particularly slow, and which would therefore benefit from optimization effort.

### 12.1 What the profiler does

With the profiler running, the Lisp process is interrupted regularly at a specified time interval until the profiler is turned off. Having halted the execution of the process the profiler scans the execution stack and records information about it, including the names of all functions found. A special note is made of which function is at the top of the stack. After profiling stops the profiler can present a report containing a call tree and/or a cumulative columnar report.

The columnar report shows aggregated information about each function as follows:

- The number of times the function was called.
- The number of times the function was found on the stack by the profiler, both in absolute terms and as a percentage of the total number of scans of the stack.

- The number of times the function was found on the top of the stack, both in absolute terms and as a percentage of the total number of scans of the stack.

The call tree shows name of a root function and a "tree" of callee functions below it. To the right of each function's name the number of times it was seen on the stack under a particular caller is shown, along with the percentage this represents of the total number of times the function was seen.

The call tree is more computationally expensive to record than the cumulative data. You can choose whether to record and output the call tree, as described in the next section.

## 12.2 Setting up the profiler

Before a profiling session can start, several parameters must be set, using the function `set-up-profiler`. If the profiler is invoked before any call to `set-up-profiler`, it calls `set-up-profiler` implicitly without any arguments. In many cases that is what you want anyway, and in these cases you do not need to call `set-up-profiler`, but in some cases you will want to change something.

There are four main areas to consider: the symbols to be profiled, the time interval between samples, the kind of profiling required, and the format of the output.

- By default, all fbound symbols in the image are monitored (and, if KnowledgeWorks is loaded, also all the forward chaining rules). This setting is useful in many cases, but in some cases you will want to see information only about some subset of the symbols, which will make it easier to read the output. Use the keywords `:packages` and `:symbols` (and `:kw-contexts` for KnowledgeWorks) to restrict the set of symbols that will be profiled.
- You might want to specify the time interval between interrupts. The resolution of this value is clearly dependent on the operating system. In most cases the default value, 10ms, is adequate. This number is important, because with these statistical methods of program profiling the accuracy of the results increases with the number of samples taken.

- On non-Windows systems the kind of profiling required may be set. This refers to what kind of time is monitored in order to determine when to interrupt the Lisp process. There are three possibilities for how the time interval is measured:
  - The time the Lisp process is actually executing plus the time that the system is executing on behalf of the process. This is called *profile time*.
  - Just the time that the process is actually executing. This is called *virtual time*.
  - The actual elapsed time, called *real time*.
- The output can be presented as a tree of calls seen and a columnar report (`style :tree`), or just the columnar report (`style :list`). You can restrict the data shown in several ways, helping you to focus on the slowest parts of your program.

## 12.3 Running the profiler

The profiler has two distinct modes. You can use both in the same session, but not at the same time.

To use either mode, you must first call `set-up-profiler` to load the profiler and set its parameters including the output format.

The macro `profile` simply profiles all processes while a body of code is run, as described in “Using the macro profile” on page 169. Start profiling this way if you don’t see a need to use the alternate mode.

Alternatively the functions `start-profiling`, `stop-profiling` and `set-process-profiling` offer programmatic control over when profiling occurs and which processes are profiled. This is described in “Programmatic control of profiling” on page 170.

The function `do-profiling` is a convenience function which allows you to profile multiple threads using `start-profiling` and `stop-profiling`.

### 12.3.1 Using the macro profile

To profile your Lisp forms enter:

```
(profile <forms>)
```

This evaluates the forms as an implicit `progn` and prints the results, according to the parameters established by `set-up-profiler`.

**Note:** you cannot use `profile` (or the graphical Profiler tool) after a call to `start-profiling` and before a call to `stop-profiling` with `print t`, because the two profiling modes are incompatible.

### 12.3.2 Programmatic control of profiling

Your program can control profiling. This is useful when you want to profile only a part of the program.

In your program, call `start-profiling` start collecting profiling information. Call `stop-profiling` with `print nil` to temporarily stop collecting, or call `stop-profiling` with `print t` to stop collecting and print the results. At any point you can call `set-process-profiling` to modify the set of processes for which profiling information is being (or will be) collected.

For example:

```
; ; start profiling, current process only
(start-profiling :processes :current)
(do-interesting-work)
; ; temporarily suspend profiling
(stop-profiling :print nil)
(do-uninteresting-work)
; ; resume profiling
(start-profiling :initialize nil)
(do-more-interesting-work)
; ; now, all processes are interesting
(set-process-profiling :set :all)
(do-some-more-interesting-work)
; ; stop profiling and print the results
(stop-profiling)
```

**Note:** you cannot call `start-profiling` inside the scope of the macro `profile` or while the graphical Profiler is profiling, because the two profiling modes are incompatible.

## 12.4 Profiler output

A typical report would be:

```

profile-stacks called 564 times

Call tree
Symbol          seen   (%)
 1: MOD          17 ( 3)
 2: FLOOR        5 ( 1)
 1: EQL          8 ( 1)
 1: >=           7 ( 1)
 2: REALP         2 ( 0)
 1: +             6 ( 1)
 1: LENGTH        4 ( 1)

Cumulative profile summary
Symbol      called  profile   (%)      top   (%)
MOD        1000000    17 ( 3)      8 ( 1)
EQL        2000117    8 ( 1)      8 ( 1)
>=         1000001    7 ( 1)      5 ( 1)
+          1000000    6 ( 1)      6 ( 1)
FLOOR      1000000    5 ( 1)      5 ( 1)
LENGTH     2000086    4 ( 1)      4 ( 1)
REALP      1000001    2 ( 0)      2 ( 0)

Top of stack not monitored 93% of the time

```

The first line means that Lisp was interrupted 564 times by the profiler.

The call tree shows that in 17 of these interrupts (3% of them) the profiler found the function `mod` on the stack, in 5 of these interrupts it found the function `floor` on the stack, and so on. Moreover, `floor` only appears under the `mod` branch of the tree, which means that each of these times `floor` was called by `mod`.

The cumulative profile summary also shows how many times each symbol was found on the stack. Moreover it shows that the function `mod` was called 1000000 times, the function `eql` was called 2000117 times, and so on. (Note: this information is not collected on Intel-based platforms by default.) In 17 of these interrupts it found the function `mod` on the stack, and on 8 of these occasions `mod` was on the top of the stack. You can deduce that 526 times the function on the top of the stack was none of those reported.

You can control sort order of the cumulative profile summary with `print-profile-list`.

### 12.4.1 Interpretation of profiling results

One important figure is the amount of time it was found on top of the stack in the cumulative profile summary. Just because a function is found on the stack does not mean that it uses up much processing time, but if it is found consistently on the top of the stack then it is likely that this function has a significant execution time. Another thing to check is that you expect the functions near to top of the call tree to take significant time.

It must be remembered that the numbers produced are from random samples and thus it is important to be careful in interpreting their meaning. The rate of sampling is always coarse in comparison to the function call rate and so it is possible for strange effects to occur and significant events to be missed. For example, “resonance” may occur when an event always occurs between regular sampling times, though in practice this does not appear to be a problem.

### 12.4.2 Displaying parts of the tree

Once profiling information has been recorded, either by `stop-profiling` or a normal exit from `profile`, it is possible to print specific parts of the information. The function `profiler-tree-from-function` prints a tree showing a specific function and the functions called inside it. The function `profiler-tree-to-function` prints a tree showing a specific function and its callers. This tree is inverted, which means that the children of a node are its callers, rather than callees as in the full tree and the tree printed by `profiler-tree-from-function`.

## 12.5 Profiling pitfalls

Profiling should only be attempted on compiled code. If it is done on interpreted code, the interpreter itself is profiled, and this distorts the results for the actual Lisp program.

Macros cannot be profiled as they are expanded during the compilation process. Similarly some Common Lisp functions may be present in the source code but not in the compiled code as they are transformed by the compiler. For example:

```
(member 'x '(x y z) :test #'eq)
```

is transformed to:

```
(memq 'x '(x y z))
```

by the compiler and therefore the function `member` is never called.

Recursive functions need special attention. A recursive function may well be found on the stack in more than one place during one interrupt. The profiler counts each occurrence of the function. Hence the total number of times a function is found on the stack may be much greater than the number of times the stack is examined.

Tail call optimization will prevent the calling function from being found on the stack after the call. You can disable tail call optimization by compiling code with optimize quality `debug 3`, but note that this might also affect the performance.

Care must be taken when profiling structure accessors. Structure accessors compile down into a call to a closure of which there is one for all structure setters and one for all structure getters. Therefore it is not possible to profile individual structure setters or getters by name.

It must be remembered that even though a function is found on the stack this does not mean that it is active or that it is contributing significantly to the execution time. However the function found on the top of the stack is by definition active, and thus this is the more important value.

It is quite possible that the amount of time the top symbol is monitored is significantly less than 100% despite the profiler being set to profile all the known functions of the application. This is because at the time of the interrupt an internal system function may well be on the top of the stack.

## 12.6 Profiling and garbage collection

The macro `extended-time` provides useful information on garbage collection activities.

The `gc` argument of `set-up-profiler` controls whether or not the system's memory management functions are profiled.

## 12.7 Profiler tree file format

The profiler tree file is produced by calling `save-current-profiler-tree`, or by using the **Save Profiler tree...** item from the **Profiler** menu on the Lisp-Works IDE.

The file contains lines of text encoded UTF-8, to allow it to contain any symbol name.

The first line is handled specially: it must contain the string "LispWorks Profiler Tree" (without the quotes), which confirms that the file is a profiler tree file. In addition, the text following the first colon in the first line, with leading and trailing spaces removed, is the name of the tree.

The remaining lines in the file are the data lines, except those starting with a semicolon which are ignored.

Each data line is divided to 6 fields by a | character. The first 5 fields are integers and the last field is an arbitrary sequence of characters (any character except newline). There must be no spaces between the fields.

Each line specifies a node in the tree, in this format:

***Depth | Count | Call-Count | Seen-Count | Top-Count | Name***

*Depth* specifies the depth of the node, from which its location in the tree is deduced. The node with depth 0 is the root. For other nodes, the parent of the node is the previous node in the file which has depth smaller by 1. The children of the node, are all following nodes with depth larger by 1, until the next node with a depth less than or equal to *Depth*. In other words, each node is followed by its children in depth-first order.

*Count* is the number of times that the function associated with the node was seen on the call stack within the same branch of the tree, that is with the same chain of callers and on the same process.

*Call-Count*, *Seen-Count*, *Top-Count* and *Name* are the *function-info* of the function associated with the node. Hence they are not specific to the node itself and if the function occurs more than once in the tree (which is common), then copies of the *function-info* will be present in each occurrence.

The fields of the *function-info* are:

<i>Call-Count</i>	The number of times that the function was called, if this is recorded. Note that the count is not recorded by default in SMP LispWorks, so it is 0.
<i>Seen-Count</i>	The number of times that the function was seen in all the branches of the tree.
<i>Top-Count</i>	The number of times that the function was seen at the top of the stack, that is it was actually executing.
<i>Name</i>	The name of the function. Note that some nodes do not correspond to actual functions, in which case the name will be a string (including the double quotes).

### 12.7.1 Parsing the file

Because the *function-info* fields of each node are repeated for each occurrence of the same function, it is useful to record function-info keyed on the Name. This allows you to associate nodes that are in different branches of the tree but represent the same function.

The name can be read using the Common Lisp reader, provided the currently interned symbols are the same as the interned symbols when the file was produced. Otherwise you may get an error if the package of a symbol does not exist, or if it was external but it is not external when reading. In many cases, just using the name as a string is probably good enough.

### 12.7.2 Viewing the file as text

While it is not possible to see the tree in the file, you can perform simple "queries" just by viewing it in a text editor, for example checking if a function appears anywhere in the tree, finding how often it was visible or getting an idea which function(s) mostly call it.



# 13

---

# Customization of LispWorks

This chapter gives examples of how to make changes to LispWorks to make it more suitable for use by you and your colleagues.

## 13.1 Introduction

### 13.1.1 Pre-loading code

You can save an image with changes pre-loaded. This is suitable for changes you want to share with other users of that image, and for code which takes some time to load. It cannot be used to alter settings which the system makes automatically on startup.

“Saving a LispWorks image” on page 179 describes how to do this.

### 13.1.2 Loading code at start up

You can also load changes each time you start LispWorks. This is suitable for code which loads quickly. For changes only you want to see, put the code in your personal initialization file. For changes to share with other users at your site, put the code in your site initialization file.

“Initialization files” on page 178 describes these initialization files.

### 13.1.3 Specific customizations

The remainder of this chapter describes some customizations, all of which can be saved in an image or placed in an initialization file, as needed. You can use both techniques: stable code including patches is saved in the image, while experimental or fast-loading code is loaded via the initialization file.

## 13.2 Configuration and initialization files

There are a number of files that contain configuration and initialization information:

### 13.2.1 Configuration files

- The LispWorks file `config/configure.lisp` contains many default configuration settings. You can create a customized copy of this file when you install LispWorks, as described in the *LispWorks Release Notes and Installation Guide*.
- The LispWorks file `config/key-binds.lisp` gives the default editor key bindings for Emacs emulation.
- The LispWorks file `config/mac-key-binds.lisp` gives the editor key bindings for Mac OS editor emulation, if supported on your platform.
- The LispWorks file `config/msw-key-binds.lisp` gives the editor key bindings for Microsoft Windows editor emulation, if supported on your platform.

### 13.2.2 Initialization files

- The LispWorks file `config/siteinit.lisp` is the default site initialization file. The distributed file loads any supplied patches.
- You may also have a personal initialization file which is loaded on startup. By default LispWorks looks for a file called `.lispworks` in your home directory, although you can change its name and location (see “Setting Preferences” in the *LispWorks IDE User Guide*).

The default location of your home directory varies on Unix systems, but it is typically something like `/home`. On Windows, the directory is constructed from the environment variables HOMEDRIVE and HOME-  
PATH. The directory itself has the same name as your user name, so if you log on as `john`, your home directory might be `/home/john` on Unix systems or something like `C:\users\john` on Windows 8.

A sample personal initialization file, the LispWorks file `config/a-dot-lispworks.lisp`, is supplied. You should create a customized copy of this file when you install LispWorks, as described in the *LispWorks Release Notes and Installation Guide*.

## 13.3 Saving a LispWorks image

There are two ways to save an image with changes pre-loaded.

- This section describes the traditional method, using a configuration file and `save-image` script.
- “Saved sessions” on page 182 describes how to save a session, which allows restoring your windowing environment as well as your Lisp objects.

### 13.3.1 The configuration file

First create a file `my-configuration.lisp` containing the settings you want in your saved image. You may want to change some of the pre-configured settings shown in `config/configure.lisp`, add customizations from the rest of this chapter, or load your application code.

### 13.3.2 The save-image script

Now create a `save-image` script which is a file `save-image.lisp` containing something like:

```
(in-package "CL-USER")
(load-all-patches)
(load #-mswindows "/tmp/my-configuration.lisp"
      #+mswindows "C:/temp/my-configuration.lisp")
#+:cocoa
(compile-file-if-needed
 (sys:example-file
  "configuration/macos-application-bundle")
 :load t)
(save-image
 #:cocoa
 (write-macos-application-bundle
  "/Applications/LispWorks 7.1 (32-bit)/My LispWorks.app")
 #:-cocoa "my-lispworks")
```

The script shown loads `my-configuration.lisp` from a temporary directory. You may need to modify this.

### 13.3.3 Save your new image

The simplest way to save your new image is to use the Application Builder tool in the LispWorks IDE. Start the Application Builder as described in the *LispWorks IDE User Guide*, enter the path of your `save-image` script in the **Build script:** pane, and press the **Build the application using the script** button.

Alternatively you can run LispWorks in a command interpreter and pass your `save-image` script in the command line as shown below.

- On Macintosh, run in Terminal.app:

```
mymac$ "/Applications/LispWorks 7.1 (32-bit)/LispWorks (32-
bit).app/Contents/MacOS/lispworks-7-1-0-x86-darwin" -build save-
image.lisp
```

Your new application bundle is saved in `/Applications/LispWorks 7.1 (32-bit)/My LispWorks.app`

- On Microsoft Windows, run in a MS-DOS window:

```
C:\temp\>"C:\Program Files\LispWorks\lispworks-7-1-0-x86-
win32.exe" -build save-image.lisp
```

Your new LispWorks image is saved in `C:\temp\my-lispworks.exe`.

- On Linux, run in a shell:

```
linux:/tmp$ lispworks-7-1-0-x86-linux -build save-image.lisp
```

Your new LispWorks image is saved in `/tmp/my-lispworks`.

For other platforms and for 64-bit LispWorks the image name varies from that shown, but the principle is the same.

### 13.3.4 Use your new image

Your new LispWorks image contains the settings you specified in `my-configuration.lisp` pre-loaded.

You can add further customizations on start up via the initialization files mentioned in “Initialization files” on page 178.

Note that your newly saved image runs itself, not a saved session.

### 13.3.5 Saving a non-GUI image with multiprocessing enabled

To create an image which does not start the LispWorks IDE automatically, make a `save-image` script, for example in `/tmp/resave.lisp`, containing:

```
(in-package "CL-USER")
(load-all-patches)
(save-image "~/lw-console"
           :console t
           :multiprocessing t
           :environment nil)
```

Run LispWorks like this to create the new image `~/lw-console`:

```
lispworks-7-1-0-x86-linux -build /tmp/resave.lisp
```

### 13.3.6 Code signing in saved images

This section briefly describe when and how LispWorks images are code signed.

#### 13.3.6.1 Signing your development image

On Microsoft Windows and Mac OS X you can sign a development image saved using `save-image` with the `:split` argument.

### 13.3.6.2 Signing in the distributed LispWorks executable

The LispWorks Professional and Enterprise Edition images distributed are not signed, because of the complications around image saving and delivery that this would cause.

The LispWorks for Macintosh Personal Edition application bundle and the LispWorks for Windows Personal Edition executable are both signed in the name of LispWorks Ltd.

### 13.3.6.3 Signing your runtime application

On Microsoft Windows and Mac OS X you can sign a runtime executable or dynamic library which was saved using `deliver` with the `:split` argument.

## 13.4 Saved sessions

You can save a LispWorks session, which can be restarted at a later date. This allows you to resume work after restarting your computer.

Saving sessions is intended for users of the LispWorks IDE. The graphical tools described in *LispWorks IDE User Guide* provide the best way to use and configure session saving. However it is also possible to save a session programmatically, which is described in this section.

When you save a session, LispWorks performs the following three steps:

1. Closing all windows and stopping multiprocessing.
2. Saving an image. On Mac OS X this creates an application bundle.
3. Restarting the LispWorks IDE and all of its windows.

If a saved session is run later, then it will redo the last step above, but see “What is saved and what is not saved” on page 183 for restrictions.

Sessions are stored on disk as LispWorks images, by default within your personal application support folder (the exact directory varies between operating systems).

### 13.4.1 The default session

There is always a default session, which is used when you run the supplied LispWorks image.

When you run any other image directly, including a saved session or an image you created with `save-image`, it runs itself (not the default session).

Saved sessions are platform and version specific. In particular, a 32-bit LispWorks saved session cannot be the default session for 64-bit LispWorks, or vice-versa.

### 13.4.2 What is saved and what is not saved

All Lisp code and data that was loaded into the image or was created in it is saved. This includes all editor buffers, the Listener history and the value of `*`, `**` and `***`.

All threads are killed before saving, so any data that is accessible only through a `mp:process`, or by a dynamically bound variable, is not accessible.

All windows are closed, so any data that is accessible only within the windowing system is not accessible after saving a session.

The windows are automatically re-opened after saving the session and all Lisp data within the CAPI panes is retained.

External connections (including open files, sockets, database connections and COM interfaces) become invalid when the saved session is restarted. In the image from which the session was saved, the connections are not explicitly affected but if these connections are thread-specific, they will be affected because the thread is killed. In recreated Shell tools the command history is recovered but the side effects of those commands are not. Debugger and Stepper windows are not re-opened because they contain the state of threads that have been killed.

### 13.4.3 Saving a session programmatically

You can save a session by calling `save-current-session`

### 13.4.3.1 Save Session actions

The first thing that `save-current-session` does is to execute the action-list "Save Session Before".

After redisplaying all the interfaces, the action-list "Save Session After" is executed. That happens both in the saving invocation and the restarting saved image.

### 13.4.3.2 Non-IDE interfaces

If there are non-IDE interfaces on the screen when `save-current-session` is invoked, there interfaces are destroyed in the first step, and displayed again in the third step. Note that the display will occur in a different thread than the one running the interface before the saving (which was killed in the first step).

If the interface (or any of its children) contains information that is normally destroyed (in some sense) in the `destroy-callback`, this information can be preserved over a call to `save-current-session` by defining methods on the generic functions `capi:interface-preserving-state-p` or `capi:interface-preserve-state`.

### 13.4.4 Saving a session using the IDE

You can save a session or set up periodic automatic session saving using the configuration tools in the LispWorks IDE. See "Session Saving" in the *LispWorks IDE User Guide* for details.

## 13.5 Load and open your files on startup

Suppose you always compile and load several files after LispWorks starts. You can arrange for this to happen automatically by adding forms like these in your initialization file:

```
(defvar *my-files*
  '("/path/to/foo1"
    "/path/to/foo2"
    "/path/to/foo3"))

(dolist (file *my-files*)
  (compile-file file :load t))
```

If you also want to open these files in the Editor tool, then you can add this form in your initialization file, after those above:

```
(define-action "Initialize LispWorks Tools"
  "Open My Files"
  #'(lambda (screen)
      (declare (ignore screen))
      (dolist (file *my-files*)
        (ed file))))
```

## 13.6 Customizing the editor

This section explains some of the customizations you can make to the Editor tool in the LispWorks IDE.

### 13.6.1 Controlling appearance of found definitions

The commands `Find Source`, `Find Source for Dspec` and `Find Tag` retrieve the file containing a definition and place it in a buffer with the relevant definition visible. By default, the start of the definition is in the middle of the Editor window and is highlighted.

The variable `editor:*source-found-action*` controls the position and highlighting of the found definition. The value should be a list of length 2.

The first element controls the positioning of the definition, as follows:

`t` Show it at the top of the editor window.

A non-negative fixnum

Position it that many lines from the top.

`nil` Position it at the center of the window.

The second element can be `:highlight`, meaning highlight the definition, or `nil`, meaning don't.

For example, to configure the editor so that found definitions are positioned at the top of the window and are not highlighted, do

```
(setq editor:*source-found-action* '(t nil))
```

This variable is set in the file `a-dot-lispworks.lisp`.

### 13.6.2 Specifying the number of editor windows

You can specify the maximum number of editor windows that are present at any one time. For example, to set the maximum to 1:

```
(setq editor:*maximum-ordinary-windows* 1)
```

This variable is set in the file `a-dot-lispworks.lisp`.

### 13.6.3 Binding commands to keystrokes

You can bind existing editor commands to different keystrokes, using `editor:bind-key`.

The LispWorks file `config/key-binds.lisp` is supplied. It shows the standard Emacs key bindings for LispWorks.

The following example shows how to rebind `?` so that it behaves as an ordinary character in the echo area of tools in the LispWorks IDE — this can be useful if your symbol names include question marks.

```
(editor:bind-key "Self Insert" #\? :mode "Echo Area")
```

Since `?` is then no longer available for help, you may wish to rebind help to `Ctrl+?`.

```
(editor:bind-key "Help on Parse" "Control-?" :mode "Echo Area")
```

If you use another editor emulation, then see the LispWorks file `config/msw-key-binds.lisp` or `config/mac-key-binds.lisp` for the corresponding `editor:bind-key` forms.

## 13.7 Finding source code

**Note:** This section does not apply to LispWorks Personal Edition.

To configure LispWorks so that editor commands such as `Find Source`, the menu command `Find Source`, and the dspec system are able to locate definitions in the supplied editor source code:

1. Load the logical host for the editor source code:

```
(load-logical-pathname-translations "EDITOR-SRC")
```

2. Configure source finding to know about editor source code:

```
(setf dspec:*active-finders*
      (append dspec:*active-finders*
              (list "EDITOR-SRC:editor-tags-db")))
```

3. Now do (for example) **Meta+X Find Command Definition** and enter **Wfind File**.

The definition of the command **Wfind File** is displayed in an Editor tool.

See “Controlling appearance of found definitions” on page 185 for information on controlling how the source code is displayed.

## 13.8 Controlling redefinition warnings

By default most system-provided definers such as `c1:defun`, `c1:defmacro`, `c1:defmethod` and so on signal a warning when they redefine an existing definition. You can bind or set `*redefinition-action*` to eliminate such warnings or make it signal error instead.

Also, the system is configured to protect symbols in implementation packages against definition and redefinition. For example, an error is signaled if you attempt to put a function definition on the symbol `c1:*read-base*`. This behavior is configurable by the variables `*handle-warn-on-redefinition*` and `*packages-for-warn-on-redefinition*`. Bear in mind that the default configuration protects the stability of the system, so if you need to prevent such errors it is better to bind one or both of these variables around specific defining forms, rather than setting their global values.

## 13.9 Specifying the initial working directory

The working directory is set on startup and provides the default location for the **File > Open...** dialog. Call `change-directory` in your initialization file (see “Initialization files” on page 178) to control the initial working directory.

## 13.10 Using ! for :redo

The default way of redoing the previous command from the command history is via `:redo`. If you want to use `!` (exclamation mark) instead of `:redo`, add the following to your `.lispworks` file:

```
(set-macro-character #\\!
 #'(lambda (stream char)
   ':redo))
```

You may wish during some sessions to reset `!` back to its normal role as a character. To do this, evaluate:

```
(set-syntax-from-char #\\! #\\@)
```

## 13.11 Customizing LispWorks for use with your own code

This section contains some information on customizations you can make in order to make developing your own code a little easier.

### 13.11.1 Preloading selected modules

If you frequently use some code that is normally supplied as separate modules, you can load them at start-up time from your initialization file. This file is called `.lispworks` by default, but can be changed to be any other filename. See “Setting Preferences” in the *LispWorks IDE User Guide* for details.

For example, to load the dynamic-completion code every time you start LispWorks, include the following in your initialization file.

```
(require "dynamic-complete")
```

### 13.11.2 Creating packages

When writing your own code that uses, for instance, the `capi` package, create a package of your own that uses `capi` — do not work directly in the `capi` package. By doing this you can avoid unexpected name clashes.

## 13.12 Structure printing

By default `defstruct` generates a method on `print-object`. You can avoid this by binding at macroexpansion time the variable `structure:*defstruct-generates-print-object-method*`.

## 13.13 Configuring the printer

This section applies only on non-Windows platforms when running the Motif IDE.

You can configure your LispWorks image for your printer, by selecting **File > Printer Setup** from any tool with printing capacities, for example the editor, and choosing **Add Printer**.

When configuring a printer, the CAPI printing library prompts for a *PostScript Printer Description* file (PPD), which defines such things as the paper size and the printable area of the page, in the form of a standard PostScript language header. The printing code splices this file into the PostScript produced from submitting a CAPI printing request.

The library on the LispWorks CD contains a generic PPD file, called `generic.ppd`, that defines these values conservatively to ensure that it should work with most printers. For accurate results, you should use the PPD supplied with your printer.

The PPD files are placed in the `ppd` subdirectory of the `postscript` directory in the `lispworks` library directory. Files added to the `ppd` directory are expected to have the extension ".`ppd`".

### 13.13.1 PPD file details

A PPD file contains a description of the attributes and capabilities of a given printer, such as paper sizes supported, the printable area of the page, the number and names of input paper trays, optional features such as additional paper trays or duplex units, and so on, together with the printer-specific PostScript language commands necessary to use the features.

The file `generic.ppd` defines a simple generic printer supporting A4, A3, US letter, and US legal paper sizes, and supporting manual feed. It defines con-

servative margins (1 inch all round), and the documents generated should be compatible with most PostScript printers. It is suitable for producing PostScript files when the destination printer is unknown, and may also be used if the appropriate PPD for the printer is not available.

However, for the best results, we recommend the use of the appropriate PPD for the printer. This allows you to specify which optional features (if any) have been installed on the printer, and ensures that the Print dialog provides access to appropriate printer capabilities such as multiple input trays and duplex printing. This also ensures that the CAPI uses the correct values for the printable areas of the page.

# 14

---

# LispWorks as a dynamic library

This chapter describes how to create a dynamic library or DLL from LispWorks and discusses use of the library.

## 14.1 Introduction

You can use LispWorks to build a dynamic library on Microsoft Windows, Intel Macintosh, Linux, x86/x64 Solaris and FreeBSD.

To do this, use `save-image` or `deliver` and supply a list value for *dll-exports*. On platforms other than Windows passing *dll-added-files* also creates a dynamic library.

The result is a library that cannot be executed on its own, but can be dynamically loaded by another process. On Windows this is done with the Windows APIs `LoadLibrary` and then `GetProcAddress`. On other platforms the dynamic library can be loaded by `dlopen` and then `dlsym`.

The dynamic library is usually of file type `dll` on Windows, `dylib` on Macintosh and `so` on Linux, x86/x64 Solaris or FreeBSD. The first implementation of this functionality in LispWorks was on Microsoft Windows only, therefore the terminology that is used is sometimes Windows-like. In particular “DLL” refers to any dynamic library.

A program that loads a LispWorks dynamic library must be compiled and linked as follows:

Linux	Link with <code>libpthread.so</code>
FreeBSD	Link with <code>libpthread.so</code>
Mac OS X	No special requirements
Solaris	Compile and link multithreaded (for example, using the <code>-mt</code> option to Oracle's <code>cc</code> )

## 14.2 Creating a dynamic library

To deliver a LispWorks runtime as a dynamic library supply a list value for *dll-exports* when calling `deliver`.

To save a LispWorks image as a dynamic library supply a list value for *dll-exports* when calling `save-image`.

Additionally on Linux, x86/x64 Solaris, Macintosh and FreeBSD platforms, you can supply a list value for *dll-added-files* to deliver or save a dynamic library.

**Note:** a LispWorks dynamic library is licensed in the same way as a LispWorks executable.

### 14.2.1 C functions provided by the system

When LispWorks is a dynamic library the functions described in Chapter 54, “Dynamic library C functions” are automatically available. They allow the loading process control over relocation and unloading of the library.

### 14.2.2 C functions provided by the application

*dll-exports* specifies application-defined exported functions in a LispWorks dynamic library.

Exports can also be provided in the files named in *dll-added-files*, on Linux, x86/x64 Solaris, Macintosh and FreeBSD platforms.

### 14.2.3 Example

This script saves an image `hello.dll` which is a Windows DLL:

```
----- hello.lisp -----
(in-package "CL-USER")
(load-all-patches)
;; The signature of this function is suitable for use with
;; rundll32.exe.
(fli:define-foreign-callable ("Hello"
                               :calling-convention :stdcall)
  ((hwnd w:hwnd)
   (hinst w:hinstance)
   (string :pointer)
   (cmd-show :int))
  (capi:display-message "Hello world"))

(save-image "hello"
            :dll-exports '("Hello")
            :environment nil)
-----
```

Run the script by

```
lispworks-7-1-0-x86-win32.exe -build hello.lisp
```

on the command line, or use the Application Builder tool.

(See “Saving a LispWorks image” on page 179 for more information about how to save an image.)

You can test the DLL by running

```
rundll32 hello.dll,Hello
```

on the command line.

To see the dialog, you may need to dismiss the LispWorks splashscreen first.

## 14.3 Initialization of the dynamic library

Each of the exports specified via *dll-exports* ensure first that LispWorks has finished initializing. If initialization has not yet started, they start the initialization process themselves. This is true regardless of the value of *automatic-init* (see below).

A LispWorks dynamic library is initialized automatically on loading, or not, according to the value of *automatic-init* in the call to `deliver` or `save-image`.

### 14.3.1 Automatic initialization

On Microsoft Windows when *automatic-init* was true the initialization finishes before the Windows function `LoadLibrary` returns, and if LispWorks fails for some reason then the call to `LoadLibrary` fails too.

On other platforms when *automatic-init* was true, during the automatic initialization `dlopen` just causes the initialization to start and returns immediately. The initialization will finish sometime later. The LispWorks function `LispWorksState` can be used to check whether it finished initializing.

Automatic initialization is useful when the dynamic library is something like a server that does not communicate by function calls. On Windows it also allows `LoadLibrary` to succeed or fail according to whether the LispWorks dynamic library initialized successfully or not.

### 14.3.2 Initialization via `InitLispWorks`

Not using automatic initialization (that is, creating the dynamic library with *automatic-init nil*) allows using `InitLispWorks` to relocate the image if necessary, and do any other initialization that may be required.

## 14.4 Relocation

LispWorks normally maps its heap on startup in the same place that it was when it was saved, and when it needs more memory it maps this nearby. This applies when LispWorks is a dynamic library as well as for LispWorks executables.

This mapping can cause memory clashes with other software, which may be avoided by relocating LispWorks. Most of the LispWorks implementations are relocatable though the details vary between platforms and between 32-bit LispWorks and 64-bit LispWorks.

On Microsoft Windows and Macintosh, LispWorks detects and avoids memory clashes automatically. On other platforms, you can relocate a LispWorks dynamic library (for all the relocatable implementations) if necessary by a

suitable call to `InitLispWorks` as described in “Startup relocation” on page 459.

## 14.5 Multiprocessing in a dynamic library

Multiprocessing is started automatically in a LispWorks dynamic library. Therefore you can arrange for Lisp initialization operations by adding process specifications to `*initial-processes*`.

For example, if you have a function like this:

```
(defun my-server ()
  (let ((s (establish-a-socket)))
    (loop (accept-connection s))))
```

you need to do something like:

```
(pushnew '("My server" () my-server) mp:*initial-processes*
         :test 'equalp)
```

before saving or delivering your library.

## 14.6 Unloading a dynamic library

Before a LispWorks dynamic library is unloaded, LispWorks should be made to ‘quit’ cleanly, allowing it to clean up resources that it uses.

When the LispWorks dynamic library is loaded by a main process which you (the LispWorks programmer) do not control, then use `dll-quit`. If you control the main process, then use `QuitLispWorks` instead. For the details, see the respective manual entries for `dll-quit` and `QuitLispWorks`.



# 15

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## Java interface

The LispWorks Java interface allows you to:

- Define "Java Callers" which are Lisp functions that call Java methods or constructors, or access Java fields. You can either define specific callers, or "import a Java class", which means automatically generating callers for all the class public methods, constructors and fields.
- Make and access Java arrays.
- Make calls from Java into Lisp, either by calling Lisp directly or making proxies that implement some Java interface ("Lisp proxy"), and using a Lisp proxy where Java requires an object that implements an interface.
- Access Java objects.
- Integrate Java in a limited way with CLOS.
- Make socket streams using Java sockets. See "Socket streams with Java sockets and SSL on Android" on page 432.

Calling into Java using the callers and accessing arrays does not require any specific Java code. Calling from Java into Lisp requires having the `com.lisp-works.LispCalls` class (supplied as a JAR file), and using methods from it.

The Java interface is a module which needs to be loaded by calling

```
(require "java-interface")
```

The Java interface symbols are exported from the package LW-JI, documented in Chapter 41, “The LW-JI Package”.

The Java interface requires Java edition 6 or later.

## 15.1 Types and conversion between Lisp and Java

### 15.1.1 Mapping of Java primitive types to and from Lisp types

The 8 primitive Java types map naturally to Lisp types:

Table 15.1 Mapping from primitive Java types to Lisp types

Java	Lisp
<code>long, int, short, byte</code>	<code>integer</code>
<code>double</code>	<code>double-float</code>
<code>float</code>	<code>single-float</code>
<code>char</code>	<code>integer</code>
<code>boolean</code>	<code>(member t nil)</code>

The mapping from Lisp to Java is not always obvious, for example because a Lisp integer can map to `long, int, short, char` or `byte`. In most cases, like method calls, the target Java type is known. In these cases, LispWorks allows `integer` in the acceptable range for `byte, short, int, long` and `char`, any Lisp float for `float` and `double`, `t` and `nil` for `boolean`.

When the target is not known, like storing a value in a Java array object (that is type `java.lang.Object[]`) or using `lisp-to jobject`, LispWorks uses this mapping:

Table 15.2 Mapping from Lisp when target Java type is unknown

Lisp	Java
Integers that fit in 32 bits	<code>int</code>

Table 15.2 Mapping from Lisp when target Java type is unknown

Lisp	Java
Integers that do not fit into 32 bits but fit into 64 bits	<code>long</code>
Double floats	<code>double</code>
Other floats	<code>float</code>
<code>t</code> or <code>nil</code>	<code>boolean</code>
Other Lisp values	Cannot be converted.

LispWorks has a set of keywords and FLI types to match the primitive types, which can be used to specify these types, for example as the type of an array. The keyword names are the Java name (uppercase), and the FLI type names are the Java name preceded by J (and uppercase), exported from LW-JI. These are shown in the table below.

Table 15.3 Keywords and FLI types matching primitive types

Java type	Keyword	FLI type	Underlying FLI type
<code>short</code>	<code>:short</code>	<code>jshort</code>	<code>:short</code>
<code>long</code>	<code>:long</code>	<code>jlong</code>	<code>:int64</code>
<code>byte</code>	<code>:byte</code>	<code>jbyte</code>	<code>:byte</code>
<code>char</code>	<code>:char</code>	<code>jchar</code>	<code>(:unsigned :short)</code>
<code>double</code>	<code>:double</code>	<code>jdouble</code>	<code>:double</code>
<code>float</code>	<code>:float</code>	<code>jfloat</code>	<code>:float</code>
<code>boolean</code>	<code>:boolean</code>	<code>jboolean</code>	<code>(:unsigned :char)</code>
<code>int</code>	<code>:int</code>	<code>jint</code>	<code>:int</code>

**Note:** The Java type `char` (and hence the class `Character`) corresponds to UTF-16 code units, which is equivalent to `unsigned short`. It does not corre-

spond to Unicode characters, and therefore cannot be mapped to LispWorks characters.

### 15.1.2 `java.lang.String`

LispWorks deals specially with `java.lang.String` objects, converting them automatically to Lisp strings when receiving them (return value of methods or arguments to calls into Lisp), and converting Lisp strings to `java.lang.String` when passing them (argument to method calls, return values from calls into Lisp). It is therefore possible to think of strings as another primitive type. The overhead associated with this conversion for short strings (tens of characters) is smaller than the overhead associated with passing a Java non-primitive object. Even for larger strings, the fact that all the data in the string is passed in one call without further Java/Lisp interaction make it an effective way of passing data.

### 15.1.3 Java non-primitive objects

All Java non-primitive objects are represented in LispWorks as foreign pointers of type `jobject`. `jobject` is a proper Lisp type, that is you can use `c1:typep` and specialize methods on it. The actual Java class of the object is not consistently represented, unless you explicitly ask for it using `jobject-class-name`. You can get a string describing the Java object in the way that Java "thinks" (that is the result of `toString`) using `jobject-string`. If you need a Java null value, then you can use the constant `*java-null*`.

Instances of `standard-java-object` are also considered to represent Java objects. `standard-java-object` instances have a slot that contains the actual `jobject`, which is used when an instance of `standard-java-object` is passed to the interface functions. In the text below, when argument is specified as "java-object" or "Java object", it can be either a `jobject` or an instance of `standard-java-object`.

## 15.2 Calling from Lisp to Java

To call into Java you typically define Java callers. There are two possible approach for defining the callers: importing classes or defining specific callers.

In addition, you can call Java methods and constructors and access Java fields without defining them first.

### 15.2.1 Importing classes

Importing a Java class means that the system generates definitions for all the public methods, constructors and fields for this class. For example, to generate and evaluate the definition, execute:

```
(import-java-class-definitions "java.io.File")
```

And to write the definitions to a file:

```
(write-java-class-definitions-to-file "java.io.File"
"filename.lisp")
```

The import macros and functions all take various keyword arguments to control exactly what they generate.

`import-java-class-definitions` would normally appear as a top level form in your source file, and when the file is loaded it generates all the definitions. `write-java-class-definitions-to-file` can be used to generate all the definitions and write them to a file, which is an ordinary Lisp source file that can be compiled and loaded as usual. There is also `write-java-class-definitions-to-stream`, which writes the definitions to a stream, and `generate-java-class-definitions`, which returns a list of the definitions, which may be useful sometimes (they are actually used by `import-java-class-definitions` and `write-java-class-definitions-to-file`).

The actual definitions that the importing interface generates are the same as you would write yourself, using the appropriate defining forms: `define-java-caller`, `define-java-constructor`, `define-field-accessor`. These are discussed further in “Defining specific callers” on page 202.

Importing has the obvious advantage that you do not need to type all the method names. It has two disadvantages:

- The generation of the definitions relies on having access to the class definition and running Java virtual machine (JVM), which may or may not be a hassle. For example, if your code contains an `import-java-class-definitions` form, it will need the JVM running and the class defini-

tion accessible when it is loaded as source or when it is compiled (loading the binary file does not require Java).

If the requirement for Java is an issue, you can work around it using `write-java-class-definitions-to-file` (or use `write-java-class-definitions-to-stream`), and use the resulting file as your source code. The call to `write-java-class-definitions-to-file` requires Java, but you need to do it only once, and it can be on a different computer to the one you develop on. For a public class (standard Java, standard Android) you can even ask Lisp Support to create the file for you. This approach also allows you to edit the definitions if you have any reason to. The definitions also contain the signatures of all the methods and constructors.

- The other disadvantage of importing is that it "pollutes" your namespace with many definitions, of which you may be needing only a few. To reduce the chances of clashes, the default setting creates a Lisp package for each Java package, and uses a unique name for the package. This makes the code less Lisp-like. Using the keywords to import interface allows you some control on the naming that it uses.

If you deliver your application without shaking (the default for levels 0 and 1), using import will also cause your application to be larger than it needs to be. If you import many classes this difference may be significant. If you deliver with shaking (default for level 2 or higher), the callers that are not used will get shaken out and so will not affect the size of your application.

### 15.2.2 Defining specific callers

You define specific callers by using the various definers, which are typical defining macros, but the body is automatically generated:

`define-java-caller`

Defines a caller that calls a Java method.

`define-java-callers`

Defines several method callers for the same class.

`define-java-constructor`

Defines a caller that calls a Java constructor method.

```
define-field-accessor
```

Defines callers to access (read and write) a field.

In addition, you can define callers dynamically at run time using the `setup-*` functions `setup-java-caller`, `setup-java-constructor` and `setup-field-accessor`, which are functions that match the `define-*` macros above.

The `setup-*` functions effectively do exactly what the `define-*` macros do, but the code looks nicer with the macros, and the LispWorks Editor can find your definitions.

Methods and constructors are similar enough that they are described here together. Constructors are by definition always "static" in the Java terminology.

Defining a caller for a method or constructor defines a Lisp function that when called invokes the Java method. The Java method is supplied by its class name and name (except constructors, which implicitly map to the constructor methods of the class), which means that there may be more than one Java methods or constructor that are applicable.

For example:

Define a Lisp function `my-probe-file` which invokes the Java method `java.io.File.exists`:

```
(define-java-caller my-probe-file "java.io.File" "exists")
```

Define a Lisp function that calls one of the constructors of `java.io.File`:

```
(define-java-constructor my-make-file "java.io.File")
```

At run time, `my-make-file` will check which of the constructors of `java.io.File` matches the arguments, and then call it.

See “Actual Java call” on page 205 for a description of how the callers actually work.

Defining a field accessor defines a Lisp function that reads the field value, potentially another Lisp function to set the value (if it is not final), and a symbol macro that expands to calls to the getter or setter. For ordinary (non-static)

fields, the getter needs to be called with the object from which to read the value, and the setter must be called with the object and the value. For static fields, the getter takes no arguments, and the setter takes the new value.

### 15.2.3 Verifying callers

Compared to importing classes, explicit definitions have the advantages that they do not need Java running until run time, you define only the callers you need, and you select the names of the Lisp functions. The main disadvantage is that you have to type much more, and that you may have typing errors in the method names which are not reported during compilation.

The functions `verify-java-caller` and `verify-java-callers` are provided as a way to guard against such typing errors. These functions need Java running, and they check whether the callers have matching Java methods, and return information about missing methods. The intention is that at least during development, you will call `verify-java-callers` at the beginning of the application and log the result, which will allow you to check whether any method is missing. It may also be useful if you use classes whose definitions may change, for example when the Java code and Lisp code are developed in parallel, or when you use non-standardized Java code.

`verify-java-caller` and `verify-java-callers` force the caching of run time information that the callers normally do in their first call.

### 15.2.4 Calling methods without defining callers

You can call Java methods by passing the full *method-name* as a string "`package.class.method`" to `call-java-method`. The actual run time behavior is as described in "Actual Java call" on page 205.

**Note:** `call-java-method` caches the relevant information using the string as the key, while properly defined callers close over it. Therefore `call-java-method` is slightly slower, but the difference is not significant. The only significant difference is that you can verify the caller to check against typing errors, while with `call-java-method` you will find a typing error in the method or class name only when you call it. If you find using `call-java-method` convenient and do not need the verification, there is no reason not to use `call-java-method` in preference to defining the callers explicitly.

You can construct an object of a class by calling `create-java-object`, supplying the full class name followed by the arguments to the constructor. The actual run time behavior is as described in “Actual Java call” on page 205.

You can access fields without defining accessors using `read-java-field` and `set-java-field`. There is also `checked-read-java-field`, which is like `read-java-field` but does not error on failure, `check-java-field` to check whether a field exists, and `java-field-class-name-for-setting` to find the class of the value.

### 15.2.5 Actual Java call

When a Java caller is called the first time or a call without definition is done and not cached yet, the function finds the relevant method(s), their arguments and return value types, and caches it (see `verify-java-caller` or `verify-java-callers` for pre-caching). That includes finding the class, and then finding the relevant methods or constructors. It then uses this information to decide which method is applicable, how to convert the argument to Java where needed, and how to convert the return value back to Lisp. It also decides which JNI function to use to perform the actual call.

Before doing the call LispWorks checks whether the arguments are of the correct type, and in most of the cases can catch and give Lisp errors as appropriate before calling into Java.

For an ordinary (non-static) Java method, the arguments to the Lisp function must start with the actual Java object for which the method needs to be applied. The rest of the arguments to the Lisp function are passed to the method. Thus the number of the arguments to the Lisp function needs to be one more than the number of (explicit) arguments to the Java method. The invocation is virtual (normal Java invocation), which may mean that the actual Java method that is ultimately executed may be defined in a subclass of the class that passed to the definer, if the object belongs to this subclass.

For static Java methods (including constructors) the given argument list is passed to the method.

## 15.3 Calling from Java to Lisp

Calling from Java to Lisp requires the Java class `com.lispworks.LispCalls`, and Java code that uses methods from this class. Currently all methods are static. `com.lispworks.LispCalls` is supplied by LispWorks in the file `7-1-0-0/etc/lispcalls.jar`, except on Android where it is part of the `7-1-0-0/etc/lispworks.jar` file. After Java is initialized, either by an explicit call to `init-java-interface` or implicitly by the system (for example on Android), you can check whether the Java to Lisp calls are possible (the class `LispCalls` is available) by using `check-lisp-calls-initialized`.

There are two mechanisms for calling from Java to Lisp: direct calls and using proxies. Direct calls means calling directly a Lisp function from Java, passing the name of the symbol to funcall and the arguments. Using proxies meaning creating proxies from Lisp, and then passing such Lisp proxies to places where the interface(s) that it implements are required. Invoking a method on such proxy ultimately calls a Lisp function.

Direct calls are simple to use, and if you have a simple Java/Lisp interface can be all that you need. The proxies are needed when you use somebody else's interface, for example implement callbacks to user interaction in Android. They are also useful even if you write the Java side too to make a cleaner interface on the Java side, which is easier to switch between different implementations.

### 15.3.1 Direct calls

You can make direct calls from Java to Lisp using one of the `Call<type>[VA]` static methods from `LispCalls`, which have these signatures:

```

public static int callIntV(String name, Object... args)
public static int callIntA(String name, Object[] args)
public static double callDoubleV(String name, Object... args)
public static double callDoubleA(String name, Object[] args)
public static Object callObjectV(String name, Object... args)
public static Object callObjectA(String name, Object[] args)
public static void callVoidV(String name, Object... args)
public static void callVoidA(String name, Object[] args)

```

The `<type>` in `Call<type>[VA]` specifies the return type, and `V` or `A` specify whether the arguments are supplied as `Variable` arguments or `Array`. Otherwise the pairs of `V` and `A` methods behave the same.

All these methods apply the Lisp symbol which is named by the `name` argument to the arguments supplied by the `Array` or the `variable` arguments, and return the result.

Note that on the Lisp side you will need to keep the Lisp symbol when delivering, most conveniently by `hcl:deliver-keep-symbols` (see the *LispWorks Delivery User Guide*), and the name of the symbol is not interpreted using `cl:read`.

See `com.lispworks.LispCalls` for full details.

### 15.3.2 Using proxies

Using proxies allows you to create from inside Lisp a Java proxy which implements one or more Java interfaces. The proxy can then be used whenever an object that implements any of the interfaces is required. When a method is applied to a proxy, it ultimately calls a Lisp function.

Creating a proxy in Lisp is done in two steps:

1. Defining a proxy, specifying
  - i) A name (a symbol).
  - ii) The interfaces that it implements.
  - iii) The Lisp functions that get called for each method.

- iv) A default function.
- v) Several other options.

Above, i) and ii) are obligatory, the other steps are optional.

Defining a proxy is done normally at load time by `define-lisp-proxy`. It is possible to define a proxy at run time using `setup-lisp-proxy`. For example, defining a proxy that implements the `onTouchListener` interface, specifying that when the method "onTouch" is invoked it causes the function `text-view-on-touch-callback` to be called:

```
(define-lisp-proxy my-text-view-on-touch-proxy
  ("android.view.View.OnTouchListener"
   ("onTouch" text-view-on-touch-callback)))
```

2. Making a proxy object using the name of a proxy definition by `make-lisp-proxy` or `make-lisp-proxy-with-overrides`, or by calling inside Java the method `com.lispworks.LispCalls.createLispProxy`. The result of making a proxy is a Java proxy object, which can be used in Java. For example, assuming the definition above and that you have a `View` in `mTextView`:

```
Object listener = LispCalls.createLispProxy("MY-TEXT-VIEW-ON-TOUCH-PROXY");
// Check the type of listener to allow for errors in Lisp
if (listener instanceof View.OnTouchListener)
    mTextView.setOnTouchListener((View.OnTouchListener)listener);
```

This will cause the Lisp function `text-view-on-touch-callback` to be called whenever the `view` in `mTextView` is touched.

**Note:** the result of `make-lisp-proxy` or `make-lisp-proxy-with-overrides` is "local", which means that it cannot be used outside the dynamic scope of the call to Lisp from Java in which it was created. If it is created outside the scope of a call from Java to Lisp, it must be used only in the thread that it was created.

When defining a proxy, you do not need to specify all the methods. You can specify a default function, which is called for any method for which you did not specify a function. See for example the proxy `lisp-othello-server-lazy` in this example, which does not specify any method, and instead specifies a default function that handles all of them:

```
(example-edit-file "android/android-othello-user")
```

When defining a proxy, it is also possible to specify that the Lisp functions should be called with an extra argument *user-data*, which is associated with each specific proxy by passing `:user-data` to `make-lisp-proxy` or `make-lisp-proxy-with-overrides`. This allows you to link each proxy with some of your data. If you do not specify this option, the functions in the proxy need to use the arguments and global data to decide what to do.

It is also possible to "override" the Lisp function at run time, which means specifying that when a Lisp function for a method should be invoked, another function is invoked instead. Overriding is specified by passing either of `:overrides` or `:overrides-plist` to `make-lisp-proxy`, or by using `make-lisp-proxy-with-overrides`. The main advantage of overriding is that it allows you to use run time closures, while the proxy definition itself allows only symbols. Overrides are efficient and are simple to use. For example, with the definition above, you can override the callback by:

```
(let ((closed-something (creating-something)))
  (make-lisp-proxy 'my-text-view-on-touch-proxy
                  :overrides-plist
                  (list 'text-view-on-touch-callback
                        #'(lambda (&rest args)
                            (apply 'callback-with-something closed-
                                   something args)))))
```

which will cause a touch to invoke `callback-with-something` on `closed-something` and `args`.

Note that this example could easily be done using `:user-data` instead, but that will have to be specified "statically" in the proxy definition, while overriding can all done dynamically when creating individual proxies.

The Java method `com.lispworks.LispCalls.createLispProxy` cannot do overriding, it must be done inside Lisp by `make-lisp-proxy` or `make-lisp-proxy-with-overrides`.

To make it easier to detect typing errors in specifying the interface names and method names or specifying a Lisp function, the functions `verify-lisp-proxies` and `verify-lisp-proxy` are provided to verify all proxies or only one, respectively. Verification checks that all the specified functions are actually defined, and optionally also that all the methods that are declared in the

interfaces are defined. The latter check must be done with Java running. You will typically use it when starting the application to check that all the proxies are OK, at least during the development phase.

The Lisp functions of the proxy are ordinary Lisp, but they need to return the correct value, unless the method has `void` as its return type. Returning the wrong value will call the `java-to-lisp-debugger-hook` (see `init-java-interface`) with an appropriate condition, and then return zero of the correct type (that is 0, `0d0`, `0f0`, Java `false`, or Java `null`) from the method call.

The call to the Lisp function is wrapped such that trying to throw out of it does not actually finish the throw, and instead returns zero of the correct type from the method call.

In some cases the method needs to throw some exception. The function `throw-an-exception` can be used to throw an exception from inside a call to a proxy function.

## 15.4 Working with Java arrays

Java arrays are represented inside Lisp by a `jobject` or an instance of `standard-java-object`, like any other Java object. The function `java-array-element-type` returns the element type of a Java array or `nil` if it is not an array, and it is fast enough that it can be used as a predicate to determine whether a `jobject` represents an array.

`java-array-length` returns the length of a Java array.

`java-primitive-array-element-type` and `java-object-array-element-type` return the same values as `java-array-element-type` for an array of primitive type or an array of non-primitive type respectively, otherwise they return `nil`. They are fast and can be used as predicates to decide whether an array is of primitive type or not.

Java arrays of higher dimensions are represented recursively as vectors of vectors, which affects the way you use the accessors.

### 15.4.1 Accessing a single element

The accessor `jvref` can be used to get and set (with `c1:setf`) the value in a Java "Vector" (that is, a one-dimensional array). For a multi-dimensional array,

`jvref` gets and sets the first level "Vector", in other words it returns another array of one less dimension.

`jaref` can be used to get and set elements of arrays with any number of dimensions. If the number of dimensions given is less than the rank of the array, it gets or sets the corresponding sub-array.

Both `jvref` and `jaref` can be used to access arrays of any type. `jvref` is slightly faster, and does not allow passing wrong number of arguments.

**Note:** when accessing an element of a multi-dimensional array, `jaref` needs to get the sub-arrays for the sub-dimensions. This means it is relatively inefficient when used to access elements in the same sub-array. It is more efficient to get the sub-array and access it. For example, instead of

```
(dotimes (z 10)
  (do-something (jaref java-array 3 4 z)))
```

use

```
(let ((sub-array (jaref java-array 3 4)))
  (dotimes (z 10)
    (do-something (jvref sub-array z))))
```

Assuming `java-array` is not a primitive array, it is even better to use the multiple access functions:

```
(let ((sub-array (jaref java-array 3 4)))
  (map-java-object-array 'do-something sub-array :end 10))
```

### 15.4.2 Making Java arrays

The function `make-java-array` is used to make Java arrays of any rank and type. It takes as first argument a class specifier, followed by the dimension(s). The class specifier specifies the type of the elements in the array, which may be any type (both primitives and proper classes).

It is also possible to create primitive arrays with data copied from Lisp arrays using `lisp-array-to-primitive-array`.

### 15.4.3 Multiple access functions

The multiple access functions are used to access elements in one-dimensional arrays ("Vectors"). They are much more efficient than accessing each element separately.

Multiple access of primitive and non-primitives is done in a different way: non-primitive arrays are accessed by `map-java-object-array`, which maps a function on the objects in the array. Primitive arrays are accessed by `primitive-array-to-lisp-array` and `lisp-array-to-primitive-array` (copy to or from a Lisp array) or `get-primitive-array-region` and `set-primitive-array-region` (copy to or from a foreign array). String arrays are regarded as object arrays for this distinction.

`map-java-object-array` maps a function across an array. It has keyword arguments to control the actual operation, including specifying the range and direction, writing back the result of the call, and collecting the values. When called on multi-dimensional arrays, `map-java-object-array` accesses the top level elements, that is sub-arrays of one less dimension.

`primitive-array-to-lisp-array` and `lisp-array-to-primitive-array` take a Java primitive array or a Lisp array respectively, and copy the elements to a Lisp array or Java primitive array. Both functions can copy into an existing array or create the array themselves. Keyword arguments allow you to specify the range to copy.

Both `primitive-array-to-lisp-array` and `lisp-array-to-primitive-array` require the Lisp array element type to match exactly the Java array element type. The corresponding types are:

Table 15.4

Java array element type	Lisp array element type
<code>:int</code>	<code>(signed-byte 32)</code>
<code>:long</code>	<code>(signed-byte 64)</code>
<code>:short</code>	<code>(signed-byte 16)</code>
<code>:byte</code>	<code>(signed-byte 8)</code>

Table 15.4

Java array element type	Lisp array element type
:double	<code>double-float</code>
:single	<code>single-float</code>
:char	<code>(unsigned-byte 16)</code>
:boolean	<code>(unsigned-byte 8)</code>

`get-primitive-array-region` and `set-primitive-array-region` take a primitive array and copy part of it to or from a foreign array ("buffer"), which is passed as an FLI pointer.

## 15.5 Initialization of the Java interface

The Java interface is a module which needs to be loaded by calling:

```
(require "java-interface")
```

Before doing any calls from Lisp to Java or from Java to Lisp or creating any Java object from Lisp, the Java interface must be initialized by a call to `init-java-interface`. `init-java-interface` can either connect to an already running Java virtual machine, or load the JVM library and start it. It has various keyword arguments to set global values.

On Android and in dynamic libraries that were delivered with `setup-deliver-dynamic-library-for-java` with true for `init-java` (the default), the system automatically calls `init-java-interface` on startup.

Merely defining callers to Java and proxies does not use Java. Importing classes needs Java to do the expansion, so will require initializing the Java interface. See discussion in “Importing classes” on page 201.

## 15.6 Utilities and administration

Use `jobject-p` to test whether a Lisp object is a `jobject` or not.

Use `lisp-java-instance-p` to test whether the argument is an instance of `standard-java-object`.

`get-jobject` returns the `jobject` for a Java object, `nil` otherwise, and can be used as predicate to determine whether the argument is a valid Java object. Note that if you have an instance of `standard-java-object`, `get-jobject` may return `nil` if the slot is not set. `ensure-is-jobject` is like `get-jobject`, but signals an error if its argument is not a `jobject`.

`jobject-class-name` can be used to find the Java class raw name of a Java object. `jobject-pretty-class-name` makes it "pretty", which matches how it appears in the Java code.

`jobject-string` returns a string representing the object the way Java wants to represent it (the result of `Object.toString`).

`jobject-to-lisp` and `lisp-to-jobject` can be used to convert between Lisp and Java objects of primitive types, which may sometimes be useful.

`find-java-class` can be used to find the Java class object for class specification, which normally is the string representing the full class name, but can be also be a keyword for specific primitive types.

`jobject-of-class-p` can be used to verify whether a Java object is an instance of a class or any of its subclasses.

`reset-java-interface-for-new-jvm` eliminates cached Java objects from internal Lisp structures. It is intended to be used if you need to start a JVM, stop it and start again. Currently there is no interface to stop the JVM.

`intern-and-export-list`, `default-name-constructor`, `record-java-class-lisp-symbol`, `ensure-lisp-classes-from-tree` and `ensure-supers-contain-java.lang.object` are utility functions that are used by the definition generation code, and appear in the output of the importing interface (`write-java-class-definitions-to-file`, `write-java-class-definitions-to-stream` and `generate-java-class-definitions`). Their purpose is to be used by the importing interface, but if you find them useful you can call them directly.

`get-superclass-and-interfaces-tree` returns a tree of the superclasses and interfaces of a Java class. It is also used internally by the importing interface.

`send-message-to-java-host` can be used to send a message (a string) to the Java host. This is especially useful when the Lisp is used inside Java, for example on Android, so Java needs to do the displaying of messages to the user.

The variables `*to-java-host-stream*` and `*to-java-host-stream-no-scroll*` are output streams that send anything that is written to them to Java (by calling `send-message-to-java-host`). They can be used anywhere an output stream is needed to make the output go to the Java host.

The Java interface currently may generate at run time specific Java interface conditions of the types below.

Conditions with names ending `*-exception` are all subclasses of `java-exception`, and correspond to an exception raised while calling Java. `java-exception` has two subclasses: `java-normal-exception` for exceptions that you may get during normal execution, and `java-serious-exception`, for exceptions that indicate the system is broken in some way. `java-serious-exception` should never happen, while `java-normal-exception` may happen in normal code.

The other conditions correspond to errors which are detected inside Lisp.

The `java-exception` class has three readers, `java-exception-string`, `java-exception-java-backtrace` and `java-exception-exception-name`, which you can use when handling the condition. The macros `catching-java-exceptions` and `catching-exceptions-bind` can be used to catch Java exceptions instead of signaling an error. Your code can then access the Java exception directly.

#### `java-interface-error`

Superclass of the `*-error` conditions.

#### `java-definition-error`

Superclass of `java-class-error` and `java-method-error`.

#### `java-class-error`

Class not found.

#### `java-method-error`

Method not found.

**java-field-error**  
Field not found, or was defined with the wrong *static*-*p* value.

**java-field-setting-error**  
Setting a field failed, either because it is final or an unacceptable value was supplied.

**call-java-method-error**  
`call-java-method` failed to find the method.

**create-java-object-error**  
`create-java-object` failed to find constructors.

**java-array-error**  
Superclass of all array errors.

**java-out-of-bounds-error**  
Bad index passed to `jvref` or `jaref`, or bad *start* and *end* passed to other functions accessing arrays.

**java-storing-wrong-type-error**  
Trying to store value of wrong type into a Java array.

**java-exception**  
Superclass of the `*-exception` conditions.

**java-normal-exception**  
Superclass of normal exceptions.

**java-serious-exception**  
Superclass of serious exceptions.

Normal exceptions:

**field-exception**  
Superclass of field exceptions.

**field-access-exception**

Exception accessing a field (maybe wrong type of value).

`java-method-exception`

Exception inside a call to a Java method.

Serious exceptions:

`java-id-exception`

Failed to find JNI ID for a method.

`java-low-level-exception`

Failure in some JNI function.

## 15.7 Loading a LispWorks dynamic library into Java

When a LispWorks application is delivered as a dynamic library and is loaded by Java, the Java interface must be initialized at some point to make it possible to use it for interfacing with Java. Lisp code which does not interact with Java will work without initializing Java. This includes the initialization function (the first argument to `deliver`), which can do any required Lisp initialization. However, calls to Java and accepting calls from Java require initialization of the Java interface.

The function `setup-deliver-dynamic-library-for-java` is used to set this up. In the simple case, you just call `setup-deliver-dynamic-library-for-java` without any arguments, and then call `deliver`. When the resulting delivered Lisp image is loaded into Java, Lisp is initialized as usual, and then `init-java-interface` is automatically called with the host's Java virtual machine.

`setup-deliver-dynamic-library-for-java` forces the delivered image to be saved as a dynamic library, which when loaded by Java (normally by `System.loadLibrary` or `System.load`) receives the host's Java virtual machine, initializes the Java interface (unless `init-java` is passed as `nil`) and then calls its `function` argument if it is non-nil.

The `deliver` startup function (the first argument to `deliver`) is called before Java is initialized, so any code that needs to run before initializing the Java interface should be in this function.

By default the initialization is done synchronously, that is by the time that the Java method that loads the LispWorks delivered library returns, LispWorks has finished initializing and is ready to receive calls from Java and other foreign calls. As a result, the loading code on the Java side will hang until the initialization finishes. `setup-deliver-dynamic-library-for-java` can be told to make initialization asynchronous, that is the loading method just starts the initialization and returns immediately. Calls from Java into Lisp that occur before Lisp is ready will wait until Lisp is ready, and you can check if Lisp is ready by using the Java method `com.lispworks.LispCalls.waitForInitialization`.

`setup-deliver-dynamic-library-for-java` works by internally defining a foreign-callable for `JNI_OnLoad` and exporting it. You must not define this yourself when using `setup-deliver-dynamic-library-for-java`.

If you have your own C code that uses the JNI, you can pass the JVM to Lisp yourself via a foreign-callable (or return it from a lisp-to-foreign call), and call `init-java-interface` with it. In this case, you must not use `setup-deliver-dynamic-library-for-java`.

The function `get-host-java-virtual-machine` can be used to get the Java virtual machine that was passed from Java to the internally defined `JNI_OnLoad`, and can be used as a predicate to test if `JNI_OnLoad` was called. Thus you can create a dynamic library that may be loaded by Java or by a conventional mechanism, and use `get-host-java-virtual-machine` to distinguish between these two situations.

There is a minimal example of delivering LispWorks for Java in:

```
(example-edit-file "java/lisp-as-dll/README.txt")
```

## 15.8 CLOS partial integration

The integration of CLOS is mainly the fact that the functions that take a `jobject` also accept a CLOS instances of the class `standard-java-object`, which has a slot containing the `jobject` to use. That includes arguments to Java callers, Java arrays in the array interface, and return values from Lisp to Java. However, values that come from Java to Lisp (return values of caller, arguments in Java to Lisp calls), are always a `jobject` or primitives.

You can create a subclass of `standard-java-object` either by the usual way of including it (or a subclass of it) in the superclasses of your class, or by using the keywords arguments to importing functions and macro. To be able to construct a `jobject` for a class without the constructor, the `class-name` must be passed to `define-java-constructor`. This is done automatically by the importing functions.

When defining the class using the importing function, you can force it to create the complete hierarchy of superclasses to match all Java superclasses and implemented interfaces. This creates overhead and is not necessarily useful, but in some circumstances it may be what you need. You can also force the hierarchy explicitly by using `ensure-lisp-classes-from-tree`.

The `jobject` in an instance of `standard-java-object` can be read and written by the accessor `java-instance-jobject`. Alternatively you can call `create-instance-jobject` or `create-instance-jobject-list` to create the `jobject` for a given instance.

A simple interface for making an instance and its `jobject` together is `make-java-instance`, but this does not provide a way to pass arguments to `make-instance`. The initarg `:construct` to `make-instance` on a subclass of `standard-java-object` can be used to make the instance and the `jobject`. Note, however, that the `jobject` is created in the `c1:initialize-instance` method of `standard-java-object`, which may or may not be called before your `c1:initialize-instance` methods (depending on the order of the superclasses). To ensure that the `jobject` is created after the CLOS instance initialization is complete, do not pass the `:construct` initarg, and instead call `create-instance-jobject` or `create-instance-jobject-list` afterwards.

The argument to `create-instance-jobject-list` and to the `:construct` initarg is either a list of arguments to the constructor, or `t`, which means use the default arguments list. The default arguments list is created by calling `default-constructor-arguments` on the instance. The default method returns `nil`, which is good enough for some Java classes, but not all. Note that if you pass `:construct` to `make-instance`, `default-constructor-arguments` will be called on the instance before all the `c1:initialize-instance` methods have been called, which may be a problem if it depends on some values that may be put in by other `c1:initialize-instance` methods. To avoid

this issue use `create-instance-jobcet-list` with `t` on the result of `make-instance`.

If you have a `jobcet`, and there is a CLOS class defined for its Java class, you can create a CLOS instance for it using `create-instance-from-jobcet`. `create-instance-from-jobcet` finds the class using the record that is created by `record-java-class-lisp-symbol`. The call to `record-java-class-lisp-symbol` is done automatically by the importing interface, but you can also call it directly.

## 15.9 Java interface performance issues

Both Java and Lisp do memory management on their objects, which causes the interface between them to be problematic. The result is that calls between Java and Lisp are more expensive than calls from and to C, and that keeping a pointer to a Java object (`jobcets`) in Lisp adds overhead for both sides.

In general, code that needs to be efficient should not make calls between Lisp and Java. For interactive response on a mobile device, as a rough guide, if you have more than 100 calls between Lisp and Java per user gesture, you should reduce the number of such calls, or move the processing to another thread, so that the GUI is still responsive.

Keeping pointers to a Java object in Lisp (`jobcets`) creates an overhead both for Lisp (which needs to maintain a record so it can tell Java when it is free), and for Java. It is therefore a bad idea to keep large number of pointers to `jobcet` in Lisp. As a rough guide, when you reach 100 objects you should consider changing the interface.

Accessing the first dimension of an array can be done much more efficiently by the multiple access functions than the single element accessors. When accessing a multi-dimensional array, accessing more than one element in a sub-array can be done much more efficiently by getting the sub-array and accessing it instead of accessing via the top array.

If you pass to Lisp an array of Objects where Lisp goes through many of them and just reads one or two values, it is probably faster to put these values into a primitive array or string and pass this to Lisp instead. This avoids the creation of a `jobcet` and call(s) into Java for each object, which would be much more

expensive than the allocation of a primitive array and filling it in Java. The same is true in the other way.

If you need to pass a very large (megabytes) `Array` or `String` between Java and Lisp, it may be better to write it to a file and pass the filename.



# 16

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## Android interface

To use LispWorks for Android Runtime, you need to have at least a minimal Android project written in Java, to load and initialize LispWorks. CAPI is not supported on Android, so any GUI part will need to be written in Java too.

To use the Android interface you need to deliver your application by the special image `lispworks-7-1-0-arm-linux-android`. This image does not contain the GUI part of LispWorks, but contains all the non-GUI parts.

This special image is an ARM image, and must be run on ARM architecture. That can be either an ARM machine, or an ARM emulator. To deliver a LispWorks for Android Runtime image using the QEMU emulator, you run the special image using the via the shell script `examples/android/run-lw-android.sh`

The Android interface relies on the Java interface, which is already loaded into the special image. You will typically also use the Java interface in your own code to make calls to Java methods, and define Lisp proxies that can be used inside Java, though in principle the whole interface may be done via direct calls from Java into Lisp, without using the Java interface explicitly.

The interface for Android includes the following:

- The function `deliver-to-android-project`, which is the function that you use to deliver LispWorks code for Android. The files delivered are a

dynamic library and a Lisp heap, which can then be loaded by and initialized by the Java `com.lispworks.Manager.init` method. By default it delivers the library and heap directly into the directory structure of an Android project.

- A JAR file containing a few classes in the `com.lispworks` package to support the Java/Lisp interface. This includes these classes:

`com.lispworks.Manager`

Defines the method `com.lispworks.Manager.init` to load and initialize LispWorks, error reporting interface and some basic utilities.

`com.lispworks.LispCalls`

Defines direct callers into Lisp, and support for Lisp proxies (which are Java proxies that call Lisp functions). `LispCalls` is really part of the general LispWorks Java Interface.

`com.lispworks.BugFormLogsList` and `com.lispworks.BugFormViewer`

Two activities to help display errors during development.

- A few Android-specific interface functions:

`android-funcall-in-main-thread`

`android-funcall-in-main-thread-list`

`android-get-current-activity`

`android-main-thread-p`

## 16.1 Delivering for Android

To use LispWorks in an Android project, the Android project needs three extra files:

### 1) `lispworks.jar`

This defines the support classes in the Java package `com.lispworks`. This file is part of the LispWorks distribution, and can be found in the `etc` directory in the LispWorks distribution:

```
(lispworks-file "etc/lispworks.jar")
```

You must add this file to your project. On Eclipse, it should be added to the build path, though you can also just copy it to the `libs` directory. On Android Studio 0.4.6 with the default configuration you can put it in `app/libs`.

2,3) A LispWorks heap and dynamic library. These two files are generated by `deliver-to-android-project`. Both have the same base name (default "LispWorks"). The library has "`lib`" before the base name and "`.so`" after it. The heap file name is the library name with the string "`.lwheap`" appended. The heap file needs to be in the "`assets`" sub-directory of the project, while the dynamic library needs to be in `armeabi-v7a` sub-directory of the jni libs directory of the project. For Eclipse, the jni libs directory is `libs` at the top level, and `assets` is at the top too, so the files are by default in:

```
assets/LispWorks.so.lwheap  
libs/armeabi-v7a/LispWorks.so
```

In Android Studio 0.4.6, the jni libs directory is `jnilibs`, and both it and the `assets` directory are in the "main" directory, so by default the files are in:

```
app/src/main/assets/LispWorks.so.lwheap  
app/src/main/jnilibs/armeabi-v7a/LispWorks.so
```

By default, `deliver-to-android-project` puts these files in these places, but note that on Eclipse if you have native libraries the default does not work. See full discussion in the entry for `deliver-to-android-project`.

The `lispworks.jar` file is required so that your Java IDE knows about classes in `com.lispworks`, so you need it while working on the Java code that interfaces with Lisp. The other two files are needed only when you actually build the project.

Once these three files are in place, the Android project can be built and installed like any Android project. To use LispWorks, the method `com.lispworks.Manager.init` must be called to initialize LispWorks. If *library-name* was passed to `deliver-to-android-project`, then `com.lispworks.Manager.init` must be called with a matching name, otherwise the default "LispWorks" is used. `com.lispworks.Manager.init` can be called at any point during the lifetime of the Android app.

`com.lispworks.Manager.init` is asynchronous, in other words by the time it returns Lisp is not ready yet. `com.lispworks.Manager.init` optionally

takes a `Runnable` argument, which is called when LispWorks is ready. Alternatively the method `com.lispworks.Manager.status` can be used to determine when LispWorks is ready. See the entry for `com.lispworks.Manager.init` for more details.

`com.lispworks.Manager.init` loads LispWorks and initializes it. Apart from standard initialization and starting multiprocessing, the startup function also initializes the Java interface using `init-java-interface`, passing it the appropriate arguments. That includes passing the keyword `:report-error-to-java-host`, which makes the function `report-error-to-java-host` invoke the user Java error reporters, and the keyword `:send-message-to-java-host` which makes the function `send-message-to-java-host` call the Java method `addMessage`. See Chapter 43, “Android Java classes and methods” for the details.

The startup functions also set up a global “last chance” internal debugger hook, which is invoked once the debugger actually gets called (after any hooks you set up like error handlers, debugger wrappers and `c1:*debugger-hook*`). The hook reports the error to the Java host (that is, invokes the user error reporters) and calls `c1:abort`. If you did not define a `c1:abort` restart, that will cause the current process to die, unless it is inside a call from Java, where it will cause this call to return. The return value is a zero of the correct type (see in “Direct calls” on page 206 and “Using proxies” on page 207).

Once initialization finished, if a function was passed to `deliver-to-android-project` as its *function* argument, it is invoked asynchronously, and then the `Runnable` which you passed to `com.lispworks.Manager.init` (if any) is invoked. From this point onwards, Lisp is ready to receive calls from Java, and can make calls into Java.

On Android when doing GUI operations it is essential to do them from the GUI thread, which is the main thread on Android. The functions `android-funcall-in-main-thread` and `android-funcall-in-main-thread-list` can be used to invoke a Lisp function on the main thread. To facilitate testing, these functions are also available on non-Android ports.

There is no proper debugger on Android itself, so it is important to ensure your code is working before delivering.

## 16.2 Directories on Android

On Android the temp directory that is used by default by `open-temp-file` and similar functions is the `cacheDir` of the application context. In principle the system can remove files from this directory when it needs disk space. The documentation for Android says that you should not rely too much on that, and avoid accumulating files in this directory.

LispWorks puts files with names starting with "lw" in this directory, so your code should avoid creating filenames starting with "lw".

`get-folder-path` can be used to find useful directories. `:appdata` for private directory, `:documents` for "user homedir" and `:common-appdata` for the external directory are the most useful keywords to pass. On Android `get-folder-path` can also be used to access the standard Android directories like the music and movies directories.

The function `cl:user-homedir-pathname` on Android returns the result of:

```
(sys:get-folder-path :documents)
```

## 16.3 The Othello demo for Android

The Othello demo is a simple Android app showing the basics of using LispWorks for Android Runtime. It is a full Android project that can be imported into an Android development environment, for example Eclipse with ADT and Android Studio.

The application plays the Othello game as an example of an application. When delivering "with Lisp" (see "Delivering LispWorks to the project" below), it also allows the user to type and evaluate Lisp forms. This is useful during development.

To try the demo, you need to do these steps:

1. Create an Android project containing the demo Android code.
2. Deliver the LispWorks application to it.
3. Build and install the application and run it.

These steps are described in detail in the following sections.

### 16.3.1 Creating an Android project

The Android project code is in `./OthelloDemo/`, which is the directory `examples/android/OthelloDemo` inside the LispWorks distribution. You need to make a project with this code.

The following sub-sections provide the detail for Eclipse and Android studio projects respectively.

#### 16.3.1.1 Othello project in Eclipse (with ADT)

This procedure was checked with ADT build: v22.6.2:

1. You need to have a workspace (corresponding to a directory), which may be completely empty.
2. Choose **File > Import** from the menubar to raise the **Import** dialog.
3. In the **Import** dialog expand **Android**, select **Existing Android Code Into Workspace** and click **Next**.
4. You should be in the **Import Projects** tab. Click **Browse....**
5. Navigate to the `examples/android/OthelloDemo` directory inside the LispWorks distribution directory, select it and press **Ok**.
6. Click **Select All** to ensure that the project is selected.
7. Select the **Copy projects into workspace** check button (below the list).
8. Click **Finish**.

The new project name defaults to "LispWorksRuntimeDemo", and this, relative to the workspace directory, is the project path that you will need to set the **\*project-path\*** to (below). You can change that before clicking **Finish**.

**Note:** if you get errors when trying to build, try:

1. Check that the Project build target is 3.0 or higher. Do: **Project > Preferences**, click **Android**, and it shows the list of targets available. Select the highest.
2. Try "cleaning": **Project > Clean**.

### 16.3.1.2 Othello project in Android studio

This procedure was checked with Android studio 0.4.6:

1. Inside Android studio, select **Import project...** either from the **Welcome to Android studio** dialog or from the **File** menu. That raises the **Select Gradle Project Import** dialog.
2. In the **Select Gradle Project Import** dialog, select the `examples/android/OthelloDemo` directory in the LispWorks distribution and press **OK**. That should raise a dialog called **Import Project from ADT (Eclipse Android)**.
3. Select a directory to put the project in and press **OK**. This is the "project path" that you will need to set the `*project-path*` variable to (below).
4. Leave all the default settings in the next page and press **Finish**.

### 16.3.2 Delivering LispWorks to the project

To deliver LispWorks, copy one of the build script files `deliver-android-othello.lisp` or `deliver-android-othello-with-lisp.lisp` from the `examples/android` directory in the LispWorks distribution. In the copied file change the value of the variable `*project-path*` to point to the directory of the project that you created above. For example:

```
(defvar *project-path* "~/my-workspace/LispWorksRuntimeDemo/")
```

You will then use your edited copy of the build script as the `-build` command line argument to LispWorks.

The Android delivery image is called `lispworks-7-1-0-arm-linux-android`. This must be run on an ARM architecture, currently that means ARM Linux or an emulator. To run this image under the QEMU emulator, use the script `examples/android/run-lw-android.sh`.

```
run-lw-android.sh -build /path/to/deliver-android-othello.lisp
```

See `deliver-to-android-project` for details.

If you cannot access the directories that you use in your project from the ARM machine:

1. Change \*project-path\* to some temporary directory, and add :no-sub-dir t to the call to `deliver-to-android-project`. For example, if you use `deliver-android-othello.lisp`, the call should be:

```
(deliver-to-android-project nil *project-path* 5 :no-sub-dir t)
```

This will create two files in the temporary directory called `libLisp-Works.so` and `LispWorks.so.lheap`.

2. Copy `libLispWorks.so` to the directory `libs/armeabi-v7a` inside your project, and copy `LispWorks.so.lheap` to the `assets` directory inside your project (assuming you are using Eclipse/ADT).

The two deliver scripts, `deliver-android-othello.lisp` ("without Lisp") and `deliver-android-othello-with-lisp.lisp` ("with Lisp") differ in what the application contains. The "with Lisp" script keeps a lot of Lisp in the application, and hence allows evaluation of Lisp forms when running on Android. The "without Lisp" script delivers at the maximum delivery level, and hence cannot evaluate forms. As a result the runtime image is much smaller.

### 16.3.3 Running the application

Once you have the project with the LispWorks files, you can build, install it on the device and run it as any other Android project. When it runs, It first shows a splash screen (the LispWorks splash screen image) and then the first screen displays an Othello board, where you can play against the computer (you play black), by touching the square where you want to add your piece.

The display has two elements in addition to the board:

- A small text view which displays the status of the game, and
- A checkbox **Computer Plays**, which controls whether the computer plays. When the computer does not play, the board is set for two players.

It also has a menu (which maybe partly displayed on the action bar), with these items:

**Restart**      Restart the game.

- Undo** Undo the last move. You can undo repeatedly to the beginning of the game.  
When the computer plays, each undo undoes to the state before your last move.  
When the computer does not play, it undoes one move.

When delivering "with Lisp" the menu also has these items:

- Lisp Panel** Takes you to the Lisp Panel screen, which allows you to evaluate Lisp forms. See below in the description of the Lisp Panel.

#### Command history

Takes you a list of the forms that that you evaluated. It is initialized by a few demo forms. See below about the **History** list.

- Othello Server** Raises a submenu with three items: **Java server, full proxy** and **lazy proxy**. Switching between these changes the mechanism by which Java calls into Lisp. The behavior of the game is exactly the same, only the output to the **Lisp Panel** or **Output** is different. This feature is for demonstrating different techniques of calling from Java to Lisp. See discussion of the code for details.

When delivering "without Lisp" the menu also has these items:

- Output** Takes you to the "output" screen.

#### 16.3.3.1 The Lisp Panel screen

The Lisp Panel contains a row of buttons, a text view for input, and the bottom is a text view for output. This screen is available only when delivering "with Lisp". When delivering "without Lisp", there is the Output screen instead.

The buttons are:

- Clear** Clears all the output from the output pane.

#### Evaluate the string

Send the current text in the input pane to Lisp by a direct call to `eval-for-android`.

`eval-for-android` is defined in (`example-edit-file "android/android-othello-user"`). It reads the string and evaluates it. If it is successful, it prints to the output pane the form, anything the form printed, and the result(s). If there is an error, it logs the error and prints the error message to the output pane.

<b>History</b>	Takes you to another screen which displays a list of the forms that were evaluated. The list is initialized by some forms which demonstrate some features of the multiprocessing on Android. See below in the section “Prepared forms”. Whenever you evaluate a form by pressing <b>Evaluate the string</b> , it adds the form to the history in the beginning of it. If the form matches exactly a form which is already in the list, the old item is removed.  In the history list, when you touch an item it is inserted into the input pane, and the application switches to the Lisp Panel. It does not evaluate the form at that point.  You can also reach the history list from the menu in the Othello screen.
<b>Bug form logs</b>	Invokes <code>com.lispworks.Manager.showBugFormLogs</code> . This shows another screen with a list of the logged errors displaying the error string for each item. Touching an item opens another screen with bug form log of this error.
<b>Clear logs</b>	Clears all the bug form logs, including removing the files.

The input pane below the buttons is just a passive text view, in which you can type Lisp forms, and evaluate by touching the **Evaluate the string** button.

The bottom part of the Lisp Panel, in the Output screen when delivering “without Lisp”, is the output pane. It prints the output of evaluation as above. It also prints whenever you touch a square in the Othello board. When the Full or Lazy proxy is used for communication, it also prints this fact.

### 16.3.3.2 Prepared forms

Initially, the **History** list contains the forms described below. When using forms, note that evaluating a form moves it to the top of the list. When you should evaluate more than one of these forms in order, you will need to look down the list for each one in turn.

The idea is that you can try these forms, and then modify them to check and perform things that you need to do when debugging your application.

Forms:

1.

```
(mp:ps)
```

Shows the Lisp processes. Initially there are at least the idle process and the GUI process which displays as "created by foreign code".

2.

```
(setq *computer-plays-waste-time-in-seconds* 2)
```

That causes the computer to pretend that it takes time to compute a move. When playing against the computer after setting this, you will see that after your move, the display says "Computer to play" for two seconds before it actually plays. Set **\*computer-plays-waste-time-in-seconds\*** back to **nil** to make it behave normally.

3.

```
(defun eval-and-print (form)
  (let ((res (eval form)))
    (lw-ji:send-message-to-java-host
      (princ-to-string res) :reset)))
```

Defines a function to be used by the next two forms. Note that it uses **send-message-to-java-host** to print, which comes in the output and works on any thread. When it is on the current thread it will end up printing before the printing of the evaluation, but on another thread it is random which output comes first.

4.

```
(eval-and-print '(mp:get-current-process))
```

Use the function defined above to print the process in the current thread. That is the GUI process.

5.

```
(mp:funcall-async 'eval-and-print '(mp:get-current-process))
```

Use the function `eval-and-print` defined above to print the process on which `funcall-async` executes the function. This will be one of the Background Execute processes.

6.

```
(progn
  (defun loop-executing-events ()
    (loop
      (let ((event (mp:process-wait-for-event)))
        (lw-ji:format-to-java-host "~%got event ~s" event)
        (let ((res (mp:general-handle-event event)))
          (lw-ji:format-to-java-host
            "~%Handling got ~s" res))))
    (setq loop-executing-events-process
      (mp:process-run-function "Loop Execute Events" ()
        'loop-executing-events)))
```

Create a process called "Loop Execute Events" and set `loop-executing-events-process` to it. The process has a process function `loop-executing-events` which read events and handles them using `process-wait-for-event` and `format-to-java-host`. It prints "got event <event>" and then "handling got <result of handling>". Note the usage of `format-to-java-host`, which prints to the output pane too (it actually calls `send-message-to-java-host`).

7.

```
(mp:process-send loop-executing-events-process '(mp:get-current-process))
```

Sends to the "Loop Execute Events" process (that started in the previous step) an event, which cause `get-current-process` to be called, and hence return the process. You should see "got event (MP:GET-CURRENT-PROCESS)" and "Handling got <process name>"

8.

```
(othello-user-change-a-square 5 2)
```

Changes square 5 (sixth from the left in the top row) to color 2 (black). This function is defined in (`example-edit-file "android/android-othello-user"`) and is part of the "interface" that the Lisp Othello code uses to tell Java to change the board.

**9.**

```
(mp:process-run-function
  "multiplier" ()
  #'(lambda()
      (setq *finish-multiply* nil)
      (dotimes (x 100)
        (sleep 1)
        (when *finish-multiply* (return))
        (lw-ji:format-to-java-host
          \"~%~d * ~d = ~d\"
          x x (* x x)))))
```

Starts a process that performs "a lengthy computation" (simulated by using `(sleep 1)`) and prints results while doing it. In each "step in the computation" (the `cl:dotimes` iteration) it prints the square of the iteration number. To stop it, evaluate the next form.

**10.**

```
(setq *finish-multiply* t)
```

Tell the "multiplier" process (see above) to stop.

**11.**

```
(mp:process-run-function
  "Error"
  () #'(lambda () (open "junk;;file::name")))
```

Starts another process that gets an error (because the argument to `cl:open` is an illegal pathname). It prints that it got the error, and you can use the **Bug form logs** button to look at the bug form log.

**12.**

```
(raise-alert-dialog
  "What do you want to eat?" +
:ok-title "Chicken"
:ok-callback '(raise-alert-dialog "Here is some chicken") +
:cancel-title "Salad"
:cancel-callback '(raise-alert-dialog "We do not have salad"))
```

Raises an alert dialog using `raise-alert-dialog` which is defined in `dialog.lisp`. Note that this works because the `LispPanel` class uses `com.lispworks.Manager.setCurrentActivity` to set the current activity.

### 13.

```
(raise-a-toast "Bla Bla Bla" :gravity :left)
```

Raises an Android "toast" at the middle of the left side, using `raise-a-toast` which is defined in `toast.lisp`.

#### 16.3.4 Lisp interface usage in the Java code

The Othello Demo Java code is in the package `com.lispworks.example.othellodemo`. LispWorks interfaces in Java are all in the package `com.lispworks`. The methods appear in full, to make it is easy to see where there is a call to the LispWorks interface.

##### 16.3.4.1 Class Othello

`Othello` is a subclass of `Activity` that displays the screen with the Othello board. The display is all in standard Java. The board is made of a grid of 64 `ImageView` panes, each one displaying one of three images (blank, white, black). Each view has an `OnClickListener` (`SquareListener`) that remembers its index and passes it when clicked.

The Java code does not know anything about the game that is being played, and does not keep a record of the state of the game. That is all done in Lisp.

The Java code processes user gestures concerning the game (touching the board, and touching any of the buttons and items `Computer plays`, `undo move`, `restart`) by calling methods on an object that implements the nested interface `OthelloServer`, which is kept in `mOthelloServer`. The object can be either a Lisp proxy, or of the nested class `JavaOthelloServer`. All of these objects do exactly the same thing (calling the Lisp functions defined in `(example-edit-file "misc/othello")`), and the purpose of having all these options is to demonstrate different techniques to call into Lisp. There is also a nested class `ErrorOthelloServer` in case LispWorks does not work, which displays the error. `mOthelloServer` is set by the method `setupServer`.

The nested class `JavaOthelloServer` is plain Java with methods that call into Lisp using the “Direct calls” interface (`com.lispworks.LispCalls.callIntv` and `com.lispworks.LispCalls.callVoidv`). This has the advantage that on the Lisp side all you have to do is to ensure that the functions are not shaken, which you can do with `hcl:deliver-keep-symbols` (see the *Lisp-Works Delivery User Guide*). It has the disadvantage that you hardwire Lisp function names in Java (though the names can be variables too).

The other two possible implementations of the `OthelloServer` are Lisp proxies which are defined in Lisp (in `examples/android/android-othello-user.lisp`). See the discussion of the Lisp code for more details. The code in `setupServer` demonstrates two techniques of using the proxy definitions: either calling a Lisp function that makes a proxy (using `com.lisp-works.LispCalls.callObjectv` to call `create-lisp-othello-server`), or using `com.lispworks.LispCalls.createLispProxy` with the name of the proxy definition (`lisp-othello-server-lazy`) to create a proxy.

To actually respond to moves, the `othello` class exports 3 methods (“`updateState`”, “`signalBadMove`” and “`change`”) which are called directly from Lisp to change the board and the status text.

When an `othello` instance is created, it calls `setupAndInit` to do anything with Lisp (mainly call `mOthelloServer.init`). Before doing anything that may interact with Lisp, it checks the status of Lisp using `com.lisp-works.Manager.status`. If Lisp is not ready and there was no error, it calls `com.lispworks.Manager.init` to initialize LispWorks, passing it a `Runnable` that with call `setupAndInit` again to actually do the initialization. In the Demo the Lisp side will already be initialized, because it is done by the `Lisp-WorksRuntimeDemo` activity, but the `othello` class avoids relying on it.

When LispWorks is ready, `setupAndInit` sets up the server by calling `setUpServer` and initializes the game by calling `mOthelloServer.init`.

If there is an error, `setupAndInit` gets the error details using `com.lisp-works.Manager.mInitErrorString`, and `com.lispworks.Manager.init_result_code` and adds a message, set `mOthelloServer` to `ErrorOthelloServer`, and then shows the Lisp Panel which will be displaying the error.

There is also an `onCreateOptionsMenu` method which checks whether Lisp is working and can evaluate forms (using `LispPanel.canEvaluate`), and accordingly decides which menu to use.

#### 16.3.4.2 Class LispPanel

`LispPanel` is a subclass of `Activity` that displays the Lisp panel, or just the output when delivering "without Lisp" (see "Delivering LispWorks to the project" on page 229).

The main purpose of the Lisp Panel is to evaluate Lisp forms, which it does by calling the Lisp function `eval-for-android` using `com.lispworks.LispCalls.callIntv`. That can work only if `eval-for-android` is defined, so `LispPanel` has a method `canEvaluate` that works by checking if `eval-for-android` is defined using `com.lispworks.LispCalls.checkLispSymbol`. If `eval-for-android` is fbound, `LispPanel` displays in full, otherwise it shows only output `TextView`.

`LispPanel` is also responsible for displaying messages in its output `TextView`. To achieve that, it uses `com.lispworks.Manager.setTextView`. Once it sets the `TextView`, all calls to `com.lispworks.Manager.addMessage` and calls to the Lisp functions `send-message-to-java-host` and `format-to-java-host` put their output in this `TextView`.

Other usage of the `com.lispworks` package in `LispPanel` are:

- `com.lispworks.Manager.setErrorReporter` to set an error reporter. Since the Lisp application does not set `cl:*debugger-hook*`, uncaught errors will end up calling this reporter.
- Calls to `com.lispworks.Manager.showBugFormLogs` to show bug form logs, and `com.lispworks.Manager.clearBugFormLogs` to clear them.
- Calls to `com.lispworks.Manager.setCurrentActivity` in `onResume` and `onPause` to allow Lisp code to raise dialogs when `LispPanel` is visible. This is needed to allow the `raise-alert-dialog` form to work.

#### 16.3.4.3 Class MyApplication

`MyApplication` is not actually used in the demo. It is a demonstration of how to initialize LispWorks when the application starts, by calling `com.lisp-`

`works.Manager.init` in the `onCreate` of the application. The demo itself does not use this mechanism. Instead the `SplashScreen` activity does it, and the `Othello` activity also checks using `com.lispworks.Manager.status`, and if LispWorks needs initializing does it.

#### 16.3.4.4 Class LispWorksRuntimeDemo

Display a splash screen and initialize the Lisp side, by checking `com.lispworks.Manager.status` and using `com.lispworks.Manager.init` if needed. The purpose of this class is just to give an example of displaying a splash screen while initializing Lisp. It is not really needed, because the `Othello` class checks too (in `setupAndInit`). On Eclipse the name of this class is the default project name.

#### 16.3.4.5 Class History

A simple class to display Lisp forms. Does not do anything related to Lisp.

#### 16.3.4.6 Class SquareLayout

A simple class to make a square layout for displaying the `Othello` board. Does not do anything related to Lisp.

### 16.3.5 Java and Android interface in the Lisp code

The file

```
(example-edit-file "misc/othello")
```

is a generic implementation of the playing Othello part, and has nothing to do with Java or Android.

The Lisp code that interacts with Java and Android to play Othello and evaluate the forms is in

```
(example-edit-file "android/android-othello-user")
```

The Java callers to update the game are defined by a `define-java-caller` form. All these methods need to be called on the GUI thread (because they interact with GUI elements), so the actual functions that are called from the

Othello code are defined to call the Java callers using `android-funcall-in-main-thread`.

The function `eval-for-android` is what the Java code uses to evaluate Lisp forms. The function has no Java-specific features, but it has error handling and binding of some of the top-level variables like `c1:*` to make it more usable in repeated calls from "outside".

The code also defines two proxy definitions that implement the `othello.OthelloServer` interface which responds to user gestures. To demonstrate the various features of proxies, there are two definitions which achieve exactly the same thing. The full proxy definition (`lisp-othello-server-full`) specifies functions for all the methods that the interface defines. The lazy (programmer) proxy definition does not define any method. Instead it has a default function that decides what to do based on the method name.

The two files

```
(example-edit-file "android/dialog")
```

and

```
(example-edit-file "android/toast")
```

define the functions `raise-alert-dialog` and `raise-a-toast` respectively, to demonstrate using Android code directly from Lisp. See the comments in these files.

# 17

---

## iOS interface

To build an application using LispWorks for iOS Runtime, you need an Xcode project to implement the main function of the application. CAPI is not currently supported on iOS, so any GUI part will need to be written in Objective-C using Xcode too.

### 17.1 Delivering for iOS

The Lisp part of the application needs to be delivered using one of four special images:

- `lispworks-7-1-0-x86-darwin-ios` and `lispworks-7-0-0-amd64-darwin-ios` which build runtimes for the iOS Simulator, 32-bit and 64-bit, running on Mac OS X, or
- `lispworks-7-1-0-arm-linux-ios` and `lispworks-7-0-0-arm64-linux-ios` which build runtimes for the real iOS device, 32-bit and 64-bit. To do this, you run the QEMU emulator on Mac OS X and tell it to run the `lispworks-7-1-0-arm-linux-ios` or `lispworks-7-0-0-arm64-linux-ios` image.

There is an example script `examples/ios/run-lw-ios.sh` which can be used to invoke all of these images in sequence with the same command line arguments.

These images do not contain the GUI part of LispWorks, but do contain all the non-GUI parts.

There are no iOS-specific Lisp functions required to build the Lisp part of an application: you use `deliver` in the normal way. The only difference compared to a desktop application is that the *file* passed to `deliver` should have a ".o" extension and the generated file will be an iOS object file that must be linked with the other parts of the application using Xcode. Generation of shared libraries is not supported (this is a limitation of iOS).

To include the delivered object file in an Xcode project, add the file to the project using the **File > Add files to <project>...** menu item. Xcode should detect this as a file of type "Object Code".

If you want to run the same Xcode project with both the iOS Simulator and a real device or build for 32-bit and 64-bit devices then you can conditionalize the filename passed to `deliver` to create four different files. For example,

```
(deliver 'init-othello-server
         (merge-pathnames
           (format nil "OthelloDemo/OthelloServer-~A.o"
                  #+arm "armv7"
                  #+arm64 "arm64")
                  #+x86 "i386")
                  #+x86-64 "x86_64")
         *project-path*)
0
:keep-symbols '(othello-server))
```

Then add `OthelloServer-armv7.o`, `OthelloServer-arm64.o`, `OthelloServer-i386.o` and `OthelloServer-x86_64.o` to the Xcode project. Building the project will result in warnings such as

```
ld: warning: ignoring file
/Users/developer/Documents/OthelloDemo/OthelloDemo/OthelloServer-
armv7.o, file
was built for armv7 which is not the architecture being linked
(i386):
/Users/developer/Documents/OthelloDemo/OthelloDemo/OthelloServer-
armv7.o
```

These warnings can be ignored.

## 17.2 Initializing LispWorks

In order to use Lisp code within an application built using Xcode, the main function of the application must call `LispWorksInitialize`. For example, `main` might be implemented like this:

```
#import "LispWorks.h"

int main(int argc, char *argv[])
{
    if (!LispWorksInitialize(argc, argv)) abort();

    @autoreleasepool {
        return UIApplicationMain(argc, argv, nil,
        NSStringFromClass([OthelloAppDelegate class]));
    }
}
```

`LispWorksInitialize` is automatically included in the object file generated by `deliver`. The file `LispWorks.h` can be found in the `examples/ios/OthelloDemo/OthelloDemo/` directory of the LispWorks installation and should be copied into the Xcode project.

## 17.3 Using Objective-C from Lisp

LispWorks calls the function `objc:ensure-objc-initialized` when it starts the iOS runtime, so there is no need for you to call it.

For other details, see the *LispWorks Objective-C and Cocoa Interface User Guide and Reference Manual*.

## 17.4 Limitations of the iOS Runtime

There are some limitations that iOS imposes that affect the LispWorks for iOS Runtime.

- Compiled code cannot be generated, so `c1:compile` cannot be called at run time.
- Shared libraries cannot be loaded dynamically, so `fli:register-module` cannot be used. Instead, add references to any required frameworks in the Xcode project.

## 17.5 The Othello demo for iOS

The Othello demo is a simple iOS app showing the basics of using LispWorks for iOS Runtime. It contains an Xcode project to run the GUI and some Lisp source code to play the game.

To try the demonstration, see the file

```
(example-edit-file "ios/README.txt")
```

### 17.5.1 Notes about the Xcode project

The Xcode project in `examples/ios/OthelloDemo/` has a standard layout, with the class `OthelloAppDelegate` defined in

```
(example-edit-file "ios/OthelloDemo/OthelloDemo/
OthelloAppDelegate.m")
```

implementing the `UIApplicationDelegate` protocol.

The file

```
(example-edit-file "ios/OthelloDemo/OthelloDemo/main.m")
```

initializes LispWorks by calling `LispWorksInitialize` and then runs the application main loop using the `OthelloAppDelegate`.

The application has two storyboards (`MainStoryboard_iPhone` and `MainStoryboard_iPad`) which display a Tab Bar allowing you to switch between an Othello game and a Lisp evaluation pane.

### 17.5.2 The Othello game

The Othello game is displayed by the `Othello` scene and contains an Othello board (the `boardView` outlet), a few buttons on a toolbar and a label showing the state of the game (the `stateView` outlet).

The scene is controlled by the class `OthelloViewController`, defined in

```
(example-edit-file "ios/OthelloDemo/OthelloDemo/
OthelloViewController.m")
```

The 64 tiles on the board are represented by `UIImageView` objects, created dynamically in the `viewDidLoad` method. The contents of the tiles are the

images "empty", "white" and "black" which are loaded from the `Images.xcassets` asset catalog. The `viewDidLoad` method also creates an instance of the class `OthelloServer`, which is implemented in Lisp (see "Notes about the Lisp code" on page 246).

The tiles in the board are dynamically positioned by the `viewDidLayoutSubviews` method.

The action methods `restartOthello:` and `undoMove:` are connected to the toolbar buttons in the storyboards and call into the Lisp code to update the game.

The action method `playUISquare:` is triggered when the user touches a square on the board (see `viewDidLoad`) and calls into the Lisp code to play that square.

The methods `changeOthelloSquare:, updateStateString:` and `signalBadMove` are called by the Lisp code to modify the GUI.

### 17.5.3 The Lisp evaluation pane

The Lisp evaluation pane is displayed by the `Lisp Panel` scene and contains a text field for entering a Lisp form (the `formInputView` outlet), a text field to display the evaluation results (the `textOutputView` outlet) and toolbar.

The scene is controlled by the class `LispPanelViewController`, defined in

```
(example-edit-file "ios/OthelloDemo/OthelloDemo/
LispPanelViewController.m")
```

The action methods `evaluate:, clearTextOutput:` and `showHistory:` are connected to the toolbar buttons in the storyboards.

The **History** button pops up a history of the forms entered so far. This is displayed by the `History Table` scene controlled by `HistoryTableViewController`, defined in

```
(example-edit-file "ios/OthelloDemo/OthelloDemo/
HistoryTableViewController.m")
```

and communicates back to the `LispPanelViewController` using the `HistoryTableViewControllerDelegate` protocol.

The `keyboardWasShown:` and `keyboardWillBeHidden:` notification methods resize the `textOutputView` to avoid the on-screen keyboard.

The method `appendTextOutputString:` is called by Lisp code to update the `textOutputView`.

#### 17.5.4 Notes about the Lisp code

The Lisp code triggered by the GUI is in the file

```
(example-edit-file "ios/ios-othello-user")
```

and uses the shared Othello logic in

```
(example-edit-file "misc/othello")
```

The function `init-othello-server` is the main entry point of the Lisp code and is called when `LispWorksInitialize` is called from `main.m`. It initializes the LispWorks Objective-C interface and creates a helper object (`lispworks-main-threads-funcalls-object`) used by `invoke-in-main-thread` for making Lisp calls in the main thread of the application.

The Lisp code implements an Objective-C class `othelloServer` using the Lisp class `othello-server`. This class implements the methods `initWithViewController` for initialization and `initOthello`, `playSquare:` and `undoMove` for the Othello game GUI code to call into Lisp in response to user gestures.

The Lisp code also implements the functions `othello-user-change-a-square`, `othello-user-update-state-string`, `othello-user-signal-bad-move` and `othello-user-print-diagnostics-message` which the shared Othello logic calls to update the GUI. Most of these functions call methods on the `OthelloViewController` object, taking care to invoke them in the main (GUI) thread of the application. This thread switching is needed because the Othello logic plays the game in a background thread to avoid hanging the GUI while considering its move (see `perform-computer-play` in `examples/misc/othello.lisp`).

Finally, the Lisp code implements an Objective-C class `LispPanelServer` using the Lisp class `lisp-panel-server`, with a method `evaluate:` to evaluate a Lisp form. This `evaluate:` method is called by the `evaluate:` action method in `LispPanelViewController`.

## 17.6 The Mobile GC

The Mobile GC is a 64-bit GC that is written to run on 64-bit iOS (we are also considering using it for 64-bit Android). When LispWorks is delivered for 64-bit iOS, the "saved image" (the code in the object file that delivery creates) switches automatically to use the Mobile GC. Thus normally you do not need to know anything about the Mobile GC, and if your application has moderate memory requirements (a few tens of megabytes of live allocation at run time), then there is a good chance that you do not need to do anything about memory management.

However, it is useful in general to create a log file of the activity of the application (at least during development), and to include the output of periodic calls to `(room)` or `(room n11)` in this log, which will give you some idea of the memory behavior of your application. In particular, if the "Total allocated" that is reported in the last line of `(room)` (which is the only line in `(room n11)`) approaches 100 MB then you may want to look at memory management. Note that is only for a mobile device: Desktop applications can grow much larger without a problem.

The main problem that you may encounter in the Mobile GC are GCs of generation 2 causing noticeable delays (on the order of 1 second, depending on the size of the application and the hardware). Depending on the application, such delays may or may not be an issue, but for most GUI applications you should ensure they do not happen too frequently. In this situation you should consult "Preventing/reducing GC of generation 2" on page 159.

You may also consider implementing a response to low memory warning from the OS. All applications can benefit a little by calling `reduce-memory` with `n11` or `0` or `1` at that point, but for most applications the benefit is minimal. If most of the live memory in your application contains caches that can be freed and recreated again without much loss in performance, you may be able to get significant improvement by implementing a low memory warning response that clears the caches. Consult "Response to low memory" on page 158 for details.

The output of `room` and the results of related functions are different when the Mobile GC is used. If you want to understand this output better, consult "Mobile GC technical details" on page 154.



# 18

---

# The Metaobject Protocol

LispWorks CLOS essentially supports the metaobject protocol described in chapters 5 & 6 of *The Art of the Metaobject Protocol* (Kiczales, des Rivières & Bobrow, The MIT Press, 1991). Throughout the LispWorks documentation, “AMOP” refers to this book. The relevant chapters are available in the LispWorks IDE via the menu command **Help > Manuals > CLOS Metaobject Protocol**.

All the LispWorks MOP symbols are in the `clos` package.

There are some discrepancies between LispWorks and AMOP, which are described in this chapter, which also describes some common problems encountered by programmers using the MOP.

## 18.1 Metaobject features incompatible with AMOP

### 18.1.1 Instance Structure Protocol

The generic functions implementing slot access are like those described in AMOP, except that each takes a *slot-name* argument rather than a slot definition object, and the primary methods are therefore specialized differently.

For details, see `slot-boundp-using-class`, `slot-value-using-class` and `slot-makunbound-using-class`.

**Note:** by default, standard slot accessors are optimized to not call `slot-value-using-class`. This can be overridden with the `:optimize-slot-access` class option. See the second definition of `virtual-metaclass` below for an example of the use of this.

`standard-instance-access` is not supported as defined in AMOP. Note that there is an internal function of the same name, but this is not optimal. Also, `funcallable-standard-instance-access` is not supported. An alternative for fast instance access is to use the `:optimize-slot-access` class option.

### 18.1.2 Method Metaobjects

`standard-reader-method`, `standard-accessor-method` and `standard-writer-method` all have a required `:slot-name` initarg, rather than a `:slot-definition` initarg as specified in AMOP.

**Compatibility note:** in LispWorks 4.3 and previous versions, `accessor-method-slot-definition` was not implemented. This is implemented in the current version.

### 18.1.3 Method Lambdas

LispWorks `make-method-lambda` is not AMOP-compatible. It takes separate `lambda-list` and `body` arguments, and the returned `lambda` form is different to that specified in AMOP (see “Method Functions” on page 250 below).

LispWorks does not support user defined methods for the generic function `make-method-lambda`.

### 18.1.4 Method Functions

LispWorks method functions take the same arguments as the method itself, whereas in AMOP they take a list of arguments and a list of next methods.

### 18.1.5 EQL specializers

`eql-specializer`, `eql-specializer-object` and `intern-eql-specializer` are not implemented.

`eql` specializers in LispWorks are lists.

### 18.1.6 Generic Function Invocation Protocol

`compute-applicable-methods-using-classes` is not implemented.

`compute-discriminating-function` is implemented and returns the discriminator but:

- It does not use `compute-applicable-methods-using-classes` since LispWorks does not have that function.
- It does not call `compute-applicable-methods`.

Moreover `add-method` does not call `compute-discriminating-function` because this would be inefficient when doing multiple calls to `add-method`. Instead, `compute-discriminating-function` is called when the generic function is called.

### 18.1.7 Method combinations

`method-combination` objects do not contain the arguments, merely the type. There is a single `method-combination` object per type.

Therefore the value returned by `generic-function-method-combination`, and the default value of the `:method-combination` initarg, and the `:method-combination` argument processed by `ensure-generic-function-using-class` are specific only to the type of the method combination.

Also, `find-method-combination` is not implemented.

### 18.1.8 Compatible metaclasses

The AMOP defines that the standard primary method for `validate-superclass` should return true if the class of one of the arguments is `standard-class` and the class of the other is `funcallable-standard-class`.

In LispWorks, objects of these metaclasses are not completely compatible, so `validate-superclass` will return false in these cases.

Beware that defining a class that mixes `standard-class` and `funcallable-standard-class` can lead to inconsistencies with the predicate `functionp`, the type `function` and the class `function`.

### 18.1.9 Inheritance Structure of Metaobject Classes

`funcallable-standard-object` is implemented as defined in AMOP, except that its class precedence list has direct superclasses

`(function standard-object)`

rather than

`(standard-object function)`

so that LispWorks is compliant with the ANSI Common Lisp rules.

For details, see `funcallable-standard-object`, page 494.

## 18.2 Metaobject features additional to AMOP

### 18.2.1 Computing the effective method function

The generic function `compute-effective-method-function-from-classes` is called by LispWorks to compute the effective method function. You can add methods to implement non-standard behavior for your own classes of generic functions.

## 18.3 Common problems when using the MOP

### 18.3.1 Inheritance across metaclasses

Usually an inherited class is of the same metaclass as the parent class.

For other kinds of inheritance, you need to define a method on `validate-superclass` which returns true when called with the respective metaclasses. For example:

```
(defclass mclass-1 (standard-class)
  ())

(defclass mclass-2 (standard-class)
  ())

(defclass a ()
  ()
  (:metaclass mclass-1))

(defmethod validate-superclass
  ((class mclass-2)
   (superclass mclass-1))
  t)

(defclass b (a)
  ()
  (:metaclass mclass-2))
```

Without the `validate-superclass` method, the last form signals an error because `mclass-1` is an invalid superclass of `mclass-2`.

### 18.3.2 Accessors not using structure instance protocol

By default, `defclass` creates optimized standard accessors which do not call `slot-value-using-class`.

This optimization is controlled by the `defclass` option `:optimize-slot-access`, which defaults to `t`.

There is an illustration of this effect of `:optimize-slot-access` in the example below.

### 18.3.3 The MOP in delivered images

Issues with MOP code that occur only in delivered LispWorks images are documented in the section “Delivery and the MOP” in the *LispWorks Delivery User Guide*.

## 18.4 Implementation of virtual slots

This is an implementation of virtual slots with readers, writers and which also allow access by `slot-value`.

```

;; ----- Virtual Slots -----
(in-package "CL-USER")

;; Metaclass of objects that might contain virtual slots.

(defclass virtual-metaclass (standard-class)
  ()
  )

;; Mixin metaclass for virtual slots and methods to make them
;; appear virtual.

(defclass virtual-slot-definition
  (standard-slot-definition)
  ((function :initarg :function
             :accessor virtual-slot-definition-function)))
  )

(defmethod slot-definition-allocation
  ((slotd virtual-slot-definition))
  :virtual)

(defmethod (setf slot-definition-allocation)
  (allocation (slotd virtual-slot-definition))
  (unless (eq allocation :virtual)
    (error "Cannot change the allocation of a ~S"
          'virtual-direct-slot-definition))
  allocation)

;; Class of direct virtual slots and methods to construct them
;; when appropriate.

(defclass virtual-direct-slot-definition
  (standard-direct-slot-definition
   virtual-slot-definition)
  ()
  )

;; Called when the class is being made, to choose the metaclass of
;; a given direct slot. It should return the class of slot
;; definition required.

(defmethod clos:direct-slot-definition-class
  ((class virtual-metaclass) &rest initargs)
  ;; Use virtual-direct-slot-definition if appropriate.
  (if (eq (getf initargs :allocation) :virtual)
      (find-class 'virtual-direct-slot-definition)

```

```

        (call-next-method)))

;; Called when the defclass is expanded, to process a slot option.
;; It should return the new list of slot options, based on
;; already-processed-options.

(defmethod clos:process-a-slot-option
    ((class virtual-metaclass) option value
     already-processed-options slot)
  ;; Handle the :function option by adding it to the
  ;; list of processed options.
  (if (eq option :function)
      (list* :function value already-processed-options)
      (call-next-method)))

;; Class of effective virtual slots and methods to construct
;; them when appropriate.

(defclass virtual-effective-slot-definition
    (standard-effective-slot-definition
     virtual-slot-definition)
  ()
  )

;; Called when the class is being finalized, to choose the
;; metaclass of a given effective slot.  It should return the
;; class of slot definition required.

(defmethod clos:effective-slot-definition-class
    ((class virtual-metaclass) &rest initargs)
  ;; Use virtual-effective-slot-definition if appropriate.
  (let ((slot-initargs (getf initargs :initargs)))
    (if (member :virtual-slot slot-initargs)
        (find-class 'virtual-effective-slot-definition)
        (call-next-method)))

(defmethod clos:compute-effective-slot-definition
    ((class virtual-metaclass)
     name
     direct-slot-definitions)
  ;; Copy the function into the effective slot definition
  ;; if appropriate.
  (let ((effective-slotted (call-next-method)))
    (dolist (slotted direct-slot-definitions)
      (when (typep slotted 'virtual-slot-definition)
        (setf (virtual-slot-definition-function effective-slotted)

```

```

(virtual-slot-definition-function slotd))
  (return)))
effective-slotd))

;; Underlying access methods for invoking
;; virtual-slot-definition-function.

(defmethod clos:slot-value-using-class
  ((class virtual-metaclass) object slot-name)
  (let ((slotd (find slot-name (class-slots class)
                      :key 'slot-definition-name)))
    (if (typep slotd 'virtual-slot-definition)
        (funcall (virtual-slot-definition-function slotd)
                 :get
                 object)
        (call-next-method)))))

(defmethod (setf clos:slot-value-using-class)
  (value (class virtual-metaclass) object slot-name)
  (format t "~% setf slot : ~A" slot-name)
  (let ((slotd (find slot-name (class-slots class)
                      :key 'slot-definition-name)))
    (if (typep slotd 'virtual-slot-definition)
        (funcall (virtual-slot-definition-function slotd)
                 :set
                 object
                 value)
        (call-next-method)))))

(defmethod clos:slot-boundp-using-class
  ((class virtual-metaclass) object slot-name)
  (let ((slotd (find slot-name (class-slots class)
                      :key 'slot-definition-name)))
    (if (typep slotd 'virtual-slot-definition)
        (funcall (virtual-slot-definition-function slotd)
                 :is-set
                 object)
        (call-next-method)))))

(defmethod clos:slot-makunbound-using-class
  ((class virtual-metaclass) object slot-name)
  (let ((slotd (find slot-name (class-slots class)
                      :key 'slot-definition-name)))
    (if (typep slotd 'virtual-slot-definition)
        (funcall (virtual-slot-definition-function slotd)
                 :unset
                 object)
        (call-next-method)))))


```

```

          object)
(call-next-method)))))

(defmethod clos:slot-exists-p-using-class
  ((class virtual-metaclass) object slot-name)
(or (call-next-method)
  (and (find slot-name (class-slots class)
             :key 'slot-definition-name)
       t)))

;; Example virtual slot which depends on a real slot.
;; Compile this separately after the virtual-metaclass etc.

(defclass a-virtual-class ()
  ((real-slot :initarg :real-slot :accessor real-slot
              :initform -1)
   (virtual-slot :accessor virtual-slot
                 :initarg :virtual-slot
                 :allocation :virtual
                 :function
                 'a-virtual-class-virtual-slot-function))
  (:metaclass virtual-metaclass))

(defun a-virtual-class-virtual-slot-function
  (key object &optional value)
  (ecase key
    (:get (let ((real-slot (real-slot object)))
            (if (<= 0 real-slot 100)
                (/ real-slot 100.0)
                (slot-unbound (class-of object)
                              object
                              'virtual-slot))))
    (:set (setf (real-slot object) (* value 100))
          value)
    (:is-set (let ((real-slot (real-slot object)))
               (<= real-slot 100)))
    (:unset (setf (real-slot object) -1))))
;; ----- Virtual Slots -----

```

Compile the code above. Then make an object and access the virtual slot:

```

CL-USER 1 > (setf object (make-instance 'a-virtual-class))
#<A-VIRTUAL-CLASS 2067B064>

CL-USER 2 > (setf (virtual-slot object) 0.75)

      setf slot : VIRTUAL-SLOT
0.75

CL-USER 3 > (virtual-slot object)
0.75

CL-USER 4 > (real-slot object)
75.0

```

Note that when you call `(setf real-slot)` there is no output since `(setf clos:slot-value-using-class)` is not called. Compare with `(setf virtual-slot)`.

```

CL-USER 5 > (setf (real-slot object) 42)
42

```

Redefine `a-virtual-class` with `:optimize-slot-access nil`:

```

CL-USER 6 > (defclass a-virtual-class ()
               ((real-slot :initarg :real-slot
                           :accessor real-slot
                           :initform -1)
                (virtual-slot :accessor virtual-slot
                           :initarg :virtual-slot
                           :allocation :virtual
                           :function
                           'a-virtual-class-virtual-slot-function))
               (:metaclass virtual-metaclass)
               (:optimize-slot-access nil))

Warning: (DEFCLASS A-VIRTUAL-CLASS) being redefined in LISTENER
(previously in H:\tmp\vs.lisp).
Warning: (METHOD REAL-SLOT (A-VIRTUAL-CLASS)) being redefined in
LISTENER (previously in H:\tmp\vs.lisp).
Warning: (METHOD (SETF REAL-SLOT) (T A-VIRTUAL-CLASS)) being
redefined in LISTENER (previously in H:\tmp\vs.lisp).
Warning: (METHOD VIRTUAL-SLOT (A-VIRTUAL-CLASS)) being redefined
in LISTENER (previously in H:\tmp\vs.lisp).
Warning: (METHOD (SETF VIRTUAL-SLOT) (T A-VIRTUAL-CLASS)) being
redefined in LISTENER (previously in H:\tmp\vs.lisp).
#<VIRTUAL-METACLASS A-VIRTUAL-CLASS 21AD908C>

```

Now the standard accessors call `slot-value-using-class`, so we see output when calling `(setf real-slot)`

```
CL-USER 7 > (setf (real-slot object) 42)

  setf slot : REAL-SLOT
  42
```



# 19

---

# Multiprocessing

LispWorks supports threads for running computations in parallel. The programming environment, for example, makes extensive use of this mechanism to create separate threads for the various tools.

On Microsoft Windows, Mac OS X, Linux, x86/x64 Solaris, FreeBSD and AIX, LispWorks multiprocessing uses native threads and supports Symmetric Multiprocessing (SMP). The implementation is referred to as "SMP LispWorks" where relevant.

On other platforms LispWorks uses a single native thread and implements user level threads. The implementation is referred to as "non-SMP LispWorks" where relevant.

In SMP LispWorks, Lisp processes (as reported by the Lisp function `ps`) are Operating System threads. These do not necessarily correspond to what system tools show you, for example in Microsoft Windows the Activity monitor shows OS processes, including exactly one for each running LispWorks image.

## 19.1 Introduction to processes

A process (sometimes called a thread) is a separate execution context. It has its own call stack and its own dynamic environment.

A process can be in one of three different states: *running*, *waiting*, and *inactive*. When a process is *waiting*, it is still active, but is waiting for the system to wake it up and allow its computation to restart. A process that is *inactive* has stopped, because it has an arrest “reason”.

For a process to be active (that is, running or waiting), it must have at least one run reason and no arrest reasons. If, for example, it was necessary to temporarily stop a process, it could temporarily be given an arrest reason. However the arrest reason mechanism is not commonly used in this manner.

The process that is currently executing is termed “the current process”. The function `get-current-process` gets the current process, and is the preferred way of doing so. The variable `*current-process*` is normally bound to the same process, except inside a wait function when it is called by the scheduler.

The current process continues to be executed until either it becomes a waiting process by calling a Process Wait function as described in “Process Waiting and communication between processes” on page 280, or it allows itself to be interrupted by calling `process-allow-scheduling` (or its current timeslice expires and it involuntarily relinquishes control).

In SMP LispWorks all processes that are not waiting are running as far as LispWorks is concerned, and are scheduled by the operating system to the available CPUs.

In non-SMP LispWorks, the system runs the waiting process with the highest priority. If processes have the same priority then the system treats them equally and fairly. This is called round robin scheduling.

The simplest way to create a process is to use `process-run-function`. This creates a process with the specified name which commences by applying the specified function to arguments. `process-run-function` returns immediately and the newly created process runs concurrently.

## 19.2 Processes basics

### 19.2.1 Creating a process

To create a new process, use `process-run-function`.

A process can exit either by returning from the process function or by calling `current-process-kill`.

### 19.2.2 Finding out about processes

The system initializes a number of processes on startup. These processes are specified by `*initial-processes*`.

The current process is obtained by `get-current-process`. A list of all the current processes is returned by `list-all-processes` and the number of them is returned by `processes-count`. The function `ps` is analogous to the UNIX command `ps`, and returns a list of the processes in the system, ordered by priority.

To find a process when you know its name, use `get-process`. To find the name, when you have the process, use `process-name`. The variable `*process-initial-bindings*` specifies the variables that are initially bound in a process.

### 19.2.3 Multiprocessing

To start multiprocessing, use `initialize-multiprocessing`. This function does not return until multiprocessing has terminated.

It is not necessary to use `initialize-multiprocessing` when the LispWorks IDE is already running. Note that, on Windows, Mac OS X, Linux, x86/x64 Solaris, FreeBSD and AIX, the LispWorks images shipped do start the IDE. If you create an image which does not start the IDE, by using the `:environment nil` argument to `save-image`, then multiprocessing can be started in this new image as described below.

#### 19.2.3.1 Starting multiprocessing interactively

You can call `initialize-multiprocessing` from the REPL interface, which generates a default Listener process if no other processes are specified by `*initial-processes*`.

### 19.2.3.2 Multiprocessing on startup

There are three ways to make a LispWorks executable start multiprocessing on startup.

1. Use the `-multiprocessing` command line argument
2. Save an image which starts multiprocessing by doing

```
(save-image "mp-lispworks"
  :restart-function 'mp:initialize-multiprocessing)
```

3. Use delivery to create the executable and pass the argument `:multiprocessing t` to `deliver`. The delivery function will be called automatically in a new process. See the *LispWorks Delivery User Guide* for more details.

LispWorks dynamic libraries always start multiprocessing on startup. See “Multiprocessing in a dynamic library” on page 195 for more information.

In all cases, `*initial-processes*` can be used to control which processes are created on startup, as described in “Running your own processes on startup” on page 264.

**Note:** On Windows, Mac OS X, Linux, x86/x64 Solaris, FreeBSD and AIX you cannot save a LispWorks image with multiprocessing running.

### 19.2.3.3 Running your own processes on startup

`*initial-processes*` is a list of lists. Each list is used by the system as a set of arguments to `process-run-function`. During initializing multiprocessing, the system does this:

```
(dolist (x mp:*initial-processes*)
  (apply 'mp:process-run-function x))
```

This script saves a LispWorks image which starts multiprocessing on restart and runs a user-defined process.

```
(load-all-patches)
(load "my-server-code")
(push '("Start Server" () start-my-server)
      mp:*initial-processes*)
(save-image "my-server"
            :remarks "My Server"
            :restart-function 'mp:initialize-multiprocessing
            :environment nil)
```

See `save-image`, page 1001 for a description of how to save an image.

## 19.3 Atomicity and thread-safety of the LispWorks implementation

Access to all Common Lisp objects is thread-safe in the sense that it does not cause an error because of threading issues.

### 19.3.1 Immutable objects

Immutable (or read-only) objects such as numbers, characters, functions, pathnames and restarts can be freely shared between threads, but special precautions must be taken when all of the following conditions are true:

- A new object is made accessible to other threads ("globally accessible") by storing it in an object that is globally accessible.
- The store that makes it globally accessible is not by `(setf gethash)`, `vector-push` or `vector-push-extend` into a "multithreaded" hash-table or vector (see "Single-thread context arrays and hash-tables" on page 276).
- Other threads read from the globally accessible object without synchronizing with the thread that created it. Synchronizing is typically done by `lock`, but can also be done by using `barrier`, `condition-variable` or `semaphore`, and by using `hash-table` locks.

In this situation, it is your responsibility to ensure that all of the stores that occurred when creating the new object are visible to the other threads, as described by "Making an object's contents accessible to other threads" on page 268.

### 19.3.2 Mutable objects supporting atomic access

This section outlines for which types of mutable Common Lisp object access is atomic. That is, each value read from the object will correspond to the state at some point in time. Note however, that if several values are read, there is no guarantee about how these values will relate to each other if they are being modified by another thread (see “Issues with order of memory accesses” on page 276).

When one of these mutable atomic objects is modified, readers see either the old or new value (not something else), and it is guaranteed that the Lisp image is not corrupted by the modification even if multiple threads read or write the object simultaneously.

Access to conses, simple arrays except arrays with element type of integer with less than 8 bits, symbols, packages and structures is atomic. Note that this does not apply to non-simple arrays.

Slot access in objects of type `standard-object` is atomic with respect to modification of the slots and with respect to class redefinition.

`vector-pop`, `vector-push`, `vector-push-extend`, `(setf fill-pointer)` and `adjust-array` are all atomic with respect to each other, and with respect to other access to the array elements.

The Common Lisp functions that access hash tables are atomic with respect to each other. See also `modify-hash` for atomic reading and writing an entry and `with-hash-table-locked`. See also “Modifying a hash table with multiprocessing” on page 279 for thread-safe ways to ensure a table entry.

Access to packages is atomic.

Note that pathnames cannot be modified, and therefore access to them is always atomic.

Access to synchronization objects (of type `mailbox`, `barrier`, `semaphore` and `condition-variable`) is atomic. More information about these objects is in “Synchronization between threads” on page 285.

Operations on editor buffers (including points) are atomic and thread-safe as long as their arguments are valid. This includes modification to the text. However, buffers and points may become invalid because of execution on another thread. The macros `editor:with-buffer-locked` and `editor:with-point-`

`locked` should be used around editor operations on buffers and points that may be affected by other processes. Note that this is applicable also to operations that do not actually modify the text, because they can behave inconsistently if the buffer they are looking at changes during the operation. See the *LispWorks Editor User Guide* for details of these macros.

### 19.3.3 Mutable objects not supporting atomic access

This section outlines for which types of mutable Common Lisp object access is not atomic.

Access to arrays with element type of integer of less than 8 bits is not guaranteed to be atomic.

Access to non-simple arrays is not guaranteed to be atomic.

Access to lists (including alists and plists) is not atomic. Lists are made of multiple cons objects, so although access to the individual conses is atomic, the same does not hold for the list as a whole.

Sequence operations which modify multiple elements are not atomic.

Macros that expand to multiple accesses are in general not atomic. In particular, modifying macros like `push` and `incf` are not atomic (but see the atomic versions of some of them in “Low level atomic operations” on page 299).

Making several calls to Common Lisp functions that access hash tables will not be atomic overall. However LispWorks provides thread-safe ways to ensure a hash table entry - see “Modifying a hash table with multiprocessing” on page 279. See also `modify-hash` for atomic reading and writing an entry and `with-hash-table-locked`.

Stream operations are in general not atomic. There is an undocumented interface for locking of streams when this is required - contact Lisp Support if you need this.

Operations on CAPI objects are not atomic in general. The same is true for anything in the LispWorks IDE. These operations need to be invoked from the thread that owns the object, for example by `capi:execute-with-interface` or `capi:apply-in-pane-process`.

### 19.3.4 Making an object's contents accessible to other threads

An object's contents become accessible to other threads when it is stored into a cell that may be accessed by those threads (a "globally accessible cell"). In most cases, you should either use a synchronization mechanism (typically a `lock`) to control access to the cell because it is the most reliable approach or use a `mailbox` to make the object accessible to other threads (the mailbox acts as the globally accessible cell).

If you do not use a synchronization mechanism or mailbox, then all stores into the object must be forced to be visible to other threads ("ensured") before the object is stored in the globally accessible cell. This also applies to any stores that LispWorks did during construction of the object. Normally, LispWorks does not do that for every store, because it would slow the program too much. Note that numbers, except `fixnum` and `short-float` (in 32-bit LispWorks) or `fixnum` and `single-float` (in 64-bit LispWorks), are also objects that are constructed using stores that need to be ensured.

Storing objects into globally accessible cells would typically be done by `setf` or a related macro such as `push` or `incf`, but can also be done by Common Lisp functions such as `rplaca`, `fill`, `nsublis`, `nsubst` or `replace` (when the target is globally accessible). If stores into the objects that these functions store have not been ensured and may be read by another thread without synchronization, then one of the mechanisms in "Ways to guarantee the visibility of stores" on page 268 must be used. Note that when a sequence itself, rather than the elements, is modified, for example by `delete`, `nreverse`, `nconc`, `nunion`, then all access to the sequence needs to be controlled by a synchronization mechanisms, which will also guarantee the visibility of stores.

#### 19.3.4.1 Ways to guarantee the visibility of stores

The visibility (in other threads) of stores in an object referenced by a globally accessible cell can only be guaranteed in these situations:

1. You use a `lock` or any other synchronization mechanism (`barrier`, `condition-variable`, `semaphore`, `mailbox`, or the lock of a `hash-table`) to serialize all access to the globally accessible cell. Any use of a synchronization mechanism that may affect the behavior of another thread will implicitly ensure all preceding stores on the current thread.

2. The store is done by `(setf symbol-function)` or `(setf macro-function)` into a symbol, or by one of `(setf gethash)`, `vector-push`, `vector-push-extend` into a "multithreaded" hash-table or vector (see "Single-thread context arrays and hash-tables" on page 276).
3. You store a newly interned symbol (all stores that occur during interning are ensured). However, if the store is done using an operator that allocates (see "Special care for macros and accessors that may themselves allocate" on page 270) then you will still need to ensure.
4. You use one of the low level atomic operations, all of which ensure all stores on the current thread before they modify the cell. This includes stores from any allocation they may do and applies also to user defined atomic modify macros that are defined by `define-atomic-modify-macro`. Currently these atomic operations are: `compare-and-swap`, `atomic-exchange`, `atomic-push`, `atomic-pop`, `atomic-fixnum-incf`, `atomic-fixnum-decf`, `atomic-incf`, `atomic-decf`. Any atomic operations added in the future will do the same.
5. You start a new thread and access the object from that thread. LispWorks ensures all preceding stores on the current thread before the new thread runs, so if all accesses to an object occur in threads that start after the object was last modified then you do not need to ensure the stores into it.
6. You are storing an immediate object (`fixnum`, `character` or `short-float` in 32-bit LispWorks; `fixnum`, `character` or `single-float` in 64-bit LispWorks) in the globally accessible cell. There are no stores that need to be ensured during the creation of these objects. However, if the store is done using an operator that allocates (see "Special care for macros and accessors that may themselves allocate" on page 270) then you will still need to ensure.
7. The store is by `setf` or a related macro (for example `push` or `incf`), and the *place* argument is wrapped by the macro `globally-accessible`.
8. You call `ensure-stores-after-stores` between the time the object was made (and any stores of interest were done into it) and the time it is stored into a globally accessible cell. `ensure-stores-after-stores` ensures all preceding stores in the current thread.

Note: `ensure-memory-after-store` and `ensure-stores-after-memory` do what `ensure-stores-after-stores` does and more, but may be more expensive and are not required in this context.

Stores into objects must be "ensured" once by one of the above mechanisms, before the object becomes globally accessible. Stores that occur after this are not guaranteed to be visible to other threads until another ensuring operation.

In some circumstances you can make the program more efficient by explicitly ensuring stores using `globally-accessible` (7) or `ensure-stores-after-memory` (8) before or when the object is first made visible. See "Ensuring stores are visible to other threads" on page 271 for more details.

A synchronizing operation (1), atomic operation (4) or a call to `ensure-stores-after-stores` (8) ensures all stores into objects that were created by the current thread. The other situations ensure the stores that they perform and anything pointed to by those stores, but are not guaranteed to ensure other stores (because they may be able to skip ensuring in some circumstances).

#### **19.3.4.2 Special care for macros and accessors that may themselves allocate**

A situation that always requires special care is storing into a globally accessible cell using macros and accessors that may themselves allocate. If the store is not done using (1), (4) or (5) in "Ways to guarantee the visibility of stores" on page 268, then you need to use `globally-accessible` to ensure the stores in new objects that may be allocated are visible, even if the object that is stored does not need it (because it is an immediate, an interned symbol or was ensured earlier). These macros and accessors include:

Macros:            `push`, `pushnew`, `push-end`, `push-end-new`, `incf` (when not a fixnum), `decf` (when not a fixnum).

Accessors:        `getf`, `cdr-assoc`, `mask-field` (when not a fixnum), `ldb` (when not a fixnum).

User defined accessors that allocate:

Any user defined accessor (that is an operator with a `setf` expander defined by `define-setf-expander` or `defsetf`) that allocates during the setting operation. Note that allocation during the macro expansion is not an issue.

See “Destructive macros and accessors that allocate internally” on page 274 for more details.

### 19.3.5 Ensuring stores are visible to other threads

A store to a cell from one thread is said to be "visible" from another thread when a load from that cell from the other thread obtains the value that was stored. Within a single thread, all stores are visible immediately to loads from the same thread, but that is not always the case in a multithreaded situation. Store operations that occur in one thread are not necessarily visible from other threads until something ensures that they are. In other words, another thread loading from the cell where the store was done may still obtain the cell's previous value, even if "logically" it seems that the load happened after the store. For a new object, the previous value may be anything that was in memory, including an invalid value that may cause crashes.

#### 19.3.5.1 An example to consider the issues

For example, assume that the symbol `*a-global-symbol*` is not dynamically bound anywhere and its value is `nil`, and we have two threads, A and B, executing without synchronization.

Thread A executes this code:

```
(setq *a-global-symbol* (cons 1 2))
```

and thread B executes this code:

```
(let ((maybe-cons *a-global-symbol*))  
  (if (consp maybe-cons)  
      (car maybe-cons)  
      -1))
```

It looks like the form that thread B executes will always return either 1 (if it happens after thread A has set `*a-global-symbol*`) or -1 (otherwise), because in the case that `maybe-cons` is a cons it must already have 1 in the car. However, that is not necessarily true because the store of the cons into `*a-global-symbol*` may be visible to thread B before the store of 1 into the cons (which happens inside the call to `cons`) is visible. This applies to explicit stores in the program as well, for example if thread A executes:

```
(setq *a-global-symbol* (rplaca (list nil) 1))
```

then the same problem arises (in this case, the call to `car` in thread B may return 1, `nil` (the value that `list` stored in the car), or whatever was in that memory before that).

Note: the second load in thread B (inside `car`) is dependent on the first load (reading the value cell from `*a-global-symbol*`). Such dependent loads are guaranteed to occur in the program order in all current LispWorks releases. In situations when the two loads are independent, but you still need them to occur in the program order, you will need to use `ensure-loads-after-loads`.

### 19.3.5.2 The general solution using a lock

In most circumstances, all access to globally accessible cells should be controlled by a `lock`, which eliminates all of these problems because releasing a lock implicitly ensures that all stores in that thread are visible to all other threads, so by the time another thread gets ownership of the lock, all the stores are already visible. Sending an object via a `mailbox`, using `(setf gethash)`, `vector-push` or `vector-push-extend` or synchronizing using any of the other synchronization mechanisms (`barrier`, `condition-variable`, `semaphore` or the lock of a `hash-table`) also ensures the stores are already visible (for a full list, see “Making an object's contents accessible to other threads” on page 268). If you make an object globally accessible without any of these mechanisms, then you need to ensure explicitly that the stores are all visible. Note that if the store occurs inside a lock but the object is not read inside the same lock, then you still need to ensure the stores, because the reading may happen before unlocking has ensured the stores are visible. Note also that, for some macros and accessors (listed below), you need to ensure the stores even if the value that you store does not need ensuring.

### 19.3.5.3 An alternative solution using globally-accessible

If you need to explicitly ensure that all stores are visible, then the best approach is to use `globally-accessible`, which takes a single argument, `place`, which can be any generalized reference form as described in section [5.1.1 Overview of Places and Generalized Reference](#) of the Common Lisp HyperSpec. In most cases, (`globally-accessible place`) is the same as `place`. However, when `globally-accessible` is used inside `setf` or a related macro such as `push` or `incf` then it also ensures all stores are visible to other threads before modifying `place`. For example, if we change the code that thread A in Section 19.3.5.1 executes to:

```
(setf (sys:globally-accessible *a-global-symbol*)
      (cons 1 2))
```

then the value returned by the form in thread B is guaranteed to be 1 or -1 as expected.

### 19.3.5.4 An alternative solution using ensure-stores-after-stores

The other approach is to use `ensure-stores-after-stores` just before storing into the globally accessible cell, but after any allocation or other operations that modify the object being stored in the cell. In the example in Section 19.3.5.1, thread A would do:

```
(let ((cons (cons 1 2)))
  (sys:ensure-stores-after-stores)
  (setq *a-global-symbol* cons))
```

`ensure-stores-after-stores` cannot be used when the form that stores the object is a destructive macro such as `push` (for a full list, see “Destructive macros and accessors that allocate internally” on page 274 below), because `push` itself allocates a `cons` using stores that need to be ensured. `globally-accessible` takes care of that, by ensure the stores after any allocation that the macro may do (except when it is a macro with a non-standard `setf` expansion that allocates or stores in the setter). Thus `globally-accessible` is preferable when you can use it. You need to use `ensure-stores-after-stores` when the store is encapsulated in some other operation. For example, if you use `fill` to store a new object in a globally accessible sequence (`some-vector` below) then you will need to do something like this:

```
(let ((new-object (cons x y)))
  (sys:ensure-stores-after-stores)
  (fill some-vector new-object))
```

`ensure-stores-after-stores` always ensures all the stores that have happened in the current thread. `globally-accessible` is not guaranteed to ensure all preceding stores accept into the value that it stores, because it may be able to skip ensuring in some circumstances.

### 19.3.5.5 Destructive macros and accessors that allocate internally

The macros `push`, `pushnew`, `push-end`, `push-end-new`, `incf` (when not a fixnum) and `decf` (when not a fixnum) may generate new objects internally, so if they are used to destructively modify a globally accessible cell without synchronization then you will need to use `globally-accessible`.

For example:

```
(pushnew some-object (sys:globally-accessible *a-global-symbol*))
```

Note that `globally-accessible` is needed with `push`, `pushnew`, `push-end`, and `push-end-new` even if there are no stores into the object being pushed that need ensuring. For `incf` and `decf`, if you can guarantee that the new value is fixnum, then you do not need `globally-accessible`.

The accessors `getf`, `cdr-assoc`, `mask-field` and `ldb` take a *place* argument that may generate new objects when modified, so if *place* is globally accessible and it is modified without synchronization then you will need to wrap `globally-accessible` around such modifications of *place*.

For example:

```
(setf (getf (sys:globally-accessible *a-global-symbol*)
             :key)
      value)
```

For `getf` and `cdr-assoc`, `globally-accessible` is needed even if there are no stores into the new object and key that need ensuring because new conses might be added to the *place*. For `mask-field` and `ldb`, if you are absolutely sure that the new value is fixnum then you do not need `globally-accessible`.

In addition, `setf` expanders defined by `define-setf-expander` or `defsetf` cannot be used on globally accessible cells without synchronization (by a lock or other synchronization mechanism) if they do any of the following:

- allocate inside the value forms (the second value returned by `get-setf-expansion`);
- allocate inside the storing form (the fourth value returned by `get-setf-expansion`);
- store to anywhere except the *place*.

See section 5.1.1.2 *Setf Expansions* of the Common Lisp HyperSpec for the definition of "value forms" and "storing form".

#### 19.3.5.6 Miscellaneous notes

For an object that is not modified later, ensuring all stores when the object is created is sufficient, and after that the object can be used freely from any thread.

`ensure-stores-after-stores` can be used to ensure stores for objects that are modified after becoming globally accessible. However, if you need to ensure that the new values are seen by other threads that may be already accessing the modified objects then you need to use some synchronization mechanism anyway. Thus in most cases you should use a lock, which will deal with the synchronization.

`ensure-stores-after-stores` does slow the program a little on architectures that need it (Currently ARM, ARM64 and PowerPC), so you can consider the following optimizations:

- If you construct several objects that all need to be stored into globally accessible cells, then you can reduce the overhead by making them all, calling `ensure-stores-after-stores` once and then storing them all.
- If the store is done while holding a lock but the load is done without the lock, and loading happens less frequently than storing, then you may consider loading while holding the lock as well to avoid needing to explicitly ensure the stores.

As noted in “Ensuring stores are visible to other threads” on page 271, loads from an object that was obtained from a globally accessible cell are currently guaranteed to occur after the load the cell itself, because all the architectures that LispWorks runs on guarantee that. In principle, sometime in the future there may be a new architecture that does not provide that guarantee. You can guard against this by using `globally-accessible` when reading from the globally accessible cell as well. Currently that just macroexpands into its argument, so does not affect the performance, but for an architecture that requires anything it will do the right thing.

### 19.3.6 Issues with order of memory accesses

When multiple threads access the same memory location, the order of those accesses is not generally guaranteed. You should therefore not attempt to implement "lockless algorithms" which depend on the order of memory accesses unless you have a good understanding of multiprocessing issues at the CPU level (see “Ensuring order of memory between operations in different threads” on page 301).

However, all of the “Low level atomic operations” and locking operations (see “Locks” ) do ensure that all memory accesses that happen before them have finished and that all memory accesses that happen after them start after them. Therefore, normally there is nothing special to consider when using those operations. The modification check macros described in “Aids for implementing modification checks” also take care of this.

### 19.3.7 Single-thread context arrays and hash-tables

Access to hash tables and non-simple arrays can be improved where they are known to be accessed in a single thread context. That is, only one thread at the same time accesses them.

The `make-hash-table` argument *single-thread* tells `make-hash-table` that the table is going to be used only in single thread context, and therefore does not need to be thread-safe. Such a table allows faster access.

Similarly the `make-array` argument *single-thread* creates an array that is single threaded. Currently, the main effect of *single-thread* is on the speed of `vector-pop`, `vector-push`, and `vector-push-extend` on non-simple vectors. These

operations are much faster on "single threaded" vectors, typically more than twice as fast as "multithreaded" vectors.

You can also make an array be "single-threaded" with `set-array-single-thread-p`.

The result of parallel access to a "single-threaded" vector is unpredictable.

## 19.4 Locks

Locks can be used to control access to shared data by several processes.

The two main operators used in locking are the function `make-lock`, to create a `lock`, and the macro `with-lock`, to execute a body of code while holding the specified `lock`.

A `lock` has a name (a string) and several other components. The printed representation of a `lock` shows the name of the `lock` and whether it is currently locked. Additionally if the `lock` is locked it shows the name of the process holding the `lock`, and how many times that process has locked it. For example:

```
#<MP:LOCK "my-lock" Locked 2 times by "My Process" 2008CAD8>
```

The function `lock-owner` returns the process that locked a given `lock`.

The function `lock-name` returns the name of a `lock`.

The function `process-lock` blocks the current process until a given `lock` is claimed or a timeout passes, and `process-unlock` releases the `lock`.

The macro `with-lock` executes code with a `lock` held, and releases the `lock` on exit, as if by `process-lock` and `process-unlock`.

If you need to avoid blocking on a `lock` that is held by some other thread, then use `with-lock` with *timeout* 0, like this:

```
(unless (mp:with-lock (lock nil 0)
                      (code-to-run-if-locked)
                      t)
  (code-to-run-if-not-locked))
```

The macros `with-sharing-lock` and `with-exclusive-lock` can be used with sharing locks.

### 19.4.1 Recursive and sharing locks

The keyword argument *recursivep* to `make-lock`, when true, allows the `lock` to be locked recursively. *recursivep* is true by default. If *recursivep* is false then trying to `lock` again causes an error. This is useful for debugging code where the `lock` is not expected to be claimed recursively.

The keyword argument *sharing* to `make-lock`, when true, creates an "sharing" `lock` object, which supports sharing and exclusive locking. A sharing `lock` is handled by different functions and methods. See `with-exclusive-lock`, `with-sharing-lock`, `process-exclusive-lock`, `process-exclusive-unlock`, `process-sharing-lock` and `process-sharing-unlock`.

### 19.4.2 Querying locks

See `lock-recursive-p`, `lock-owned-by-current-process-p`, `lock-owner`, `lock-locked-p` and `lock-recursively-locked-p`.

### 19.4.3 Guarantees and limitations when locking and unlocking

In compiled code `process-lock`, `process-exclusive-lock` and `process-sharing-lock` are guaranteed to return if they locked their argument. In other words there will not be any throw between the time they locked the `lock` and the time they return. That means that in compiled code the next form will at least start executing, and if it is an `unwind-protect` the cleanup forms will at least start executing. (If the code is evaluated, this is not guaranteed.) "Locking" here also means incrementing the count of a `lock` that is already held by the current thread.

However these functions may throw before locking. For example, in the following code `process-lock` may throw without locking, for example because something interrupts the process by `process-interrupt`:

```
(unwind-protect
  (progn (mp:process-lock lock)
         (whatever))
  (mp:process-unlock lock))
```

If this call to `process-lock` does throw without locking, then `process-unlock` will be called on a `lock` that is not locked.

The correct code that guarantees (when compiled) that `process-unlock` is called on exit only when `process-lock` did lock is:

```
(mp:process-lock lock)

(unwind-protect
  (whatever)
  (mp:process-unlock lock))
```

Conversely, `process-unlock`, `process-exclusive-unlock` and `process-sharing-unlock` guarantee to successfully unlock the `lock`, but are not guaranteed to return.

For example, the following code may fail to call `another-cleanup`:

```
(mp:process-lock lock)

(unwind-protect
  (whatever)
  (mp:process-unlock lock)
  (another-cleanup))
```

If `another-cleanup` is essential to execute in all throws, it needs its own `unwind-protect`:

```
(mp:process-lock lock)

(unwind-protect
  (whatever)
  (unwind-protect
    (mp:process-unlock lock)
    (another-cleanup)))
```

**Note:** the guarantees described in this section are relevant only in compiled code.

## 19.5 Modifying a hash table with multiprocessing

Each `hash-table` access operation is thread-safe and atomic, but there is no guarantee of atomicity between access operations.

The modify macros (for example `incf`) all expand to two access operations, reading the value and writing the modified value, and are therefore not atomic. They need to be either done while holding a `lock`, or using `modify-hash`.

Another common operation is "ensuring an entry", that is reading and, if reading fails, adding a value to the table. For example:

```
(or (gethash key hash-table)
      (setf (gethash key hash-table) (construct-new-value)))
```

If two threads do that in parallel, one of them may end up with a value that is not in the table. One solution is to lock that table:

```
(with-hash-table-locked hash-table
  (or (gethash key hash-table)
      (setf (gethash key hash-table) (construct-new-value))))
```

However that always locks the table, which is inefficient. The correct way to do it is either to do:

```
(or (gethash key hash-table) ; first try without the lock
    (with-hash-table-locked hash-table
      (or (gethash key hash-table) ; check again inside the lock
          (setf (gethash key hash-table) (construct-new-value)))))
```

or use `gethash-ensuring` or `with-ensuring-gethash`.

## 19.6 Process Waiting and communication between processes

Process Waiting means that a process suspends its own execution until some condition is true. The generic Process Wait functions take a *wait-function* argument, which is arbitrary though somewhat restricted Lisp code. A process resumes running when the *wait-function* returns true. The specific Process Wait functions wait for a specific condition.

### 19.6.1 Specific Process Wait functions

For communication between processes, these are:

`mailbox-read`, `process-wait-for-event`, `mailbox-wait` and `mailbox-wait-for-event`.

For synchronization, these are:

`condition-variable-wait` and `barrier-wait`, also `semaphore-acquire` and `semaphore-release`.

For locking these are:

`process-lock`, `process-exclusive-lock` and `process-sharing-lock`.

For sleeping, these are:

`cl:sleep` and `current-process-pause`.

The specific Process Wait functions are designed to reduce latencies and to increase efficiency. In particular, in SMP LispWorks they should be used in preference to the generic Process Wait functions.

### 19.6.2 Generic Process Wait functions

The generic Process Wait functions are:

`process-wait` and `process-wait-with-timeout`

`process-wait-local` and `process-wait-local-with-timeout`

`process-wait-local-with-periodic-checks` and `process-wait-local-with-timeout-and-periodic-checks`.

**Note:** For brevity we sometimes refer to "the `*-periodic-checks` functions" or "the `*-with-timeout` functions".

All the generic Process Wait functions take *wait-reason* and *wait-function* arguments and potentially also arguments to pass to the *wait-function*. The `*-with-timeout` functions mentioned above also take a *timeout* argument. The `*-periodic-checks` functions also take a *period* argument.

The *wait-reason* is used only to mark the process as waiting for something for debugging purposes. It does not affect the behavior of the functions.

The generic Process Wait functions "wake up" (that is, they simply return to the caller) either when the timeout passed (if they take a *timeout* argument), or when the wait function returns true. The three pairs of functions mentioned above differ in the mechanism that calls the wait function.

`process-wait` and `process-wait-with-timeout` arrange that the "scheduler" will call the wait function when it runs. The "scheduler" is invoked at various points, in an indeterminate process. The advantage of this is that the programmer does not need to worry too much about when the wait function is going to be called. In non-SMP LispWorks (that is, LispWorks 5.1 and ear-

lier) the programmer does not need to worry at all: when some process sets up something that would make the wait function return true, the waiter process could not run anyway until the setting-up process stopped for some reason (including preemption), by which time the scheduler would have called the wait function if it had not done it before. In SMP LispWorks (that is, Lisp-Works 6.0 and later), these two processes can run simultaneously, so the delay between the setting up and the scheduling is not necessary. It can be avoided by "poking" the waiting process with `process-poke`, if the waiting process is known, or by invoking the scheduler by `process-allow-scheduling`.

**Note:** All the specific Process Wait functions, described in “Specific Process Wait functions” on page 280, record that they wait, and the operations that allow them to continue implicitly “poke” the waiting process. Therefore the specific functions avoid the problem of latency or needing `process-poke`, and should be used in preference where possible.

A large disadvantage of `process-wait` and `process-wait-with-timeout` is that their *wait-function* is called by the “scheduler” in an indeterminate process. That means that the wait function does not see the dynamic environment of the calling process (including error handlers), and cannot be debugged properly. It is also called often, and so it needs to be reasonably fast and not allocate much. In addition, having to call the wait function adds overhead to the system. Therefore in general, if you can achieve the required effect by using either any of the specific wait functions or a `process-wait-local*` function, you should do that and avoid `process-wait` and `process-wait-with-timeout`.

`process-wait-local` and `process-wait-local-with-timeout` do not have all the disadvantages listed above, but their *wait-function* is called only when the process is poked (or at the end of the *timeout*). That means that the programmer does not need to worry about when they are called. Typically some other process will set up something, and then poke the waiting process to check that it can run.

**Note:** if the setting up process always knows for sure whether the waiting process can run, then it is normally simpler to use one of the specific Process Wait functions, or maybe even `process-stop` and `process-unstop`.

The `*-periodic-checks` functions give a partial solution to the question of calling the wait function, by ensuring there is a maximum period of time between calls. If having a bounded delay where a bound of more than 0.1 sec-

ond is not a problem, then the `*-periodic-checks` functions are a simple and efficient way to achieve it.

When the delays need to be bounded by a shorter period, either one of the specific Process Wait functions or explicit calls to `process-poke` need to be used. The latter combined with `process-wait-local` is the most efficient mechanism, but it does require the programmer to ensure that `process-poke` is called in all the right places.

### 19.6.3 Communication between processes and synchronization

The simplest way to pass a specific event between two processes is to use `process-wait-for-event` on the receiving process, and `process-send` on the sender side. The "event" that is passed is can be any Lisp object.

`process-send` and `process-wait-for-event` use a `mailbox` to pass the object (the `process-mailbox` of the receiver). It is possible to use a `mailbox` object directly, and to communicate between multiple senders and receivers. Use `make-mailbox` to make a `mailbox`, and `mailbox-send` to put a message in it. In some situations there may be an imbalance between sending and receiving messages in a `mailbox`, which may cause the mailbox to become very big. When this is a problem, you can use `mailbox-send-limited` to make the sending process wait (or do something else) once the mailbox grows to some limit. There are also functions `mailbox-count`, `mailbox-size` and `mailbox-full-p` to help with these situations.

The receiver(s) use `mailbox-wait-for-event`, `mailbox-wait` OR `mailbox-read`. `mailbox-wait-for-event` should be used on processes that may make windows (including any process associated with a CAPI interface), but can be used elsewhere. `mailbox-read` is faster, but if it used on a process with a window it may cause hanging.

In general, the receiving process decides hows to interpret an event. However, the system has a "standard" generic function, `general-handle-event`, to interpret events. `general-handle-event` has methods that process lists by applying the `car` to the `cdr`, and processes function objects or symbols by calling them. There is a method on `t` that does nothing. You can add your own method on your defined classes (which can be structures).

`general-handle-event` is used when system code needs to interpret events, most importantly processes that CAPI uses to display windows use it. Hence for processes that use the "standard" event handling, you can send an object using `process-send` and expect it to be processed by `general-handle-event`. `general-handle-event` is also used by `process-all-events`, which processes all the events for the current process, and `wait-processing-events`, which waits until some predicate returns true while processing events.

In some situations it is useful to execute some code next time the current process processes events, rather than immediately. That can be achieved by `process-send` with the current process, or more conveniently by `current-process-send`.

`process-wait-for-event` and `process-send` and `mailbox` are the primary interface for communication between processes, and should be used unless there is a very good reason to use a different mechanism.

#### 19.6.4 Synchronization

Synchronization can be achieved by the various `process-wait*` functions with the appropriate `wait-function` argument, but for simple cases of synchronization it is better to use the synchronization objects: `condition-variable` or `barrier`. These synchronization objects are simple, efficient, deal with all thread-safety issues, and ensure that the processes that are ready to run will run immediately, rather than the next time that the wait function is called.

Condition variables (or type `condition-variable`) are used when one or more processes have the knowledge to control when another process(es) runs. The "ignorant" process(es) use `condition-variable-wait` to wait until they can continue. The "knowledgeable" process(es) use `condition-variable-signal` and `condition-variable-broadcast` to tell the "ignorant" processes when they can run. Because the communication is via the condition variable, the processes do not need to know explicitly about each other. For more details, see "Condition variables" on page 285.

Barriers (of type `barrier`) are used (mainly) for symmetric synchronization, when a group of processes needs to ensure that none of them goes too far ahead of the rest. The processes call `barrier-wait` when they want to synchronize, and `barrier-wait` waits until the other process arrive too (that is,

they call `barrier-wait`). Barriers have additional features that allow more complex synchronization. For more details, see “Synchronization barriers” on page 287.

## 19.7 Synchronization between threads

In LispWorks 5.1 and previous versions, the main way to synchronize between threads is to use `mp:process-wait` or `mp:process-wait-with-timeout` to supply a predicate to the scheduler. The predicate runs periodically in the background to identify threads that are no longer blocked.

These functions are still available, but there are some alternatives that can be more efficient in many cases by removing the need for the scheduler. The alternatives are:

- Mailboxes (FIFO queues). See `make-mailbox` and `mailbox-send`.
- Condition Variables (used with a `lock`). See “Condition variables” on page 285.
- Barriers (counting arrivals at a certain point in the code). See “Synchronization barriers” on page 287.
- Counting Semaphores (limiting the number of users of a shared resource). See “Counting semaphores” on page 287

Access to all of these objects is atomic and does not require additional locks (except for the `lock` that is already used with a `condition-variable`).

### 19.7.1 Condition variables

A `condition-variable` allows you to wait for some condition to be satisfied, based on the values stored in shared data that is protected by a `lock`. The condition is typically something like data becoming available in a queue.

The function `condition-variable-wait` is used to wait for a `condition-variable` to be signaled. It is always called with the `lock` held, which is automatically released while waiting and reclaimed before continuing. More than one thread can wait for a particular `condition-variable`, so after being notified about the condition changing, you should check the shared data to see if it represents a useful state and call `condition-variable-wait` again if not.

The function `condition-variable-signal` is used to wake exactly one thread that is waiting for the `condition-variable`. If no threads are waiting, then nothing happens.

Alternatively, the function `condition-variable-broadcast` can be used to wake all of the threads that are waiting at the time it is called.

Any threads that wait after the call to `condition-variable-signal` or `condition-variable-broadcast` will not be woken until the next call.

In most uses of condition variables, the call to `condition-variable-signal` or `condition-variable-broadcast` should be made while holding the `lock` that waiter used when calling `condition-variable-wait` for this `condition-variable`. This ensures that the signal is not lost if another thread is just about to call `condition-variable-wait`.

The function `condition-variable-wait-count` can be used to determine the current number of threads waiting for a `condition-variable`.

The `condition-variable` implementation in LispWorks aims to comply with the POSIX standard where possible.

`condition-variable-wait`, `condition-variable-signal` and `condition-variable-broadcast` have corresponding functions `lock-and-condition-variable-wait`, `lock-and-condition-variable-signal` and `lock-and-condition-variable-broadcast`. For `condition-variable-wait` there is also `simple-lock-and-condition-variable-wait`, which is simpler to use. The `lock-and-condition-...` functions perform the equivalent of locking and in the scope of the lock doing something and calling the corresponding `condition-...` function.

The `lock-and-condition-...` functions not only make it simpler to code, they also make it easier to avoid mistakes, and can optimize some cases (in particular, the quite common case when there is no need to lock on exit from `condition-variable-wait`). They are the recommended interface.

The `lock-and-condition-...` functions can be used together with `condition-...` functions on the same `locks` and `condition-variables`.

**Note:** In cases when only one process waits for the condition, using `process-wait-local` for waiting and `process-poke` for signaling is easier, and involves less overhead.

### 19.7.2 Synchronization barriers

Barriers are objects of type **barrier** that are used to synchronize multiple threads. A **barrier** has a *count* that determines how many "arrivals" (calls to **barrier-wait**) have to occur before these calls return.

The main usage of barriers is to ensure that a group of threads have all finished some stage of an algorithm before any of them proceeds.

The typical way of using a **barrier** is to make one with a *count* that is the same as the number of threads that are going to work in parallel and then create the threads to do the work. When each thread has done its work, it synchronizes with the others by calling **barrier-wait**. In most cases **barrier-wait** is the only barrier API that is used.

For example, assume you have a task that be broken into two stages, where each stage can be done in parallel by several threads, but the first stage must be completely finished before any processing of the second stage can start. Then the code will do:

```
(let ((barrier (mp:make-barrier num-of-processes)))
  (dotimes (p num-of-processes)
    (mp:process-run-function (format nil "Task worker ~d" p)
      ()
      #'(lambda (process-number barrier)
          (do-first-stage process-number)
          (mp:barrier-wait barrier)
          (do-second-stage process-number))
      p
      barrier)))
```

It is also possible to use a **barrier** to block an indefinite number (up to **most-positive-fixnum**) of processes, until another process decides that they can go. For this the **barrier** is made with *count t* (or **most-positive-fixnum**). The other process then uses **barrier-disable** to "open" the **barrier**. If required, the **barrier** can be enabled again by **barrier-enable**.

See also **barrier-block-and-wait**.

### 19.7.3 Counting semaphores

A counting semaphore is a synchronization object that allows different threads to coordinate their use of a shared resource that contains some num-

ber of available units. The meaning of each unit depends on what the semaphore is being used to synchronize.

The three main functions associated with semaphores are: `make-semaphore`, which makes a new `semaphore` object; `semaphore-acquire`, which acquires units from a `semaphore` and `semaphore-release`, which releases units back to a `semaphore`. The current thread will block if it attempts to acquire more units than are current available.

The functions `semaphore-name`, `semaphore-count` and `semaphore-wait-count` can be used to query the name, available unit count and count of waiting units from a `semaphore`.

## 19.8 Killing a process, interrupts and blocking interrupts

### 19.8.1 Killing a process

When the function of the process (third argument to `process-run-function`) returns the process exits, but in many cases it is more convenient to terminate the process without returning all the way to the process function.

The function `current-process-kill` can be used to kill the current process. It executes all the unwind forms on the stack first. Checking in appropriate places and calling `current-process-kill` is a convenient and safe way (as long as there are `unwind-protect` forms where needed) of causing processes to exit when they should.

`process-terminate` can be used to kill any process. If there is no Terminate Method (see `current-process-set-terminate-method`) it uses the process interrupting mechanism, so if the other process blocks interrupts it will continue to run until it stops blocking. Because the killing interrupt can happen inside unwind forms of `unwind-protect` (unless they are executed with interrupts blocked) `process-terminate` is not safe unless all essential unwinding forms are executed with interrupts blocked. In most cases it is probably easier to not use `process-terminate` in actual applications.

## 19.8.2 Interrupting a process

`process-interrupt` and `process-interrupt-list` can be used to interrupt a process and execute arbitrary code. Since the interrupt happens at a "random" time, it should have minimal interaction with any data structures that are being modified. For robust applications it is probably better never to use it except during development.

## 19.8.3 Blocking interrupts

The purpose of blocking interrupts is to prevent a process aborting in the middle of an operation that needs to be completed. A typical example is the cleanup forms of an `unwind-protect`.

Blocking interrupts does not provide atomicity. Other processes may continue to execute.

Blocking interrupts limits the control that LispWorks has over the processes, so interrupts should not be blocked except when necessary. However, apart from blocking interrupts in a process it does not affect the behavior of the system.

The following macros and functions allow control over blocking interrupts: `allowing-block-interrupts`, `with-interrupts-blocked`, `current-process-unblock-interrupts` and `current-process-block-interrupts`.

Additionally the macros `unwind-protect-blocking-interrupts` and `unwind-protect-blocking-interrupts-in-cleanups` allow your program to prevent interrupts from stopping cleanup forms from completing.

**Compatibility note:** In LispWorks 5.1 and previous versions, `mp:without-preemption` and `mp:without-interrupts` are sometimes used to block interrupts, but they also provide atomicity. In many cases (probably most), they are used to provide atomicity, and in these cases they cannot be replaced by blocking interrupts. To get atomicity in LispWorks 6.0 and later you need to use locks or atomic operations. To get atomicity while debugging, you can also use `with-other-threads-disabled`.

#### 19.8.4 Old interrupt blocking APIs removed

The macros `mp:without-interrupts` and `mp:without-preemption`, which were available in LispWorks 5.1 and earlier, are no longer supported. The semantics of these macros allowed them to be used for several different purposes, which now require specific solutions.

- Atomic operations. This use was designed to make operations atomic with respect to other uses of the same macro or with respect to some other unquantified operations that were expected to be atomic, such as reading or writing a single slot in an object. Code of this kind should be converted to use locks (see “Locks” on page 277) or low level atomic operations (see “Low level atomic operations” on page 299).
- Complete operations. This use was designed to ensure that a set of operations completed without being interrupted by `mp:process-interrupt`, keyboard breaks and so on. See “Blocking interrupts” on page 289 for the new approach.

The following subsections show examples of typical uses of the old interrupt blocking APIs together with their replacements. The examples use `mp:without-interrupts` but the ideas also apply to uses of `mp:without-preemption`.

##### 19.8.4.1 Atomic increment

Old:

```
(without-interrupts
  (incf *global-counter*))
```

New: use low level atomic operations.

```
(sys:atomic-incf *global-counter*)
```

##### 19.8.4.2 Atomic push/pop

Old:

```
(without-interrupts
  (push value *global-list*)
  (without-interrupts
    (pop *global-list*)))
```

New: use low level atomic operations.

```
(sys:atomic-push value *global-list*)
(sys:atomic-pop *global-list*)
```

### 19.8.4.3 Atomic push/delete

Old:

```
(without-interrupts
  (push value *global-list*))
  (without-interrupts
    (setq *global-list* (delete value *global-list*)))
```

New: use a **lock**, because delete cannot be done atomically since it reads more than one object before modifying one of them.

```
(defvar *global-list-lock* (mp:make-lock :name "Global List"))

(mp:with-lock (*global-list-lock*)
  (push value *global-list*))

(mp:with-lock (*global-list-lock*)
  (setq *global-list* (delete value *global-list*)))
```

### 19.8.4.4 Atomic plist update

Old:

```
(without-interrupts
  (setf (getf *global-plist* key) value))
  (without-interrupts
    (getf *global-plist* key))
```

New: use a **lock**, because a plist consists of more than one object so cannot be updated with low level atomic operations.

```
(defvar *global-plist-lock* (mp:make-lock :name "Global Plist"))

(mp:with-lock (*global-plist-lock*)
  (setf (getf *global-plist* key) value))

(mp:with-lock (*global-plist-lock*)
  (getf *global-plist* key))
```

#### 19.8.4.5 Atomic update of a data structure

The example below is a resource object, which maintains a count of free items and also list of them. These two slots must stay synchronized.

Old:

```
(without-interrupts
  (when (plusp (resource-free-item-count resource))
    (decf (resource-free-item-count resource))
    (pop (resource-free-items resource))))
```

New: use a lock, because more than one slot has to be updated, so cannot be updated with low level atomic operations.

```
(mp:with-lock ((resource-lock resource))
  (when (plusp (resource-free-item-count resource))
    (decf (resource-free-item-count resource))
    (pop (resource-free-items resource))))
```

#### 19.8.4.6 Atomic access to a cache in a hash table

Old:

```
(without-interrupts
  (or (gethash value *global-hashtable*)
      (setf (gethash value *global-hashtable*)
            (make-cached-value))))
```

New: use the hash table lock.

```
(hcl:with-hash-table-locked
  *global-hashtable*
  (or (gethash value *global-hashtable*)
      (setf (gethash value *global-hashtable*)
            (make-cached-value))))
```

Alternative new: use the hash table lock only if the value is not already cached. This can be faster than the code above, because it avoids locking the hash table for concurrent reads.

```
(or (gethash value *global-hashtable*); probe without the lock
    (hcl:with-hash-table-locked
      *global-hashtable*
      (or (gethash value *global-hashtable*); reread with the lock
          (setf (gethash value *global-hashtable*)
                (make-cached-value)))))
```

## 19.9 Timers

Use timers to run code after a specified time has passed. You can schedule a timer to run once or repeat at regular intervals, and you can unschedule it before it expires.

The timers are measured in elapsed time and the accuracy depends on various factors, including the operating system and the load on the computer.

For the details, see the reference entries for `make-timer` and `schedule-timer`.

### 19.9.1 Timers and multiprocessing

Timers run in unpredictable threads, therefore it is not safe to run code that interacts with the user directly. The recommended solution is something like

```
(mp:schedule-timer-relative
  (mp:make-timer 'capi:execute-with-interface
    interface
    'capi:display-message "Time's up")
  5)
```

or

```
(mp:schedule-timer
  (mp:make-timer 'capi:execute-with-interface
    interface
    'capi:display-message "Lunchtime")
  (* 4 60 60))
```

where *interface* is an existing CAPI interface on the screen.

Timers actually run in the process that is current when the scheduled time is reached. This is likely to be The Idle Process in cases where LispWorks is sleeping, but it is inherently unpredictable.

### 19.9.2 Input and output for timer functions

I/O streams default to the standard input and output of the process, which is initially `*terminal-io*` in the case of The Idle Process.

## 19.10 Process properties

A "process property" is a pair of an indicator and a value that is associated with it for a process.

LispWorks has two kinds of process properties: general and private. These two kinds of properties are stored separately, and the association of indicator/value in each property kind is independent of any in the other property kind.

General properties are stored in the process plist, and can be modified from other processes.

Private properties can only be modified by the current process. Private properties are faster to modify, because the modification does not need to be thread-safe.

Otherwise there is little difference between general and private properties.

`process-plist` and `(setf process-plist)` are not thread-safe. In LispWorks 5.1 and earlier the only interface to process properties is `process-plist`, but this does not work well in SMP LispWorks, and so it is deprecated.

There is no parallel to `process-plist` for the private properties.

The general properties are accessed by: `process-property`, `(setf process-property)`, `remove-process-property`, `pushnew-to-process-property` and `remove-from-process-property`.

The private properties are accessed by: `get-process-private-property` (access from other processes), `process-private-property`, `(setf process-private-property)`, `remove-process-private-property`, `pushnew-to-process-private-property` and `remove-from-process-private-property`.

## 19.11 Other processes functions

### 19.11.1 Process Priorities

Each process has a priority and can either be runnable, blocked or suspended.

The effect of process priorities is significantly different between SMP LispWorks and non-SMP LispWorks.

### 19.11.1.1 Process priorities in SMP LispWorks

Process priorities are almost completely ignored in SMP LispWorks.

The main exception is that for processes that wait with `process-wait` for something to happen, a process with higher priority is likely to wake up earlier, but even then it is not guaranteed.

### 19.11.1.2 Process priorities in non-SMP LispWorks

If there is a runnable process with priority P, then no processes with priority less than P will run. When there are runnable processes with equal priority, they will be scheduled in a round-robin manner.

If a process with priority P is running and a blocked process with priority greater than P becomes runnable, the second process will run when the scheduler is next invoked (either explicitly or at the next preemption tick).

To find the priority of a process, use `process-priority`. This can be changed using `change-process-priority`.

```
(mp:change-process-priority proc-1 10)
```

Another way to specify the priority is to create the process with `process-run-function`, passing the keyword `:priority`:

```
(list
  (mp:process-run-function
    "SORTER-DOT" '(:priority 10) #'sorter #\.)
  (mp:process-run-function
    "SORTER-DASH" () #'sorter #\-))
```

### 19.11.2 Accessing symbol values across processes

Use `symeval-in-process` to read the value of a dynamically bound symbol in a given process.

`(setf mp:symeval-in-process)` can set the value of such a symbol.

`symeval-in-process` is mostly intended for debugging. Do not call it while the thread is actually running.

### 19.11.3 Stopping and unstopping processes

This section describes a typical way of using `process-stop` and `process-unstop`.

Suppose a pool of "worker" processes is managed by a "manager" process. A process in the worker pool marks itself as available for work, and then calls `process-stop`. The manager process later finds a worker process that is marked as available for work, puts the work in a place known to the worker process, and then calls `process-unstop` on the worker process.

For this scheme to work properly, the check of whether the worker is available needs to include a call to `process-stopped-p`. Otherwise, it is possible for the following sequence of events to occur:

1. A worker marks itself as available.
2. The manager process finds the worker and gives it the work.
3. The manager process calls `process-unstop` on the worker.
4. The worker process proceeds and calls `process-stop`, and never wakes up.

To guard against this possibility, then the manager should call `process-stopped-p` when finding the worker in the second step above. Alternatively, it could check the result of `process-unstop`.

## 19.12 Native threads and foreign code

Support for native threads differs between platforms as described in this section.

### 19.12.1 Native threads on Windows, Mac OS X, Linux, x86/x64 Solaris, FreeBSD and AIX

Each Lisp `mp:process` has a separate native thread and in LispWorks 6.0 and later versions these threads can run simultaneously.

**Note:** In LispWorks 5.1 and earlier versions, you can have many runnable `mp:process` objects/native threads, but Lisp code can only run in one thread at a time and a lock is used to enforce this. This can limit performance on a

computer with multiple CPU cores. When a foreign function is called using the FLI, the lock is released until the function returns. This allows other Lisp threads to run, for instance while waiting for a database query to execute.

You can call back into Lisp using `fli:define-foreign-callable` in any thread, without any other setup.

Threads running Lisp code can be rescheduled preemptively, so if you call into Lisp from more than one thread simultaneously and one request takes a long time then it will not delay the requests in other threads.

### 19.12.2 Native threads on other platforms

Lisp uses a single native thread and implements user level threads to support `mp:process`.

You can only call back into Lisp from its single native thread.

**Note:** This section applies only to LispWorks for SPARC Solaris.

### 19.12.3 Foreign callbacks on threads not created by Lisp

When foreign code creates a native thread (a "foreign thread") and code running on this thread calls into Lisp, then Lisp needs to associate a Lisp process object with this thread to be able to work properly.

When there is a call on a foreign thread into Lisp which is not a recursive call (an "outer call"), Lisp first checks if there is a process associated with this thread, and if there is it uses it. Otherwise, it creates a new process and associates it with the foreign thread. Recursive calls into Lisp (when Lisp calls foreign code which calls back into Lisp) are processed in the same way as recursive calls in Lisp threads.

When the outer call returns, Lisp by default keeps the process associated with the thread, but this is not guaranteed. Keeping the process means that next call into Lisp requires less work, but comes at the cost of using more memory. Lisp eliminates the process if it detects that the thread has died, if there is call to `last-callback-on-thread` inside the outer call or if the process is killed by `process-terminate`.

Once Lisp has a process associated with the thread, it establishes it as the current process, as returned by calling `get-current-process`, and then calls the foreign callable Lisp code.

Part of establishing the process involves binding the variables in `*process-initial-bindings*`. Note that this binding happens repeatedly for each outer call. The computation of the bound value is done when the process is created, so if the process is not eliminated between outer calls (the default behavior), this happens only once. The computation of the value occurs in the dynamic environment of the new process.

Compatibility note: Before LispWorks 7.1, the computation occurred in a "no-process" scope, and an error would have entered the debugger in the console without an option to abort.

#### 19.12.3.1 Performance considerations for foreign threads

Keeping the process between outer calls (the default behavior), makes each call faster, but uses memory. For few processes, this is probably the best approach. With many processes, the memory usage may become an issue.

There is an overhead for an outer call, which is larger than a recursive call. A few outer calls per second should not be a problem, but it should be avoided inside a heavy computation.

## 19.13 Low level operations

### 19.13.1 Low level atomic operations

Low level atomic operations are defined in all cases for a specific set of places. These places are listed in Table 19.1:

Table 19.1 Places for low-level atomic operations

Place	Notes
<code>(symbol-value symbol)</code>	When <i>symbol</i> is dynamically bound, this means the dynamically bound value.
A dynamically bound <i>symbol</i>	The dynamically bound value.
A lexically bound <i>symbol</i>	It is an error to use a low level atomic operation on a lexically bound symbol.
<code>(car cons)</code>	
<code>(cdr cons)</code>	
<code>(the type place)</code>	For another <i>place</i> listed in this table.
<code>(svref sv index)</code>	Only <code>simple-vector</code> .
Structure accessors	The structure must be defined at compile time.
<code>(slot-value object slot-name)</code>	See below.

Notes about atomic `slot-value` operations:

1. They ignore the MOP `slot-value-using-class` protocol and can only be used for `:instance` and `:class` allocated slots.

2. They are slower than the atomic operations on other types of object because they have to lock the instance. Normally it would be better to have a slot pointing to some other object (for example a structure) and do the atomic operations on that object.

The low level atomic operations implicitly ensure order of memory between operations in different threads.

The low level atomic operations are: `atomic-push`, `atomic-pop`, `atomic-fixnum-incf`, `atomic-fixnum-decf`, `atomic-incf`, `atomic-decf`, `atomic-exchange` and `compare-and-swap`.

Application of macros that are defined by `define-atomic-modify-macro` is also restricted to the places in Table 19.1 above, because they implicitly use low level atomic operations.

You can test whether a place is suitable for use with these operations by the predicate `low-level-atomic-place-p`.

### 19.13.2 Aids for implementing modification checks

The macros `with-modification-check-macro` and `with-modification-change` provide a way for a body of code to execute and check whether there was any "modification" during this execution, where modification is execution of some other piece of code. This is useful in situations when reading some data out of some data structure is more common than modification, and reading the data involves getting some values that need to be consistent. It makes it possible to ensure consistency of the values without a `lock`.

The checking code should be wrapped by the macro `with-modification-check-macro`, and the modifying code should be wrapped by the macro `with-modification-change`. They are associated by the fact that their `modification-place` argument is the same.

`modification-place` is a place as defined in Common Lisp (it does not need to be one of the places for atomic locking) which can receive a fixnum. It must be initialized to a fixnum. It must not be modified by any code except `with-modification-change`.

`with-modification-check-macro` defines a lexical macro (by `macrolet`) with the name `macro-name` which takes no arguments, and is used to check whether there was any change since the entering the body.

Note that these macros do not guard against errors that may occur because of changes to the data structures that are accessed, and do not create any locking between users of these macro. In particular, the modifying code will typically need to lock something too, and the checking code must do only operations that cannot fail because of modification in another thread.

### 19.13.2.1 Example modification check

```
(defstruct my-cache
  (modification-count 0)
  a
  b)

;; modifier code
(sys:with-modification-change
 (my-cache-modification-count cache)
 (setf (my-cache-a cache) (calculate-a-value ....)
       (my-cache-b cache) (calculate-b-value ....)))

;; reading code
(loop
 (sys:with-modification-check-macro
  my-cache-did-not-change-p (my-cache-modification-count cache)
  (let ((a (my-cache-a cache))
        (b (my-cache-b cache)))
    (when (my-cache-did-not-change-p)
      (return (values a b)))))
```

Provided that all modification to the `a` and `b` slots of a `my-cache` object are done by the modifier code above, the return values of `a` and `b` in the reading code are guaranteed to have been set by the same `setf` invocation in the modifier code.

### 19.13.3 Ensuring order of memory between operations in different threads

A set of synchronization functions is provided which ensure order of memory between operations in different threads. These are `ensure-loads-after-`

`loads`, `ensure-memory-after-store`, `ensure-stores-after-memory` and `ensure-stores-after-stores`.

**Note:** You should have a good understanding of multiprocessing issues at the CPU level to write code that actually needs these functions.

The effect of each of these functions is to ensure that all the operations of the first type (the word following the `ensure-`) that are in the program after the call to the function are executed after all the operations of the second type (last word in the function name) that are in the program before the call to the function.

Before or after "in the program" means the order that a programmer interpreting (correctly) the program would expect the operations to be executed. On a modern CPU this is not necessarily the same as the actual execution order. On a single CPU the end result is guaranteed to be the same, but on a computer with multiple CPU cores it is not.

An operation of type *load* is an operation that reads data from an object into a local variable. Typical *load* operations are `car`, `cdr`, `svref`, structure accessors, `slot-value` and getting the value of a symbol. A *store* operation is an operation that modifies data in an object. A *memory* operation is either a *load* or a *store*.

You need these functions when you need to synchronize between threads and you do not want to use the system supplied synchronization objects ("Locks", mailboxes, "Condition variables", "Counting semaphores", "Synchronization barriers"). In most cases you should try first to use a synchronization object. Using the synchronization functions described in this section is useful if you can identify a serious bottleneck in your code that can be optimized using them.

For simple cases you should consider whether `with-modification-check-macro` and `with-modification-change` gives you the functionality you need.

### 19.13.3.1 Example of ensuring order of memory

Suppose you have two code fragments, which may end up executed in parallel, and both of which access a global structure `*gs*`. The first fragment is a

setter, and you can be sure that it is not executed in parallel to itself (normally because it actually runs while holding a `lock`):

```
(setf
  (my-structure-value-slot *gs*) ; store1
  some-value)
(setf
  (my-structure-counter-slot *gs*) ; store2
  counter)
```

The second fragment is the reader. You want to guarantee that it gets a value that was stored after the counter reached some value (the counter value always increases). You may think that this will suffice:

```
(if (>=
      (my-structure-counter-slot *gs*) ; load1
      counter)
    (my-structure-value-slot *gs*) ; load2
  (.. something else ...))
```

Programmatically, if the `>=` is true then `store2` already occurred before `load1`, therefore `store1` also occurred before `load1`, and `load2` which happens after `load1` must happen after `store1`.

On a single CPU that is true. On a computer with multiple CPU cores it can go wrong (that is, `load2` can happen before `store1`) because of two possible reasons:

1. `load2` may happen before `load1`.
2. `store2` may happen before `store1`.

To guarantee that `load2` happens after `store1`, both of these possibilities need to be dealt with. Thus the setter has to be:

```
(setf (my-structure-value-slot *gs*) ; store1
      some-value)
(sys:ensure-stores-after-stores) ; ensure store order
(setf (my-structure-counter-slot *gs*) ; store2
      (incf-counter))
```

and the reader has to be:

```
(if (> (my-structure-counter-slot *gs*) ; load1
      my-counter)
    (progn
      (sys:ensure-loads-after-loads) ; ensure load order
      (my-structure-value-slot *gs*)) ; load2
    (.. something else ...))
```

Note that somehow both threads know about `counter`, and normally will have to synchronize the getting of its value too.

# 20

---

# Common Defsystem and ASDF

This chapter describes tools for managing programs comprising many source files. Most of the material concerns LispWorks' native `defsystem` ("Common Defsystem"), but the last section describes how to use the popular open source alternative ASDF with LispWorks.

## 20.1 Introduction

When an application becomes large, it is usually prudent to divide its source into separate files. This makes the individual parts of the program easier to find and speeds up editing and compiling. When you make a small change to one file, just recompiling that file may be all that is necessary to bring the whole program up to date.

The drawback of this approach is that it is difficult to keep track of many separate files of source code. If you want to load the whole program from scratch, you need to load several files, which is tedious to do manually, as well as prone to error. Similarly, if you wish to recompile the whole program, you must check every file in the program to see if the source file is out of date with respect to the object file, and if so re-compile it.

To make matters more complicated, files often have interdependencies; files containing macros must be loaded before files that use them are compiled. Similarly, compilation of one file may necessitate the compilation of another

file even if its object file is not out of date. Furthermore, one application may consist of files of more than one source code language, for example Lisp files and C files. This means that different compilation and loading mechanisms are required.

The LispWorks system tools, and the System Browser in the LispWorks IDE, are designed to take care of these problems, allowing consistent development and maintenance of large programs spread over many files. A system is basically a collection of files that together constitute a program (or a part of a program), plus rules expressing any interdependencies which exist between these files.

You can define a system in your source code using the `defsystem` macro. Once defined, operations such as loading, compiling and printing can be performed on the system as a whole. The system tools ensure that these operations are carried out completely and consistently, without doing unnecessary work. A system may itself have other systems as members, allowing a program to consist of a hierarchy of systems. Each system is treated independently of the others, and can be used to collect related pieces of code within the overall program. Operations on higher-level systems are invoked recursively on member systems.

It is also possible to define a system in your code using `asdf:defsystem`, an open source system definition utility with similar functionality to LispWorks `defsystem`. See “Using ASDF” on page 311 for a description of how to use ASDF with LispWorks.

## 20.2 Defining a system

A system is defined with a `defsystem` form in an ordinary Lisp source file. This form must be loaded into the Lisp image in order to define the system in the environment. Once loaded, operations can be carried out on the system by invoking Lisp functions, or, more conveniently, by using the system browser.

For example, the expression:

```
CL-USER 5 > (compile-system 'debug-app :force t)
```

would compile every file in a system called `debug-app`.

**Note:** When defining a hierarchy of systems, the leaf systems must be defined first — that is, a system must be declared before any systems that include it.

By convention, system definitions are placed in a file called `defsys.lisp` which usually resides in the same directory as the members of the system.

The full syntax is given in `defsystem`, page 1109. Below is a brief introduction.

### 20.2.1 DEFSYSTEM syntax

`defsystem` takes four arguments: *name*, *options*, *members* and *rules*.

*name* should be a string that names the system.

*options* is a list of keyword-value pairs specifying attributes of the system such as the default location of its member files or the default compiler optimize qualities in effect when `compile-system` is called.

*members* lists the members of the system which can be source files (of Common Lisp or foreign code) or other systems (that is, subsystems).

*rules* is a set of rules describing the requirements for compilation and loading of the system members and the order in which this should take place.

See the following sections for more information about these parameters.

### 20.2.2 DEFSYSTEM options

Options may be specified to `defsystem` which affect the behavior of the system as a whole. For example, `:package` specifies a default package into which files in the system are compiled and loaded if the file itself does not contain its own package declaration. The `:default-pathname` option tells the system tools where to find files which are not expressed as a full pathname.

### 20.2.3 DEFSYSTEM members

The `:members` keyword to `defsystem` is used to specify the members of a system. The argument given to `:members` is a list of strings. A system member is either a file or another system, identified by a name. If a full pathname is given then the function `pathname-name` is used to identify the name of the

member. Thus, for example, the name of a member expressed as `/u/duby/a/foo.lisp` is `foo`.

System members must have unique names, by a case-insensitive string comparison, so if a system has a member called "`foo`" then it cannot have another member (a file or a system) named "`foo`", "`FOO`" or `foo`.

The behavior of any member within a system can be constrained by supplying keyword arguments to the member itself. So, for example, specifying the `:source-only` keyword ensures that only the source file for that member is ever loaded.

#### 20.2.4 DEFSYSTEM rules

Rules may be defined in a system which modify the default behavior of that system, ensuring, for instance, that certain files are always loaded or compiled before others.

Rules apply to files and subsystems alike as members of their parent system, but are not inherited by subsystems.

When you invoke an action such as compiling a system, the following happens by default:

- Each member of the system is considered in turn, in the order they are given in the system definition.
- If the member is itself a system then the action is performed on that system too, and so on recursively.
- If the member is a file and action-specific constraints are satisfied, the file action is inserted into a *plan*.

For example, in the case of compiling, a “compile this file” event is put into the plan if the source file is newer than the object file.

- After the plan has been assembled, it can be viewed or executed.

This behavior can be modified by describing dependencies between the members using *rules*. These are specified using the `:rules` keyword to `defsystem`.

A rule has three components:

The target(s).	The action that is performed if the rule executes successfully.
	This is an action-member description like <code>:compile "foo"</code> . The member can be an actual member of the system or <code>:all</code> (meaning the rule should apply to each member of the system).

The actions that the target(s) are `:caused-by`.

The actions that cause the rule to execute successfully.

This is a list of action-member descriptions. The member of each of these descriptions should be either a real system member, or `:previous`, which means all members listed before the member of the target in the system description.

If any of these descriptions are already in the current plan (as a result of other rules executing successfully, or as a result of default system behavior), they trigger successful execution of this rule.

The actions that the target(s) `:requires`.

The actions that need to be performed before the rule can execute successfully.

This is a list of action-member descriptions that should be planned for before the action on the target(s). Again, each member should either be a real member of the system, or `:previous`.

The use of the keyword `:previous` means, for example, that you can specify that in order to compile a file in the system, all the members that come before it must be loaded.

When the action and member of a target are matched during the traversal of the list of members, the target is inserted into the plan if either of the following are true:

- any of the action-member descriptions in the `:caused-by` clause is already in the plan, or

- any implicit conditions (such as the source file being newer than the object file) are satisfied.

If the target is put into the plan then other targets are inserted beforehand if the action-member description of any `:requires` clause is not already in the plan.

### 20.2.5 Examples

Consider an example system, `demo`, defined as follows:

```
(defsystem demo (:package "USER")
  :members ("parent"
            "child1"
            "child2")
  :rules ((:in-order-to :compile ("child1" "child2"))
           (:caused-by (:compile "parent")))
           (:requires (:load "parent"))))
```

This system compiles and loads members into the `USER` package if the members themselves do not specify packages. The system contains three members — `parent`, `child1`, and `child2` — which may themselves be either files or other systems. There is only one explicit rule in the example. If `parent` needs to be compiled (for instance, if it has been changed), then this causes `child1` and `child2` to be compiled as well, irrespective of whether they have themselves changed. In order for them to be compiled, `parent` must first be loaded.

Implicitly, it is always the case that if any member changes, it needs to be compiled when you compile the system. The explicit rule above means that if the changed member happens to be `parent`, then every member gets compiled. If the changed member is not `parent`, then `parent` must at least be loaded before compiling takes place.

The next example shows a system consisting of three files:

```
(defsystem my-system
  (:default-pathname "~/junk/")
  :members ("a" "b" "c")
  :rules ((:in-order-to :compile ("c"))
           (:requires (:load "a")))
           (:caused-by (:compile "b"))))
```

What plan is produced when all three files have already been compiled, but the file `b.lisp` has since been changed?

First, file `a.lisp` is considered. This file has already been compiled, so no instructions are added to the plan.

Second, file `b.lisp` is considered. Since this file has changed, the instruction `compile b` is added to the plan.

Finally file `c.lisp` is considered. Although this has already been compiled, the clause

```
(:caused-by (:compile "b"))
```

causes the instruction `compile c` to be added to the plan. The compilation of `c.lisp` also requires that `a.lisp` is loaded, so the instruction `load a` is added to the plan first. This gives us the following plan:

1. Compile `b.lisp`.
2. Load `a.lisp`.
3. Compile `c.lisp`.

This last example shows how to make each fasl get loaded immediately after compiling it:

```
(defsystem my-system ()
  :members ("foo" "bar" "baz" "quux")
  :rules ((:in-order-to :compile :all
    (:requires (:load :previous)))))

(compile-system my-system :load t)
```

## 20.3 Using ASDF

You can load the supplied version of ASDF 2 by

```
(require "asdf")
```

Optionally, if you actually want your later version of ASDF 2, do

```
(asdf:load-system :asdf)
```

You may need to configure ASDF. For the language-level interface you should follow the ASDF documentation at <http://common-lisp.net/project/asdf/>.

Then load your ASDF system definitions and you are ready to work with ASDF systems in LispWorks.

It is possible to work with both Common Defsystem and ASDF in the same LispWorks image, as long as you use the appropriate APIs to operate on each type of system.

### 20.3.1 Bypassing the supplied version of ASDF

To use a specific version of ASDF 2 without loading the version supplied with LispWorks, you should load it directly and then call

```
(provide "asdf")
```

to prevent the distributed version from being loaded later.

### 20.3.2 Using ASDF in the LispWorks IDE

You can work with your ASDF systems using the LispWorks IDE tools.

This needs some integration code which makes the System Browser, Editor and Search Files tools work with ASDF systems as well as 'native' LispWorks systems. The ASDF integration code is in

```
(example-edit-file "misc/asdf-integration")
```

in the LispWorks library and if necessary you can load it directly. However, it is more convenient to rely on this code being loaded automatically.

The variable `*autoload-asdf-integration*` is consulted when the LispWorks IDE starts. If its value is true (this is the default) then the ASDF integration code is loaded automatically when ASDF is loaded.

See the comments in `asdf-integration.lisp` for more information about using ASDF with LispWorks.

# 21

---

## The Parser Generator

### 21.1 Introduction

The parser generator generates an LALR parser from a specification of a grammar. The parser generator has a simple facility for the static resolution of ambiguity in the grammar and supports an automatic run time error correction mechanism as well as user-defined error correction. Semantic actions can be included in the rules for the grammar by specifying Lisp forms to be evaluated when reductions are performed.

For further details on LALR parsing, see *Compilers, Principles Techniques and Tools*, by Aho, Sethi and Ullman, publishers Addison Wesley, 1986.

Load the parser generator by (`(require "parsergen")`).

### 21.2 Grammar rules

The parser generator is accessed by the macro `defparser`. After the *name*, of the parser, the macro form specifies the reduction rules and semantic actions for the grammar.

The *rules* specified in a `defparser` form are of three types, *normal rules*, *error rules* and *combined-rules*, described below.

Each *normal rule* corresponds to one production of the grammar to be parsed:

```
( (non-terminal {grammar-symbol}*) {form}*)
```

The *non-terminal* is the left-hand side of the grammar production and the list of grammar symbols defines the right-hand side of the production. (The right-hand side may be empty.) The list of forms specifies the semantic action to be taken when the reduction is made by the parser. These forms may contain references to the variables \$1 ... \$n, where n is the length of the right hand side of the production. When the reduction is done, these variables are bound to the semantic values corresponding to the grammar symbols of the rule.

### 21.2.1 Example

If a grammar contains the production:

```
expression -> expression operator expression
```

with a semantic representation of a list of the individual semantic values, the Lisp grammar would contain the rule:

```
((expression expression operator expression) (list $1 $2 $3))
```

Error productions of the form:

```
((nt :error) (some error behavior))
```

are explained in the section below.

The first rule of the grammar should be of the form:

```
((nt nt1) $1)
```

where the non-terminal *nt* has no other productions and *nt1* serves as the main “top-level” non-terminal.

### 21.2.2 Combined rules

The *combined-rule* clause is a way to group multiple *normal-rule* or *error-rule* clauses for the same non-terminal. For example, this single *combined-rule* clause:

```
(constant
  ((:FLOAT-CONSTANT) $1)
  ((:INTEGER-CONSTANT) $1))
```

is equivalent to these two *normal-rule* clauses:

```
((constant :FLOAT-CONSTANT) $1)
((constant :INTEGER-CONSTANT) $1)
```

### 21.2.3 Resolving ambiguities

If the grammar is ambiguous, there is conflict between rules of the grammar: either between reducing with two different rules or between reducing by a rule and shifting an input symbol. Such a conflict is resolved at parser generation time by selecting the highest priority action, where the priority of a reduce action is determined by the closeness of the rule to the beginning of the grammar. A priority is assigned to a shift by associating it with the rule that results in the shift being performed.

For example, if the grammar contains the two rules:

- Rule a: *statement* -> `:if expression :then statement :else statement`
- Rule b: *statement* -> `:if expression :then statement`

this results in a conflict in the parser between a shift of `:else`, for rule a, and a reduce by rule b. This conflict may be resolved by listing rule a earlier in the grammar than rule b. This ensures that the shift is always done.

Note that ambiguities cannot always be resolved successfully in this way. In this example, if the ambiguity is resolved the other way around, by listing rule b first, this results in the `if ... then ...` part of an `if ... then ... else ...` statement being reduced, and a syntax error is produced for the `else` part.

During parser generation, any conflicts between rules are reported, together with information about how the conflict was resolved.

## 21.3 Functions defined by defparser

The form `(defparser name grammar)` defines a number of functions. The main function *name* is defined as the parsing function. For example:

```
(defparser my-parser .. grammar .. )
```

defines the function

```
my-parser lexer &optional symbol-to-string =>
```

`lexer` specifies the lexical analyzer function to be used. The optional argument `symbol-to-string` should be a function mapping grammar symbols to strings for printing purposes. The default value of `symbol-to-string` is the function `c1:identity`.

`defparser` also defines functions corresponding to the individual actions of the parser.

Normal actions are named:

`name-actionindex`

and error actions are named:

`name-error-actionindex`

where `name` here is the name as given to `defparser` and `index` is the number of the rule or error rule in the grammar.

All function names are interned in the current package when `defparser` is called.

## 21.4 Error handling

The parser supports automatic error correction of its input. The strategy used involves attempting to either push a new token onto the input, replacing an erroneous symbol, or discarding an erroneous symbol. Such action is only taken if it is guaranteed that the parser can continue parsing and read at least one more symbol from its input.

If the correction strategy fails, then error recovery is invoked.

The parser allows the inclusion of grammar productions of the form:

`non-terminal -> :error`

This means that the parser accepts an erroneous string of tokens as constituting an occurrence of the non-terminal. Such productions may be used to skip over portions of input when attempting to recover from an error. The action associated with such an error is specified by a form in the same way as for ordinary actions. The action may perform manipulation of the parser state and input.

## 21.5 Interface to lexical analyzer

The lexical analyzer function that is passed to the parser is expected to be a function of zero arguments that returns two values each time it is called. The first value is the next token on the input and the second value is the semantic value corresponding to that token. If there is no more input, then the lexical analyzer may return either the token `:eof` or `nil`.

For example:

```
(defparser my-parser
  ...)

(defun my-lexer (stream)
  .. read next token from stream ..
  (values token value))
(defun my-symbol-to-string (symbol)
  .. returns a string ..)
(defun my-parse-stream (stream)
  (let ((lexer #'(lambda () (my-lexer stream))))
    (my-parser lexer #'my-symbol-to-string)))
```

Note that during error correction, the parser may push extra tokens onto the input, in which case they are given the semantic value `nil`. The semantic actions should therefore be capable of dealing with this situation. Manipulation of the input (for example pushing extra tokens) is done within the parser generator and the lexical analyzer need not concern itself with this.

## 21.6 Example

The following example shows a simple grammar for a very small subset of English.

```

(defpackage "ENGLISH-PARSER")
  (:use "PARSERGEN")
  (:add-use-defaults t))
(in-package "ENGLISH-PARSER")

;; Define the parser itself.

(defparser english-parser
  ((bs s) $1)
  ((s np vp)
   `($1 ,$2))
  ((bnp :adj bnp)
   `($1 ,$2))
  ((bnp bnp relp)
   `($1 ,$2))
  ((bnp :noun) $1)
  ((relp :rel vp)
   `($1 ,$2))
  ((vp :verb np locp)
   `($1 ,$2 ,$3))
  ((vp :verb locp)
   `($1 ,$2))
  ((vp :verb np)
   `($1 ,$2))
  ((vp :verb)
   $1)
  ((np :art bnp locp)
   `($1 ,$2 ,$3))
  ((np :art bnp)
   `($1 ,$2))
  ((np bnp) $1)
  ((locp :loc np)
   `($1 ,$2)))

;; The lexer function.

;; The basic lexing function

(defvar *input*)
(defun lex-english ()
  (let ((symbol (pop *input*)))
    (if symbol (get-lex-class symbol)
        nil)))

;; Getting syntactic categories.

(defparameter *words*

```

```
'((the :art) (a :art) (some :art) (ate :verb) (hit :verb)
(cat :noun) (rat :noun) (mat :noun) (which :rel) (that :rel)
(who :rel) (man :noun) (big :adj) (small :adj) (brown :adj)
(dog :noun) (on :loc) (with :loc) (behind :loc) (door :noun)
(sat :verb) (floor :noun)))

(defun get-lex-class (word)
  (values
    (or (cadr (assoc word *words*))
        :unknown)
    word))

;;; The main function -- note bindings of globals (these
;;; are exported from the parsergen package).

(defun parse-english (input)
  (let ((*input* input)
        (english-parser #'lex-english)))
```

The following example session shows the parsing of some sentences.

```
ENGLISH-PARSER 34 > (parse-english '(the cat sat on the
                                      mat))
((THE CAT) (SAT (ON (THE MAT)))))

ENGLISH-PARSER 35 > (parse-english '(the big brown dog
                                      behind the door ate the cat
                                      which sat on the floor))
((THE (BIG (BROWN DOG)) (BEHIND (THE DOOR)))
 (ATE (THE (CAT (WHICH (SAT (ON (THE FLOOR))))))))
```



# 22

---

# Dynamic Data Exchange

## 22.1 Introduction

Dynamic data exchange (DDE) involves passing data and instructions between applications running under the Microsoft Windows operating system. Typically the data is passed in the form of a string, which is interpreted when it is received. One application acts as a *server* and the other as a *client*.

### 22.1.1 Types of transaction

The server is normally a passive object, which waits for a client object to tell it what to do. The client can communicate with the server in four ways:

- The client can issue a *request transaction* to the server. This means the client is asking for some information about the server application.
- The client can issue a *poke transaction*. This means the client is passing data to be stored by the server application.
- The client can issue an *execute transaction*. This means the client is asking the server to get the server application to run a command.
- The client can ask the service to set up an *advise loop*, or to close an existing advise loop. An advise loop causes the server to communicate with the client whenever a specified change occurs in the server application.

### 22.1.2 Conversations, servers, topics, and items

For a transaction to take place between a client and a server, a conversation must be established. A conversation is established when a client makes a request by broadcasting a service name and topic name, and a server responds. Transactions can then take place across the conversation. When no more transactions are to be made, the conversation is terminated.

The following list identifies the elements involved with client/server activity:

- |              |   |
|--------------|---|
| conversation | A conversation is established when a server responds to a client.   |
| service name | A service name is a string broadcast by a client hoping to establish a conversation with a server that recognizes the service name. The service name is usually clearly related to the server application name.   |
| topic name   | The topic name identifies what the conversation between client and server is to be about. For example, it could be the name of a file that is open in the server application. Each topic is attached to one particular server. A server can have many topics. |
| item name    | The item usually identifies an element of the file identified by the topic which should be read (in the case of a request) or written to (in the case of a poke). For example, it might refer to a cell in a spreadsheet document.                            |

### 22.1.3 Advise loops

A DDE advise loop describes a connection back to the application that is used to track changes to a DDE topic. It instructs the server to inform the client when data in the server's application changes. Advise loops are set up across a conversation, and closing the conversation closes the advise loop.

An advise loop is identified by an item and a key. The key is included to allow any number of uniquely identifiable advise loops to be set up on the same server/topic/item combination.

A successfully established advise loop is also known as a link. When a change occurs to item, the link informs the client by causing it to execute a function.

There are two types of link: the warm link which only informs the client that a change to item has occurred, and the hot link which also sends the new data across.

**Note:** a DDE advise loop is not a loop in the program source code. In particular it should not be confused with the "event loop" which is a loop in source code that processes low level events.

#### 22.1.4 Execute transactions

When a client issues an execute transaction to a server, the command to be executed is transferred as a string. This involves the marshalling of the command and its arguments into a suitable string format. The standard format of such a string is:

```
[command(arg1,arg2,...)]
```

## 22.2 Client interface

### 22.2.1 Opening and closing conversations

A LispWorks client can open a conversation by using `dde-connect`, which takes a service designator and a topic designator as its arguments. If successful, a conversation object is returned which can be used to refer to the conversation. Conversations are closed by the LispWorks client at the end of a transaction by using `dde-disconnect`.

Another method for managing conversations uses `with-dde-conversation` to bind a conversation with a server across a body of code. If no conversation is available for `with-dde-conversation`, then one is automatically opened. The code is executed and the conversation is closed after the body of code exits.

### 22.2.2 Automatically managed conversations

There is an alternative to manually establishing a conversation and then disconnecting it once all transactions between server and client are concluded: the automatically managed conversation. Client functions that end with a \* conduct automatically managed conversations.

A function handling an automatically managed conversation takes a service designator and topic designator as two of its arguments, and either automatically establishes a conversation with a server responding to the service designator/topic designator pair, or uses an existing equivalent conversation. For the purpose of brevity, functions conducting automatically managed conversations are only briefly mentioned in this chapter. For the details see `dde-advise-start*`, `dde-advise-stop*`, `dde-execute*`, `dde-execute-command*`, `dde-execute-string*`, `dde-item*`, `dde-poke*` and `dde-request*`.

### 22.2.3 Advise loops

A LispWorks client can set up an advise loop across a conversation using `dde-advise-start`, which takes a *conversation* (or a *service designator/topic* designator pair in the case of an automatically managed conversation using `dde-advise-start*`), an *item*, and a *key* as its main arguments. The *key* argument defaults to the conversation name, and can be used to distinguish between multiple advise loops established on the same service/topic/item group.

Whenever the data monitored by the advise loop changes, a function is called to inform the client. By default this function is the generic function `dde-client-advise-data`. You can add methods to `dde-client-advise-data` specialized on the *key* or the client conversation class. Alternatively, you can supply a different function in the call to `dde-advise-start`.

**Note:** a DDE advise loop is not a loop in the program source code. In particular it should not be confused with the "event loop" which is a loop in source code that processes low level events.

#### 22.2.3.1 Example advise loop

The example shows you how to set up an advise loop. The code assumes that `win32` package symbols are visible.

The first step defines a client conversation class, called `my-conv`.

```
(defclass my-conv (dde-client-conversation)
  ())
```

The macro `define-dde-client` can now be used to define a specific instance of the `my-conv` class for referring to a server application that responds to the service name "FOO".

```
(define-dde-client :foo :service "FOO" :class my-conv)
```

The next step defines a method on `dde-client-advise-data` which returns a string stating that the item has changed.

```
(defmethod dde-client-advise-data ((self my-conv) item data &key
  &allow-other-keys)
  (format t "~&Item ~s changed to ~s~%" item data))
```

Finally, the next command starts the advise loop on the server `foo`, with the topic name "`file1`", to monitor the item "`slot1`".

```
(dde-advise-start* :foo "file1" "slot1")
```

When the value of the item specified by "`slot1`" changes, the server calls `dde-client-advise-data` which returns a string, as described above.

The *function* argument of `dde-advise-start` and `dde-advise-start*` specifies the function called by the advise loop when it notices a change to the item it is monitoring. The function is `dde-client-advise-data` by default. A different function can be provided, and should have a lambda list similar to the following:

```
key item data &key conversation &allow-other-keys
```

The arguments *key* and *item* identify the advise loop, or link. The argument *data* contains the new data for hot links; for warm links it is `nil`.

Advise loops are closed using `dde-advise-stop` or `dde-advise-stop*`.

#### 22.2.4 Request and poke transactions

LispWorks clients can issue request and poke transactions across a conversation using `dde-request` and `dde-poke`, which take a *conversation* (or a *service designator/topic* designator pair in the case of an automatically managed conversation), and an *item* as their main arguments. In the case of a poke transaction, data to be poked into *item* must also be provided.

In the case of a successful request transaction with `dde-request` or `dde-request*`, the data contained in *item* is returned to the LispWorks client by the server.

In the case of a successful poke transaction with `dde-poke` or `dde-poke*`, the data provided is poked into *item* by the server.

The accessor `dde-item` (or `dde-item*` for automatically managed conversations) can perform request and poke transactions. It performs a request transaction when read, and a poke transaction when set.

### 22.2.5 Execute transactions

A client can issue an execute transaction across a conversation, or in the case of an automatically established conversation, to a recognized server. There is no need to specify a topic, as an execute transaction instructs the server application to execute a command.

The command and its arguments are issued to the server in the form of a string in a standard format (see “Execute transactions” on page 323). LispWorks provides two ways of issuing an execute transaction, namely `dde-execute-string` and `dde-execute-command` (and the corresponding \* functions that automatically manage conversations).

The following example shows how `dde-execute-string*` can issue a command to a server designated by `:excel` on the topic `:system`, in order to open a file called `foo.xls`:

```
(dde-execute-string* :excel :system "[open(\"foo.xls\")]")
```

The function `dde-execute-command` takes the command to issue, and its arguments, and marshals these into an appropriate string for you. The following example shows how `dde-execute-command*` can issue the same command as in the previous example:

```
(dde-execute-command* :excel :system 'open '("foo.xls"))
```

## 22.3 Server interface

### 22.3.1 Starting a DDE server

To provide a LispWorks application with a DDE server, follow the following three steps.

1. Define a specialized Lisp DDE server class using `define-dde-server`. Here the server class is called `foo-server` and it has the service name "FOO":  

```
(define-dde-server foo-server "FOO")
```
2. Provide the server class with the functionality it requires by specializing methods on it and/or using `define-dde-server-function`. Here the server function is `bar`, which takes a string as an argument, and prints this to the standard output. For convenience, the system topic is used, though usually it is better to define your own topic.  

```
(define-dde-server-function (bar :topic :system)
    :execute
    ((x string))
    (format t "~&~s~%" x)
    t)
```

3. Start an instance of the server `foo-server` using `start-dde-server`.

```
(start-dde-server 'foo-server)
```

This function returns the server object, which responds to requests for conversations with the service name "FOO", and accepts execute transactions for the function `bar` in the "System" topic.

### 22.3.2 Handling poke and request transactions

Poke and request transactions issued to a server object are handled by defining a method on each of the generic functions `dde-server-poke` and `dde-server-request`.

### 22.3.3 Topics

DDE servers respond to connection requests containing a service name and a topic name. The service name of a server is the same for any conversation

whereas the topic name may vary from conversation to conversation, and identifies the context of the conversation. Typically, valid topics correspond to open documents within the application, so the set of valid topics varies from time to time. In addition, all servers implement a topic called "`System`", which contains a standard set of items that can be read.

The LispWorks DDE interface supports three types of topics:

- 1. General topics**

A general topic is an instance of a user-defined topic class. The actual set of topics available may vary from time to time as the application is running.

- 2. Dispatching topics**

A dispatching topic has a fixed name, and is available at all times that the server is running. It supports a fixed set of items, and each of these items has Lisp code associated with it to implement these items.

- 3. The system topic.**

The system topic is provided automatically by the LispWorks DDE interface. However, a mechanism is provided to extend the functionality of the system topic by handling additional items.

### 22.3.3.1 General topics

To use general topics, the LispWorks application must define one or more subclasses of `dde-topic`. If an application supports only a single type of document, it will typically require only one topic class. If several different types of document are supported, it may be convenient to define a different topic class for each type of document.

If the application uses general topics, it should define a method on the `dde-server-topics` generic function, specializing on the application's server class.

### 22.3.3.2 Dispatching topics

A dispatching topic is a topic which has a fixed name and always exists. Dispatching topics provide dispatching capabilities, whereby appropriate appli-

cation-supplied code is executed for each supported transaction. Dispatch topics are defined using `define-dde-dispatch-topic`.

### 22.3.3.3 The system topic

The system topic is implemented as a predefined dispatching topic called `:system`. It is automatically available to all defined DDE servers. Its class is `dde-system-topic`, which is a subclass of `dde-topic`.

The following items are implemented by the system topic:

<b>SZDDESYS_ITEM_TOPICS</b>	<i>Constant</i>
-----------------------------	-----------------

The constant `SZDDESYS_ITEM_TOPICS` has the value "`Topics`". Referring to this item in the system topic calls `dde-server-topics` to obtain a list of topics implemented by the server. The server should define a method on this generic function to return a list of strings naming the topics supported by the server. If this item is not to be implemented, do not define a method on the function, or define a method that returns `:unknown`.

<b>SZDDESYS_ITEM_SYSITEMS</b>	<i>Constant</i>
-------------------------------	-----------------

The constant `SZDDESYS_ITEM_SYSITEMS` has the value "`sysItems`". Referring to this item in the system topic calls `dde-topic-items` to obtain a list of items implemented by the system topic. If a server implements additional system topic items it should define a method on the generic function specialized on its server class and `dde-system-topic` returning the complete list of supported topics. The server can return `:unknown` if this item is not to be implemented.

<b>SZDDESYS_ITEM_FORMATS</b>	<i>Constant</i>
------------------------------	-----------------

The constant `SZDDESYS_ITEM_FORMATS` has the value "`Formats`", and returns `unicodetext` and `text`. Currently only text formats are supported.

The system topic is a single object which is used by all DDE servers running in the Lisp image. You should therefore not under normal circumstances modify

it with `define-dde-server-function` by specifying a value of `:system` for the *topic* argument, as this would make the changes to the system topic visible to all users of DDE within the Lisp image.

Instead, specify `:server my-server :topic :system`, where *my-server* is the name of your DDE server. This makes the additional items available only on the system topic of the specified server.

# 23

---

# Common SQL

This chapter is applicable to UNIX LispWorks and the Enterprise Edition of LispWorks. It describes Common SQL — the LispWorks interface to SQL. It should be used in conjunction with Chapter 47, “The SQL Package”, which contains full reference entries for all the symbols in the SQL package.

For a longer introduction to Common SQL, please see the SQL Tutorial available at [www.lispworks.com](http://www.lispworks.com).

## 23.1 Introduction

This chapter covers the following areas:

- Initialization and Connection
- The Functional SQL Interface
- The Object-Oriented (CLOS) SQL Interface
- The Symbolic SQL Syntax
- SQL I/O Recording
- SQL Interface Errors

The LispWorks SQL interface uses the following database terminology:

***Data Definition Language (DDL)***

The language used to specify and interrogate the structure of the database schema.

***Data Manipulation Language (DML)***

The language used for retrieving and modifying data.  
Also known as *query language*.

<i>table</i>	A set of records. Also known as <i>relation</i> .
<i>attribute</i>	A field of information in the table. Also known as <i>column</i> .
<i>record</i>	A complete set of attribute values in the table. Also known as <i>tuple</i> , or <i>row</i> .
<i>view</i>	A display of a table configured to your own needs. Also known as <i>virtual table</i> .

### 23.1.1 Overview

Common SQL is designed to provide both embedded and transparent access to relational databases from the LispWorks environment. That is, SQL/relational data can be directly manipulated from within Lisp, and also used as necessary when instantiating or accessing particular Lisp objects.

The SQL interface allows the following:

- Direct use of standard SQL statements as strings
- Mixed symbolic SQL and Common Lisp expressions
- Implicit SQL invocation when instantiating or accessing CLOS objects

The SQL interface provides these features through two complementary layers:

- A *functional* SQL interface
- An *object-oriented* SQL interface

The functional interface provides users with Lisp functions which map onto standard SQL DML and DDL commands. Special iteration constructs which utilize these functions are also provided. The object-oriented interface allows users to manipulate database views as CLOS classes via `def-view-class`.

### 23.1 Introduction

The two interfaces may be flexibly combined in accordance with system requirements and user preference. For example, a *select* query can be used to initialize slots in a CLOS instance; conversely, accessing a CLOS slot may trigger an implicit functional query.

#### 23.1.2 Supported databases

Common SQL supports connections to various databases using the driver/client libraries for each interface-platform combination as indicated below in Table 23.1.

Common SQL may work, but is currently untested, with driver/interface/platform combinations shown as "None tested". We would be pleased to hear of your experience with these other driver/interface/platform combinations, at [lisp-support@lispworks.com](mailto:lisp-support@lispworks.com):

Table 23.1 Supported driver/client libraries for each interface-platform combination

interface (module name)	"odbc"	"oracle"	"postgresql"	"mysql"	"sqlite"
Default database type	<code>:odbc-driver</code>	<code>:oracle</code>	<code>:postgresql</code>	<code>:mysql</code>	<code>:sqlite</code>
Other database type	<code>:odbc</code>	<code>:oracle8</code>	None	None	None
Windows	Microsoft SQL Server Oracle Postgres	Oracle 9i(r2) and later	Postgres	MySQL	SQLite 3.6.12 or later
Mac OS X	MySQL Postgres	Oracle 10g and later	Postgres	MySQL	SQLite 3.6.12 or later
Linux	MySQL Postgres	Oracle 9i(r2) and later	Postgres	MySQL	SQLite 3.6.12 or later
FreeBSD	None tested	Not supported	Postgres	MySQL	SQLite 3.6.12 or later
Solaris/Intel	None tested	Oracle 10g and later	Postgres	MySQL	None tested

Table 23.1 Supported driver/client libraries for each interface-platform combination

<i>interface</i> (module name)	"odbc"	"oracle"	"postgresql"	"mysql"	"sqlite"
AIX	None tested	Oracle 11 and later	None tested	None tested	None tested
Solaris/SPARC	None tested	Oracle 9i(r2) and later	None tested	MySQL	None tested

The keyword shown in the second and third rows is the corresponding value of the *database-type* argument to `connect`. When a client library version is shown, it is the earliest version that was tested successfully: later versions should work too, and in many cases earlier versions may work too.

**Note:** MySQL versions prior to 4.1.1 should be run in ANSI mode to work with Common SQL. That is, `mysqld` must be started with `--ansi` or the `ansi` option must appear in the `[mysqld]` section of its configuration file.

**Note:** To use PostgreSQL on any non-Microsoft Windows platform, LispWorks/Common SQL requires PostgreSQL version  $\geq 8.x$  built with `--enable-thread-safety`.

## 23.2 Initialization

The initialization of Common SQL involves three stages. Firstly the SQL interface is loaded. Next, the database type (actually class) to be used is initialized. Finally, Common SQL is used to connect to a database. These stages are explained in more detail in this section.

The Lisp symbols introduced in this chapter are exported from the `sql` package. Application packages requiring convenient access to these facilities should therefore use the `sql` package.

The examples in this chapter assume that the `sql` package is visible.

### 23.2.1 Initialization steps

Three steps are required to initialize the SQL interface:

1. At load time, the SQL interface is loaded.

## 23.2 Initialization

2. At run time, database type(s) are initialized. This step can be merged into step 3.
3. A connection is made to a database server. All further operations use the connection.

The remainder of this section describes how you perform these steps.

1. Load the SQL interface by calling `require` with the name of a database interface.

Currently implemented interfaces are "oracle", "mysql", "odbc", "postgresql" and "sqlite". However, not all platforms support all interfaces, see Table 23.1, page 333 for details.

The same application can use more than one interface, and needs to call `require` to load each interface that it uses.

Loading is done at load time. In particular, if you are building an application, loading needs to be done before calling `deliver`.

2. Initialize the database type, either when connecting or by an explicit call.

Every connection has a database type, which defines the functionality to use when performing operations on it. Each interface defines one or more database types that can be used as the database type. The database type must be initialized, which can be done either when connecting, or by explicitly calling `initialize-database-type`. Initializing a database type must be done at run time, in other words you should not save an image (by `save-image` or `deliver`) with an initialized database type.

Initializing a database type typically means that the system finds the library that implements the client, loads and initializes it. (Actually, there may be several libraries.) It is possible to delay the initialization until making the connection, but it is useful to do the initialization explicitly first as this allows you to catch errors in the initialization and report them.

The variable `*default-database-type*` holds the value of the default type, which is used when a database type is not supplied. The first database interface that is loaded sets `*default-database-type*` to its default database type. Therefore in a typical setup using one interface you do not need to specify the database type.

The database types currently supported are shown in Table 23.2:

Table 23.2 Supported database types

Interface	<i>database-type</i>	Comments
"oracle"	:oracle	default
"oracle"	:oracle8	for backwards compatibility
"mysql"	:mysql	default
"postgresql"	:postgresql	default
"odbc"	:odbc-driver	default
"odbc"	:odbc	uses <code>SQLConnect</code> rather than <code>SQLDriverConnect</code>
"sqlite"	:sqlite	default

### 3. Connect to a database by calling `connect`.

The main argument to `connect` is a connection-spec, which is interpreted in a database type specific way. See the entry for `connect` for details. By default, `connect` uses the database type in `*default-database-type*`, but it can be specified explicitly by the keyword argument `:database-type`. If the database type was not initialized yet, `connect` initializes it.

The result of `connect` is an object which is referred to as "database object", but it is really a connection object representing a connection to the server. It is possible to have multiple database objects connected independently to the same database server.

The database object is used by all the other Common SQL interface functions. `connect` sets the value of `*default-database*` to the result each time it is called, so a call to a SQL interface function without specifying the database always acts on the last connected database. That allows simpler code when there is only one connection. When there is more than one connection, you need to pass the database object to the interface function via the keyword argument `:database`.

## 23.2 Initialization

When a connection is no longer required, it should be closed by calling `disconnect`.

The minimal code to initialize a connection is loading the code and connecting. For example, using only Oracle:

```
(require "oracle")
(sql:connect "scott/tiger")
```

However, if you deliver an application then the `require` call needs to happen at load time (before calling `deliver`), while the `connect` call must happen at run time after the delivered application started. So your code should have two parts:

- In the script that loads the application code:

```
(require "oracle")
```

- In the code itself, at various places:

```
(sql:connect "scott/tiger")
```

To get better error handling, you may want to add a call to `initialize-database-type`, in the startup function:

```
(handler-case
  (sql:initialize-database-type)
  (error (cc)
    ;; tell the user of failure to initialize Oracle
  ))
```

### 23.2.2 Database libraries

**Note:** This section applies only to Unix-like operating systems.

To use a database, LispWorks needs to load foreign libraries, which is done when initializing the database type. To find the right libraries and initialize them, there may be vendor-specific environment variable(s) that need to be set, for example `ORACLE_HOME` for Oracle. Typically one of these will point to a directory where the database code is installed. You may need to ensure that these variables are set properly when your application is used.

In order to override the default loading of database library code, you may set `*sql-libraries*`. To control messages while loading the libraries, set `*sql-loading-verbose*`.

### 23.2.3 General database connection and disconnection

Database connections can be named by passing the `:name` argument to `connect`, allowing you to have more than one connection to a given database. If this is omitted, then a unique database name is constructed from `connection-spec` and a counter. Connection names are compared with `equalp`.

To find all the database connection instances, call the function `connected-databases`. To retrieve the `name` for a connection instance, call `database-name`, and to find a connection instance with a given name use `find-database`. To print status information about the existing connections, call `status`.

To close a connection to a database, use `disconnect`.

To reestablish a connection to a database, use `reconnect`.

#### 23.2.3.1 Connection example

The following example assumes that the `:odbc` database type has been initialized as described in “Initialization steps” on page 334. It connects to two databases, `scott` and `personnel`, and then prints out the connected databases.

```
(setf *default-database-type* :odbc)
(connect "scott")
(connect "personnel" :database-type :odbc)
(print *connected-databases*)
```

### 23.2.4 Connecting to Oracle

For `database-type :oracle`, `connection-spec` conforms to the canonical form described for `connect`. The `connection` part is the string used to establish the connection. When connecting to a local server, it may be the SID, otherwise it is an alias recognized by the names server, or in the `tnsnames.ora` file.

To connect to Oracle via SQL\*Net, `connection-spec` is of the form `username/password@host` where `host` is an Oracle hostname.

Common SQL uses the Oracle Call Interface internally where this is available. For Oracle version 8, Common SQL automatically uses the same API as in LispWorks 4.4. On some platforms, this can also be obtained by using `database-type :oracle8`. Note that the `:oracle8` database type is restricted

## 23.2 Initialization

because it cannot access or manipulate LOBs and all connections must use the same character set.

### 23.2.5 Connecting to ODBC

For *database-type* :`odbc` or :`odbc-driver`, *connection-spec* may take the canonical form described for `connect`, but an additional syntax is also allowed.

`connect` keyword arguments :`encoding`, :`signal-rollback-errors` and :`date-string-format` are all ignored.

#### 23.2.5.1 Connecting to ODBC using a string

*connection-spec* should have one of the forms:

`username/password@dsn`The general form.

`dsn/username/password`For backward compatibility.

The two forms of strings are distinguished by the presence (or absence) of the '@' character. In both forms, *password* can be omitted along with the preceding '/'. Also, *username* can simply be omitted.

Note that this means that "`xyz`" and "`@xyz`" are both interpreted to give the same values (*username* is null, *password* is null, *dsn* is "`xyz`").

#### 23.2.5.2 Connecting to ODBC using a plist

In the plist, the acceptable keywords are :`username`, :`password`, :`dsn` and :`connection`.

:`connection` is a synonym of :`dsn`.

### 23.2.6 Connecting to MySQL

For *database-type* :`mysql`, *connection-spec* may be in the canonical form described for `connect`, but it may also have the extensions described in this section.

In both the string and plist forms of *connection-spec* described below, any part that is omitted defaults to the MySQL default:

<i>username</i>	anonymous user
<i>password</i>	No password
<i>dbname</i>	No default database
<i>hostname</i>	localhost
<i>port</i>	3306 (unless using <i>unix-socket</i> ).

### 23.2.6.1 Connecting to MySQL using a string

*connection-spec* can be a string of the form:

*username*/*password*/*dbname*@*hostname*:*port*

where *port* is a decimal number specifying the port number to use. *port* can be omitted along with the preceding ':':

*hostname* can be omitted. If *port* is omitted too, the '@' can be omitted as well. If *port* is supplied and *hostname* is not supplied, then both the '@' and the ':' are required, for example:

`me/my-password/my-db@:3307`

*hostname* may also specify a unix socket name, which must start with the character '/':

*dbname* may be omitted along with the preceding '/':

*password* may be omitted. If *dbname* is also omitted, the preceding '/' can be omitted too.

*username* may be omitted.

### 23.2.6.2 Connecting to MySQL using a plist

*connection-spec* can be a plist containing (some of) the keywords :*username*, :*password*, :*dbname*, :*hostname*, :*port*, :*connection*, :*unix-socket*.

Each of these keywords may be omitted.

If :*unix-socket* is specified, then none of :*hostname*, :*port* and :*connection* can be specified. If :*hostname* is specified then :*connection* must not be specified. The value supplied for :*hostname* can be a raw hostname, or a

## 23.2 Initialization

string of the form **hostname:port**. If **:connection** is specified then it can be a string conforming to one of these patterns:

<b>hostname</b>	
<b>hostname:port</b>	
<b>:port</b>	
<b>unix-socket</b>	Must start with '/'

That is, the value *connection* supplied in a plist *connection-spec* is interpreted just like the part of a string *connection-spec* following the '@' character.

### 23.2.6.3 Locating the MySQL client library

The MySQL interface to initialize, it must find the appropriate MySQL client library. The special variables \*mysql-library-path\*, \*mysql-library-directories\* and \*mysql-library-sub-directories\* give you control over this.

### 23.2.6.4 Special instructions for MySQL on Mac OS X

Download the 32-bit or 64-bit MySQL package to match your LispWorks image.

The downloadable packages from the MySQL web site contain only static client libraries, but LispWorks needs a dynamic library. You need to create the dynamic library, for example by using the following shell command.

To build the 32-bit dynamic library:

```
gcc -dynamiclib -fno-common \
-o /usr/local/mysql/lib/libmysqlclient_r.dylib \
-all_load /usr/local/mysql/lib/libmysqlclient_r.a -lz
```

To build the 64-bit dynamic library:

```
gcc -m64 -dynamiclib -fno-common \
-o /usr/local/mysql/lib/libmysqlclient_r.dylib \
-all_load /usr/local/mysql/lib/libmysqlclient_r.a -lz
```

This command should be executed as the root user, or some other user with write permission to the `/usr/local/mysql/lib` directory and assumes that

MySQL was installed in `/usr/local/mysql`, which is the location used by the prepackaged downloads.

An alternate way to create a dynamic library is to build MySQL from its source code with the `--enable-shared` flag.

By default, LispWorks expects to find the library either in `/usr/local/mysql/lib` or on the shared library path. This can be overridden by setting the special variable `*mysql-library-directories*`.

By default, LispWorks expects the library to be called `libmysqlclient.*.dylib` and it searches for a library that matches that pattern, where \* is any version number. This search can be avoided by setting `*mysql-library-path*` to something other than the default (`"-lmysqlclient"`), for example, it is possible to force LispWorks to look for version 12 by evaluating

```
(setq *mysql-library-path* "libmysqlclient.12")
```

You can also set `*mysql-library-path*` to a full path, which avoids the need to set `*mysql-library-directories*`.

If the environment variable `LW_MYSQL_LIBRARY` is set, then its value is used instead of the value of `*mysql-library-path*`.

### 23.2.7 Connecting to PostgreSQL

For `database-type :postgresql`, `connection-spec` must be either a string in the format specified by the PostgreSQL libraries or a plist.

#### 23.2.7.1 Connecting to PostgreSQL using a string

If `connection-spec` is a string then it should be in the format specified by

```
http://www.postgresql.org/docs/9.3/static/libpq-connect.html#LIBPQ-CONNSTRING
```

For example,

```
dbname=test user=scott password=tiger host=scandium
```

### 23.2.7.2 Connecting to PostgreSQL using a plist

*connection-spec* can be a plist containing (some of) the keywords `:username` (or `:user`), `:password`, `:dbname`, `:hostname` (or `:host`), `:port`, `:connection`. Each of these keywords may be omitted, but if `:connection` is specified, then `:hostname` and `:port` must not be specified.

The value supplied for `:hostname` can be a raw hostname or a string of the form `hostname:port`. The value supplied for `:port` can be an integer or a string naming a service.

If `:connection` is specified then it can be a string conforming to one of these patterns:

`hostname`

`hostname:port`

The values should not be escaped or quoted: LispWorks will escape and quote it as needed before passing it to the PostgreSQL library.

### 23.2.7.3 Escaping and standard\_conforming\_strings

LispWorks sets the PostgreSQL session variable

`standard_conforming_strings` to `on` to match the escaping that Common SQL uses. Note that this variable is only available in PostgreSQL 8.2 and later, so escaping will not work correctly in older versions of PostgreSQL.

## 23.2.8 Connecting to SQLite.

For `database-type :sqlite`, *connection-spec* is used to specify the filename of the SQLite database. *connection-spec* must be one of the following:

A string.      Specifies the filename as is.

A plist containing `:dbname filename`.

If `filename` is a string, it specifies the filename as is. Otherwise, the value of `(namestring filename)` is used as the filename.

`:memory`      This is equivalent to "`:memory:`" and specifies a private, temporary in-memory database.

:temp	This is equivalent to "" and specifies a private, temporary on-disk database.
-------	---

### 23.2.8.1 Locating the SQLite client library

The special variable `sql:*sqlite-library-path*` contains the FLI shared library name for SQLite. It defaults to `"-lsqlite3"` on non-Windows platforms, which should work if SQLite is installed. On Windows, it defaults to `"sqlite3.dll"`, which requires that DLL to be on the path. Note that 64-bit and 32-bit LispWorks require different DLL files.

The Common SQL SQLite interface assumes that the library is compiled with standard options and that SQLite is not configured in an unusual way. Most importantly, if the threading mode is single-thread (either because the library is compiled as single-thread, or because `sqlite3_config` set it to single-thread), then the Common SQL SQLite interface is not thread-safe anymore. This situation is quite unlikely to happen.

### 23.2.8.2 SQLite string encoding

By default, the connection is opened as a UTF-8 connection (using the C function `sqlite3_open_v2`). The `:encoding` argument to `connect` can have the value `:default`, `:unicode` or `:utf-8` which all use the default (that is, have no effect), and `:utf-16` or `:utf-16-native`, which opens the connection using UTF-16 in the native byte order (using the C function `sqlite3_open16`). It is not obvious in what circumstances UTF-16 is better and it is made available only because the underlying library supports it. When opening as UTF-16, the keywords `:open-mode`, `:threading-mode`, `:uri` and `:vfs` are ignored.

### 23.2.8.3 SQLite connection keywords

The `sqlite-keywords` keyword argument to `connect` allows you to specify several parameters controlling the behavior of the connection. `sqlite-keywords` is a property list, providing values for the SQLite-specific keywords `:open-mode`, `:threading-mode`, `:uri`, `:cache-mode`, `:vfs` or `:uniform-type-per-column`. These keywords affect the connection as follows.

By default, the connection is opened with opening modes create and read-write, which means that the file is created if it does not exist, and the database

can be modified. The SQLite-specific keyword `:open-mode` in *sqlite-keywords* can be used to change this. The value `:readonly` specifies that the file must exist (so `connect` fails if it does not exist) and is opened for reading only (so it is not possible to modify it). The value `:readwrite` means that the file must exist and the database can be modified.

By default, the threading mode of the connection is "serialized" (so it is thread-safe). You can change this by the SQLite-specific keyword `:threading-mode` in *sqlite-keywords*, which can take the values `:multi-thread` or `:serialized`. When the threading mode is `:multi-thread` (rather than `:serialized`), it is not actually thread-safe, and you can access it only on one thread at a time (but it can be accessed from different threads over time). The term "multi-thread" means that you can access different connections at the same time on different threads. `:multi-thread` is probably more efficient, but we do not know by how much.

By default, *connection-spec* can be a URI filename, which is a string starting with "file:" (see <https://www.sqlite.org/uri.html> "URI Filenames In SQLite" for details). Whether this is allowed is controlled by the SQLite-specific keyword `:uri` in *sqlite-keywords*, which defaults to `t`, and can be switched off by passing `:uri nil`.

By default, the connection cache mode is the system default. The SQLite-specific keyword `:cache-mode` in *sqlite-keywords* can be used to change this to either `:private` or `:shared`. See <https://www.sqlite.org/sharedcache.html> "SQLite Shared-cache mode" for details. `:shared` mode probably improves performance if you connect multiple times to the same file.

The SQLite-specific keyword `:vfs` in *sqlite-keywords* can be used to specify the name of the VFS (Virtual File System) that is used. You need to be an expert on SQLite to know when this is useful.

The SQLite-specific keyword `:uniform-type-per-column` in *sqlite-keywords* affects the default type for fields in the results of queries. See "Tables containing a uniform type per column" on page 394.

See "Using SQLite" on page 392 for other SQLite-specific features.

## 23.3 Functional interface

The functional interface provides a full set of Data Manipulation and Data Definition functions. The interface provides a SQL-compatible means of querying and updating the database from Lisp. In particular, the values returned from the database are Lisp values — thus smoothly integrating user applications with database transactions. An embedded syntax is provided for dynamically constructing sophisticated queries through `select`. Iteration is also provided via a mapping function and an extension to the `loop` macro. If necessary, the basic functions `query` and `execute-command` can be called with SQL statements expressed as strings. It is also possible to update or query the data dictionary.

### 23.3.1 Functional Data Manipulation Language (FDML)

The functions available for Data Manipulation and Data Definition are described below.

#### 23.3.1.1 Querying

The function `select` returns data from a database matching the constraints specified. The data is returned, by default, as a list of records in which each record is represented as a list of attribute values.

Database identifiers used in `select` are conveniently specified using the symbolic SQL `[]` syntax. This syntax is enabled by calling `enable-sql-reader-syntax`.

The square bracket syntax assumes that sql symbols are visible. Therefore when using the `[]` syntax, ensure that the current package either is `sql`, or is a package which has the `sql` package on its package-use-list.

For a description of the symbolic SQL syntax see Section 23.5 on page 358. For example, the following is a potential query and its result:

```
(select [person_id] [person surname] :from [person])
=>
((111 "Brown") (222 "Jones") (333 "Smith"))
("PERSON_ID" "SURNAME")
```

### 23.3 Functional interface

In this example, `[person_id]`, `[person_surname]` and `[person]` are database-identifiers and evaluate to literal SQL. The result is a list of lists of attribute values. Conversely, consider

```
(select [surname] :from [person] :flatp t)
=>
("Brown" "Jones" "Smith")
("SURNAME")
```

In this case the result is a simple list of surname values because of the use of the `flatp` keyword. The `flatp` keyword only works when there is one column of data to return.

In this example we use `*` to match all fields in the table, and then we use the `result-types` keyword to specify the types to return:

```
(select [*] :from [person])
=>
((2 111 "Brown") (3 222 "Jones") (4 333 "Smith"))
("ID" "Person_ID" "Surname")

(select [*] :from [person] :result-types '(:integer :string
:string))
=>
((2 "111" "Brown") (3 "222" "Jones") (4 "333" "Smith"))
("ID" "Person_ID" "Surname")
```

If you want to affect the result type for a specified field, use a type-modified database identifier. As an example:

```
(sql:select [Person_ID :string] [Surname] :from [person])
=>
(("111" "Brown") ("222" "Jones") ("333" "Smith"))
("PERSON_ID" "SURNAME")
```

With `database-type :mysql`, further control over the values returned from queries is possible as described in “Types of values returned from queries” on page 377.

In this final example the `:where` keyword is used to specify a condition for returning selected values from the database.

```
(select [surname] :from [person] :where [= [person_id] 222])
=>
(("Jones"))
("SURNAME")
```

To output the results of a query in a more easily readable tabulated way, use the function `print-query`. For example the following call prints two even columns of names and salaries:

```
(print-query [select [surname] [income] :from [employee]]
            :titles '("NAME" "SALARY"))

NAME      SALARY
Brown    22000
Jones    45000
Smith    35000
```

### 23.3.1.2 Modification

Modifications to the database can be done using the following functions; `insert-records`, `delete-records` and `update-records`. The functions `commit`, `rollback` and the macro `with-transaction` are used to control transactions. Although `commit` or `rollback` may be used in isolation it is advisable to do any updates inside a `with-transaction` form instead. This provides consistency across different database transaction models. For example, some database systems do not provide an explicit “start-transaction” command while others do. `with-transaction` allows user code to ignore database-specific transaction models.

The function `insert-records` creates records in a specified table. The values can be either specified directly with the argument `values` or in the argument `av-pairs`, or they can be the result of a query specified in the `query` argument. The attributes can be specified with the argument `attributes` or in the argument `av-pairs`.

If `attributes` is supplied then `values` must be a corresponding list of values for each of the listed attribute names. For example, both:

```
(insert-records :into [person]
                :attributes '(person_id income surname occupation)
                :values '(115 11000 "Johnson" "plumber"))
```

and:

### 23.3 Functional interface

```
(insert-records :into [person]
                      :av-pairs `((person_id 115)
                                  (income 11000)
                                  (surname "Johnson")
                                  (occupation "plumber")))
```

are equivalent to the following SQL:

```
INSERT INTO PERSON
  (PERSON_ID, INCOME, SURNAME, OCCUPATION)
VALUES (115, 11000, 'Johnson', 'plumber')
```

If *query* is provided, then neither *values* nor *av-pairs* should be. In this case the attribute names in the query expression must also exist in the insertion table. For example:

```
(insert-records :into [person]
                :query [select [id] [firstname] [surname]
                        :from [manager]]
                :attributes '(person_id firstname surname))
```

To delete or alter those records in a table which match some condition, use `delete-records` or `update-records`.

#### 23.3.1.3 Caching of table queries

Operations which add or modify records sometimes need to perform an internal query to obtain type information for the relevant attributes. In principle it is possible for the database schema to change between update operations, and hence this query is run for each update operation. This can be a significant overhead.

For tables which are guaranteed to have a constant schema, you can optimize performance by adding a cache of these internal query results, using the function `cache-table-queries`. This can also be used to reset the cache if the table schema is actually altered. To control the default caching behavior throughout every database connection, you can set the variable `*cache-table-queries-default*`.

### 23.3.1.4 Transaction handling

A transaction in SQL is defined as *starting from the connect, or from a commit, rollback or data-dictionary update and lasting until a commit, rollback, data-dictionary update or a disconnect command.*

The macro **with-transaction** executes a body of code and then does a commit, unless the body failed in which case it does a rollback. Using this macro allows your code to cope with the fact that transactions may be handled differently in the different vendor implementations. Any differences are transparent if the update is done within a **with-transaction** form.

**Note:** Common SQL opens an ODBC database in manual commit mode, so that **with-transaction** and **rollback** take effect.

Applications should perform all database update operations in a **with-transaction** form (or follow them with **commit** or **rollback**) in order to safely commit or discard their changes. This applies to operations that modify either the data or the schema.

The following example shows a series of updates to an employee table within a transaction. This example would commit the changes to the database on exit from **with-transaction**. This example inserts a new record into the **emp** table, then changes those employees whose department number is 40 to 50 and finally removes those employees whose salary is more than 300,000.

```
(connect "personnel")

(with-transaction
  (insert-records :into [emp]
    :attributes '(empno ename job deptno)
    :values '(7100 "ANDERSON" "SALESMAN" 30))
  (update-records [emp]
    :attributes [deptno]
    :values 50
    :where [= [deptno] 40])
  (delete-records :from [emp]
    :where [> [sal] 300000]))
```

To commit or roll back all changes made since the last commit, use the functions **commit** or **rollback**.

### 23.3.1.5 Iteration

Common SQL has three iteration constructs: a `do` loop, a mapping function, and an extension to the Common Lisp `loop` macro.

The macros `do-query` and `simple-do-query` repeatedly execute a piece of code within the scope of variables bound to the attributes of each record resulting from a query.

The function `map-query` maps a function across the results of a query and returns its result in a sequence of a specified type, like the Common Lisp `map` function.

Common SQL provides an extension to the ANSI Common Lisp macro `loop` which is a clause for iterating over query results. The syntax of the clause is:

```
{for|as} var [type-spec] being
  {the|each}{tuples|tuple}
  {in|of} query-expression
```

`query-expression` can be a string, a `sql-expression-object` (a result of the "[...]" syntax) or a `prepared-statement`.

The more general word `tuple` is used so that it can also be applied to the object-oriented case. In the functional case, `tuple` is synonymous with `record`.

Each iteration of the loop assigns the next record of the table to the variable `var`. The record is represented in Lisp as a list. Destructuring can be used in `var` to bind variables to specific attributes of the records resulting from `query-expression`. In conjunction with the panoply of existing clauses available from the `loop` macro, the new iteration clause provides an integrated report generation facility.

Suppose the name of everyone in an employee table is required. This simple query is shown below using the different iteration method. The function `map-query` requires `flatp` to be specified; otherwise each name would be wrapped in a list.

```
(do-query ((name) [select [ename] :from [emp]])
  (print name))
```

```
(map-query
  nil
  #'(lambda (name) (print name))
  [select [ename] :from [emp] :flatp t])

(loop for (name)
      being each tuple in
      [select [ename] :from [emp]]
      do
  (print name))
```

The following extended `loop` example binds, on each record returned as a result of the query, `name` and `salary`, accumulates the salary, and for salaries greater than 2750 increments a count, and prints the details. Finally, the average salary is printed.

```
(loop for (name salary) being each record in
  [select [ename] [sal] :from [emp]]
  initially (format t "~&~20A~10D" 'name 'salary)
  when (and salary (> salary 2750))
    count salary into salaries
    and sum salary into total
    and do (format t "~&~20A~10D" name salary)
  else
    do (format t "~&~20A~10D" name "N/A")
  finally
  (format t "~2&Av Salary: ~10D" (/ total salaries)))
```

### 23.3.1.6 Specifying SQL directly

Sometimes it is necessary to execute vendor-specific SQL statements and queries. For these occasions Common SQL provides the functions `query` and `execute-command`. They can also be used when the exact SQL is known in advance and thus the square bracket syntax is not needed. The query expression can be a string, a `sql-expression-object` (a result of the "[...]" syntax) or a `prepared-statement`.

The function `query` runs a SQL query on a database and returns a list of values like `select` (see “Querying” on page 346). It also returns a list of the field names selected.

`execute-command` is the basic function which executes any SQL statement other than a query. It can run a stored procedure, as described in `execute-command`, page 1567.

### 23.3 Functional interface

#### 23.3.1.7 Building vendor-specific SQL

Common SQL does not provide a general interface to vendor-specific syntax.

There are two approaches you can take with SQL such as this:

```
SELECT B.PARTY_CODE_ALIAS, A.VALUE FROM CODES A, CODE_ALIASES B
    WHERE A.DOMAIN=B.CODE_DOMAIN(+) AND A.VALUE=B.CODE_VALUE(+)
        AND B.PARTY_ID(+)=<party_id>
```

1. Construct the string as above and then call `query` as described in “Specifying SQL directly” on page 352.
2. Use `sql-expression` to construct the vendor-specific pieces of the SQL.  
The above expression can be written like this:

```
(sql:select [b party_code_alias] [a value]
            :from '([codes a] [codes_aliases b])
            :where [and [= [a domain]
                        (sql:sql-expression
                            :string "B.CODE_DOMAIN(+))"]
                        [= (sql:sql-expression
                            :string "B.PARTY_ID(+)" PARTY-ID)])')
```

#### 23.3.2 Functional Data Definition Language (FDDL)

Functions in the FDDL may be used to change or query the structure of the database.

##### 23.3.2.1 Querying the schema

The functions `list-tables`, `list-attributes`, `attribute-type` and `list-attribute-types` return information about the structure of a database.

##### 23.3.2.2 FDDL Querying example

This example shows you how to query the type of the `ename` attribute of the `emp` table.

```
(attribute-type [ename] [emp]) -> :char
```

### 23.3.2.3 Modification

You may create or drop (delete) tables using the functions `create-table` and `drop-table`.

Create or drop indexes using the functions `create-index` and `drop-index`.

To create or drop a view (that is, a derived table based on a query) use the functions `create-view` and `drop-view`.

## 23.4 Object oriented interface

This section describes the object-oriented interface to SQL databases using specialized CLOS classes. These classes have `standard-db-object` as one of their superclasses and have a common metaclass which provides the specialized behavior for mapping subclasses of `standard-db-object` onto records in the database. A class of this kind is created using `def-view-class`.

### 23.4.1 Object oriented/relational model

In the simple case, a class maps onto a database table, an instance of the class maps onto a record in the table, and a slot in the class maps onto an attribute in the table.

In general, however, a class maps onto a database view, an instance of the class maps onto a collection of records in the view, and a slot in the class is either:

- A *base slot* that maps onto an attribute in the view
- A *join slot* that points to a list of other view-class instances

If an instance maps onto more than one record in the view then for each record, all the key attributes from each table in the view are the same.

#### 23.4.1.1 Inheritance for View Classes

It is not possible to inherit from a class that was defined by `def-view-class`. All of the slots need to be in the same class (and hence also in the same SQL table).

### 23.4.2 Object-Oriented Data Definition Language (OODDL)

The OODDL lets you define a mapping between the relational and object-oriented worlds to be defined. Through the mapping a CLOS object can effectively denote a collection of records in a database view, and can contain pointers to other view-based CLOS objects. The CLOS object makes explicit an object implicitly described by the flat relational values.

The mapping is defined using the macro `def-view-class`. This extends the syntax of `defclass` to allow special *base slots* to be mapped onto the attributes of database views (presently single tables). When you submit a `select` query that names a View Class (that is, a class defined by `def-view-class`), then the corresponding database view is queried, and the slots in the resulting instances are filled with attribute values from the database.

It is also possible to create *join slots* and *virtual* (ordinary) *slots*.

All the special slots are distinguished by a modified set of class and slot options. The special slots and their options are described in more detail under `def-view-class` in the *LispWorks Reference Manual*.

**Note:** `def-view-class` defines a Lisp view of an underlying database table. It is a similar concept to that of SQL VIEWS, but does not interact with them.

You can create a table based on a View Class using the function `create-view-from-class` and delete it using the function `drop-view-from-class`.

#### 23.4.2.1 Example View Class definition

The following example shows a View Class corresponding to the traditional employees table, with the employee's department given by a join with the departments table. See `def-view-class`, page 1551 for a description of the slot options.

```
(def-view-class employee (standard-db-object)
  ((employee-number :db-kind :key
                    :column empno
                    :type integer)
   (employee-name :db-kind :base
                  :column ename
                  :type (string 20)
                  :accessor employee-name)
   (employee-department :db-kind :base
                         :column deptno
                         :type integer
                         :accessor employee-department)
   (employee-job :db-kind :base
                 :column job
                 :type (string 9))
   (employee-manager :db-kind :base
                      :column mgr
                      :type integer)
   (employee-location :db-kind :join
                       :db-info (:join-class department
                                         :retrieval :deferred
                                         :set nil
                                         :home-key employee-department
                                         :foreign-key department-number
                                         :target-slot department-loc)
                       :accessor employee-location))
   (:base-table emp))
```

The `def-view-class` macro allows elements or lists of elements to follow `:home-key` and `:foreign-key`. The elements can be symbols, `nil`, strings, integers or floats.

This syntax means that an object from the join class is only included in the join slot if the values from `home-key` are `equal` to the values in `foreign-key`, in order. These values are calculated as follows:

- If the element in the list is a symbol it is taken to be a slot name and the value of the slot is used
- Otherwise the element is taken to be the value

Note that some database vendors may have short maximum identifier lengths. The CLOS interface uses constructed alias names for tables in its SQL queries, and long table names or long class names may cause the constructed aliases to exceed the maximum identifier length for a particular vendor.

### 23.4.3 Object-Oriented Data Manipulation Language (OODML)

The OODML is designed to be powerful and expressive, while remaining familiar to users of the FDML. To achieve this aim, some of the functions and macros in the SQL interface have been *overloaded* — particularly the `select` function and the iteration constructs.

The function `select` is common across the both the functional and object-oriented SQL interfaces. If its first argument, `selections`, refers to a View Class by supplying its symbolic name then the select operation becomes object-oriented and it returns a list of instances instead of a list of attributes.

A subsequent equivalent `select` call will return the same (`eq1`) instances. The `:refresh` argument can be used to ensure that existing instances get updated with any changed data. If such an update requires action by your application, then add methods on the generic function `instance-refreshed`.

In a View Class `select` call, the symbol `slot-value` is a valid SQL operator for use within the `:where` argument.

To find the View Classes for a particular database, use the function `list-classes`.

To manipulate data via a View Class, that is to modify the records corresponding to instances of the View Class, using the generic functions `update-records-from-instance`, and `update-record-from-slot`.

To delete records corresponding to instances of the View Class, use the generic function `delete-instance-records`.

To update existing instances of a View Class when data is known to have changed, use the generic functions `update-slot-from-record` and `update-instance-from-records`.

#### 23.4.3.1 Examples

```
[select 'employee']
-> #<SQL-OBJECT-QUERY (EMPLOYEE) >
```

```
(select 'employee
       :where [= [slot-value 'employee 'employee-job]
              "SALESMAN"])
((#<db-instance EMPLOYEE 8067092>
  (#<db-instance EMPLOYEE 8069536>
    (#<db-instance EMPLOYEE 8069176>))

(list-classes)
(#<db-class EMPLOYEE> #<db-class DEPARTMENT>)
```

### 23.4.3.2 Iteration

The object-oriented SQL interface has the same three iteration constructs as the functional interface (see Section 23.3.1.5 on page 351): a `do-loop`, a mapping function, and an extension to the Common Lisp `loop` macro. However, in this case, the iteration focus is not a tuple of attributes (that is, a record), but a tuple of instances. For example:

```
(loop for (jones company) being the tuples in
      [select 'person 'organization
      :where [= [slot-value 'person 'surname] "Jones"]]
      do (format t "~A ~A ~%" 
                 (slot-value jones 'forename)
                 (slot-value company 'short-name)))
```

**Note:** Instances may denote many database records, and hence the effective iteration focus in this case is a tuple of sets of tuples of attributes.

### 23.4.3.3 Garbage collection of view instances

View instance objects are not released for garbage collection (GC) until the connection is closed. This is because they are referenced by the CLOS object representing the database connection. This is to ensure that they can reliably be compared by `eq`.

## 23.5 Symbolic SQL syntax

Common SQL supports a symbolic query syntax across both the functional and object-oriented interface layers. It allows SQL and Common Lisp expressions to be mixed together — with as much processing as possible done at compile-time. Symbolic SQL expressions are read as square-bracketed lists to

## 23.5 Symbolic SQL syntax

distinguish them from Lisp expressions. However, each can be nested within the other to achieve the desired result.

By default, this reader syntax is turned off. To turn it on see Section 23.5.3 on page 370.

### 23.5.1 The “[...]" Syntax

The square bracket syntax for the SQL interface is heavily overloaded to provide the most intuitive behavior in all situations. There are three uses of square brackets:

1. To enclose a database identifier
2. To construct a SQL string representing a symbolic expression
3. To enclose an SQL expression directly

Each of these uses is demonstrated below.

#### 23.5.1.1 Enclosing database identifiers

Database identifiers are specified in the "[...]" syntax using the following rules:

There must be one, two or three Lisp forms inside the square brackets. The first form must be a symbol, string or a recursive database identifier (that is, another square brackets expression). The second form, if present, must be a symbol or a string. The third form, if present, must be a keyword.

The case with a single form that is a string is special, and is interpreted as a direct SQL expression rather than an identifier (see “Enclosing a SQL expression directly” on page 366 below).

When a string or a symbol is used to specify all or part of the identifier and the string (or name of the symbol) cannot be used as an identifier (because it contains special characters or matches a SQL reserved word), then it is wrapped with double quotes in the resulting SQL.

If there is more than one form inside the square brackets, and the first form is a symbol that is recognized as a SQL operator or a pseudo-operator, then the expression is interpreted as an operation rather than as an identifier (see the following sections).

The first form is always interpreted as specifying a string that is part or all of the identifier. For a symbol, it is the symbol name and for a recursive identifier it is the string that would be generated for this identifier. In the examples below, the text following the => (and optionally up to the semicolon) shows what is generated for the resulting SQL.

If there is only one form, it specifies the full name of the identifier. For example:

```
[foo]           => FOO
["foo"]         => foo
[[foo]]         => FOO
[W%((jj))      => W%((jj); single form string not quoted.
```

If the second form is a string and the first form is not a string, then the first form specifies the name of the identifier and the second form specifies an alias. In this case there must not be a third form. The alias identifier is useful for giving tables aliases in the `from` part of the SQL `select` statement:

```
[foo "AA"]     => FOO AA
[[foo aa] "bb"]
                => FOO.AA bb ; first form is recursive.
```

If there is a third form, or the second form is not keyword, or the first form is a string, then the second form specifies an identifier qualified by the first form, that is they are combined with a period in the middle:

```
[foo aa]       => FOO.AA
[foo aa :integer]
                => FOO.AA ; with type :integer (below).

["foo" "AA"]
                => foo.AA ; compare to [foo "AA"] above.
```

If there are only two forms and the second form is a keyword, or there are three forms, then the second form (in the two form case) or the third form (in the three form case) specifies a type associated with the identifier. The type

### 23.5 Symbolic SQL syntax

does not affect the SQL statement that the database sees. It is used when the identifier is part of the selection list, to tell Common SQL what type the value should be. Such identifiers should appear only in the selection list of queries.

```
[ColumnName :integer]
=> COLUMNNNAME ; type :integer.

[[TableName ColumnName] :string]
=> TABLENAME.COLUMNNNAME ; type :string.

[TableName ColumnName :string]
=> TABLENAME.COLUMNNNAME ; type :string
(same as previous).
```

Inside select (which is recognized as a SQL operator):

```
[select [id :integer] [name :string] :from [TableName]]
=> SELECT ID, NAME FROM TABLENAME ; interpret
ID as an integer and NAME as a string.
```

Notes:

- You can specify both an alias and a type by specifying the identifier recursively in the first form:

```
[[TableName ColumnName] "MyAlias" :string]
=> TABLENAME.COLUMNNNAME MyAlias ; type
:string
```

- Recursion through the first form also allows you to add qualifiers as needed:

```
[[[[CatalogName SchemaName] TableName] ColumnName]
"MyAlias" :string]
=> CATALOGNAME.SCHEMANAME.TABLE-
NAME.COLUMNNNAME MyAlias ; type :string.
```

- Because a string as single form is not quoted, it allows you to insert any SQL directly. For example, in the first expression below the string which contains illegal characters is quoted, but in the second example the

string appears as a single form in the recursive identifier, so is not quoted:

```
[ "W%((jj" aa]
=> "W%((jj).AA ; string is quoted.

[[ "W%((jj"] . aa]
=> W%((jj.AA ; string not quoted because it is a single
form.
```

- Evaluating an expression in "[...]" syntax returns an object of type `sql-expression-object`.

### 23.5.1.2 Specifying the type of retrieved values.

When you use a keyword to specify the type of an expression as described in “Enclosing database identifiers” on page 359, you are telling common SQL that the values retrieved for this expression should be of a specific type. For example, if you call:

```
(sql:select [name :string] :from [TableName])
```

then the `:string` keyword tells common SQL that the values for `name` should be strings.

There are four keywords that are supported by all common SQL backends: `:string`, `:integer`, `:double-float` and `:single-float`. For each of these keywords, the values are mapped to the matching Common Lisp type. If this is not possible, the value is returned as `nil`.

Note that if you specify a keyword that is incompatible with the type in the database column then either an error is signaled or all returned values will be `nil`.

The keyword `:int` is accepted as an alias for `:integer`.

The keyword `:binary` is supported by most of backends (except Microsoft Access and PostgreSQL). The value that is returned for `:binary` is an array with element type (`unsigned-byte 8`). On Oracle, `:binary` can be used only for columns of binary type, so it is only useful when you want to retrieve the

## 23.5 Symbolic SQL syntax

contents of a BLOB directly, because for plain RAW columns it is the default anyway. Other backends allow you to retrieve at least strings as binary values.

Other keywords are supported by some of the backends, and are documented in the backend specific sections.

### 23.5.1.3 Symbolic expression of SQL operators

When the first form in the square brackets is a symbol that is one of the SQL operators listed below, the expression is interpreted as an operation. For example:

```
[any '(3 4)] -> #<SQL-VALUE-EXP "(ANY (3,4))">
```

Similarly with two argument operators:

```
[> [baz] [beep]]
-> #<SQL-RELATIONAL-EXP "(BAZ > BEEP)">
```

The `select` statement itself may be prepared for later query execution using the `[]` syntax. For example:

```
[select [person_id] [surname] :from [person]]
```

This form results in a SQL expression, which could be bound to a Lisp variable and later given to `query` to execute. For example:

```
[select [foo] [bar *]
       :from '([baz] [bar])
       :where [or [= [foo] 3]
              [> [baz.quux] 10]]]
->
#<SQL-QUERY
  "(SELECT FOO,BAR.* FROM BAZ,BAR
   WHERE ((FOO = 3)
          OR (BAZ.QUUX > 10)))">
```

Strings can be inserted in place of database identifiers within a `select`:

```
[select [foo bar] [baz]
      :from '([foo] [quux])
      :where [or [> [baz] 3]
              [like [foo bar] "SU%"]]
->
#<SQL-QUERY:
  "(SELECT FOO.BAR,BAZ
   FROM FOO,QUUX
   WHERE ((BAZ > 3)
          OR (FOO.BAR LIKE 'SU%')))">
```

Any non-constant included gets filled in at run time, for example:

```
[> [foo] x]
```

when macroexpanded reads as

```
(SQL-> #<SQL-IDENT "FOO"> x)
```

which constructs the actual SQL string at run time.

Any arguments to a SQL operator that are Lisp constants are translated to the matching SQL construct at compile-time, for example:

```
"foo" -> "'foo'"
3 -> "3"
'("this" 5 "that") -> "('this', 5, 'that')"
'xyz -> "XYZ"
```

SQL operators which are supported are `null`, `exists`, `*`, `+`, `/`, `-`, `like`, `substr`, `and`, `or`, `not`, `in`, `all`, `any`, `some`, `|`, `=`, `<`, `>`, `>=`, `<=`, `<>`, `order-by`, `count`, `max`, `min`, `avg`, `sum`, `minus`, `nvl`, `distinct`, `except`, `intersect`, `union`, `slot-value`, `between` and `userenv`. There are also pseudo operators for calling database functions (see “Calling database functions” on page 365).

The general syntax is: [`<operator> <operand> ...`], for instance:

```
(sql:select [count [*]] :from [emp])
```

The operand can itself be a SQL expression, as in the following example:

## 23.5 Symbolic SQL syntax

```
(sql:create-table [company]
  '(([name] (varchar 20) not-null)))

(loop for company in '("LispWorks Ltd"
  "Harlequin"
  "Oracle"
  "Rover"
  "Microsoft")
  do
  (sql:insert-records :into [company]
    :av-pairs `(([name] ,company)))))

(sql:create-table [person]
  '(([surname] (varchar 20) not-null)
  ([firstname] (varchar 20) not-null)))

(loop for person in '(("Joe" "Bloggs")
  ("Fred" "Smith")
  ("Rover" "the Dog")
  ("Fido" "the Dog"))
  do (sql:insert-records :into [person]
    :av-pairs
    `(([firstname] ,(car person))
    ([surname] ,(second person)))))

(sql:select [name]
  :from [company]
  :where [= [name]
    [any [select [surname]
      :from [person]]]])

(sql:select [surname]
  :from [person]
  :set-operation [union [select [firstname]
    :from [person]]]))
```

### 23.5.1.4 Calling database functions

An arbitrary function can be included in the SQL using the pseudo operator `sql-function`. The first argument is the function name and the rest are its arguments, for example:

```
(select [sql-function "COS" [age]] :from [EMPLOYEES])
```

```
(insert-records
  :into [atable]
  :attributes '(a b)
  :values
  (list 1 [sql-function "TO_DATE" "02/06/99" "mm/DD/RR"])))
```

Also you can call SQL infix operators using the pseudo operators `sql-boolean-operator` and `sql-operator`.

### 23.5.1.5 Enclosing a SQL expression directly

An SQL expression can simply be enclosed directly in the square bracket syntax, as shown below.

Creating a full query (which can be used as argument to `query`):

```
["SELECT FOO, BAR FROM BAZ"]
-> #<SQL "SELECT FOO, BAR FROM BAZ">
```

Using an non-portable function condition in `:where`:

```
(sql:select [*] :from ["aTable"]
           :where ["non_portable_function() > 89"])
```

### 23.5.1.6 SQL string literals

SQL string literals can be used as arguments to operators, for example with a constant Lisp string:

```
[= [name] "John"]
```

or with a Lisp expression that evaluates to string:

```
(defun find-person-age (name)
  (car (select [age] from [table]
               :where [= [name] name])))
```

where the argument `name` is a string.

However, Microsoft SQL Server (which can be used via ODBC) requires the N syntax for string literal that are not entirely ASCII, or contain characters that are not recognized by the server code page. (The N syntax prefixes the string literal by the character N, for example `N'Greek'`, rather than `'Greek'`.)

Although this syntax is part of the SQL standard, not all SQL backends accept it (in particular, SQLite and Microsoft Access (via ODBC) do not). Thus the

### 23.5 Symbolic SQL syntax

decision whether to use the N syntax needs to be made at run time and requires the SQL backend (which is represented by the database object that `connect` returns). By default, the symbolic SQL syntax does not use the N syntax, but the special pseudo-operator `string` can be used to override this. `string` takes a required argument, which must be a string, and an optional argument, a database (which defaults to `*default-database*`), and produces the appropriate syntax for that database. The example above can be written using `string` like this:

```
(defun find-person-age (name)
  (car (select [age] from [table]
               :where [= [name] [string name]])))
```

The same database must be used for the `string` pseudo-operator and the function/macro that uses the resulting expression. In the example above, the function is `select` and the database not specified at all, so both `string` and `select` will use `*default-database*`. This restriction means that the `string` pseudo-operator cannot be used to generate a pre-existing expression, which is otherwise possible with the symbolic SQL syntax. For example, your code might contain:

```
(defvar *match-name-starting-with-cf* [like [name] "CF%"])
```

which defines `*match-name-starting-with-cf*` at load time, and then use it elsewhere:

```
(defun some-function (arg1 ...)
  ..
  (select [*] :from [table]
          :where *match-name-starting-with-cf*)
  ..
  )
```

But if you use `[string "CF%"]` in the `defvar`, it will try to use the database at load time, which is normally before the database is connected.

You can perform approximately what the `string` pseudo-operator does by using `string-prefix-with-n-if-needed`:

```
(let ((maybe-qualified
        (string-prefix-with-n-if-needed name)))
  (car (select [age] from [table]
               :where [= [name] maybe-qualified])))
```

Another option is to set the variable `*use-n-syntax-for-non-ascii-strings*` to `t` at compile time, which causes all string literals that are not entirely ASCII to be produced with N syntax. That would generate code that will work with almost all SQL backends, but not with SQLite or Microsoft Access (which do not support the N syntax). The advantage is that, if you have a large number of string literals, then you do not have to change them all: you just need to recompile your code with `*use-n-syntax-for-non-ascii-strings*` set to `t`.

### 23.5.2 Programmatic interface

In some cases it is necessary to build SQL-expressions dynamically under program control.

The function `sql-operation` returns the SQL expression for an operator applied to its arguments. It also supports building SQL expressions which contain arbitrary SQL functions using the pseudo operators `sql-function`, `sql-operator` and `sql-boolean-operator`. For examples see `sql-operation`, page 1660.

The function `sql-expression` makes a SQL expression from the given keywords. This is equivalent to the first and third uses of the `[]` syntax as discussed in Section 23.5.1 on page 359.

The function `sql-operator` returns the Lisp symbol for a SQL operator.

The function `sql` makes SQL out of the arguments supplied. Each argument to `sql` is turned into SQL and then the args are concatenated with a single space between each pair. A Lisp string maps to the same characters enclosed between single quotes (this corresponds to a SQL string constant). `nil` maps to "NULL", that is, a SQL null value. Symbols and numbers map to strings. A list maps to a parenthesised, comma-separated expression. A vector maps to a comma-separated expression, which allows the easy generation of SQL lists that require no parentheses such as table lists in select statements.

The rules for the conversion are fully specified in `sql`, page 1642.

### 23.5.2.1 Examples

The following example function, taken from the object-oriented SQL interface layer, makes a SQL query fragment that finds the records corresponding a CLOS object (using the slots as attributes), when built into the *where*-clause of an updating form.

```
(let* ((class (class-of object))
       (key-slots (db-class-keyfields class)))
  (loop
    for key in key-slots
    for slot-name = (slot-definition-name key)
    for slot-type = (db-slot-definition-type key)
    collect
      [= (make-field-name class key)
        (lisp-to-sql-format
          (slot-value object slot-name)
          (if (listp slot-type)
              (car slot-type)
              slot-type))])
  into cols
  finally (apply (sql-operator 'and) cols)))
->
#<SQL-RELATIONAL-EXP "(EMP.EMPNO = 7369)">
```

Here is another example that produces a SQL *select* statement:

```
(sql-operation 'select
  (sql-expression :table 'foo
                  :attribute 'bar)
  (sql-expression :attribute 'baz)
:from (list
        (sql-expression :table 'foo)
        (sql-expression :table 'quux))
:where (sql-operation 'or
            (sql-operation '>
                (sql-expression :attribute 'baz)
            3)
            (sql-operation 'like
                (sql-expression :table 'foo
                                :attribute 'bar)
                "SU%")))
->
#<SQL-QUERY "SELECT FOO.BAR,BAZ FROM FOO,QUUX
 WHERE ((BAZ > 3) OR (FOO.BAR LIKE 'SU%'))">
```

### 23.5.3 Utilities

The function `enable-sql-reader-syntax` switches square bracket syntax on and sets the state so that `restore-sql-reader-syntax-state` restores the syntax again if it is subsequently disabled. The function `disable-sql-reader-syntax` switches square bracket syntax off and sets the state so that `restore-sql-reader-syntax-state` disables the syntax again if it is subsequently enabled.

The functions `locally-enable-sql-reader-syntax` and `locally-disable-sql-reader-syntax` switch square bracket syntax on and off, but do not change the state restored by `restore-sql-reader-syntax-state`. The intended use of these is in a file:

```
#.(locally-enable-sql-reader-syntax)
  <code using [...]>
#.(restore-sql-reader-syntax-state)
```

## 23.6 Working with date fields

This section describes particular issues around using datetime database fields via Common SQL. Note: SQLite does not support date fields at all.

See also “Types of values returned from queries” on page 377 for information specifically about returning datetime values from MySQL.

### 23.6.1 Testing date values

Compare DATE values by formatting the date as a string in a date format that the database can parse. For example:

```
(sql:select * :from [Table] :where [= [Date] "2005-12-25"])
```

Note that it is not possible to lookup date values in the database using numeric values. This is because:

1. Common SQL cannot know that the field will be a date field until the results are returned, and
2. the database probably does not know about Common Lisp universal time.

## 23.6 Working with date fields

To convert between universal time and standard SQL DATE or TIMESTAMP string, you can use the functions `encode-db-standard-date`, `encode-db-standard-timestamp`, `decode-to-db-standard-date` and `decode-to-db-standard-timestamp`. Note that the database may have non-standard date format, in which case you will need to either format the string yourself, or on Oracle tell the database to use the standard format by passing `date-string-format` to `connect`.

### 23.6.2 DATE returned as universal time

By default Common SQL converts DATE values to Common Lisp universal times. Therefore code like this returns Common Lisp universal times (that is, integers) where `MyDate` is a DATE field type:

```
(sql:select [MyDate] :from [MyTable] :where [= [id] 1])
```

#### 23.6.2.1 Timezone of returned DATEs

Common SQL creates universal time values from DATE fields assuming that the database contains times in Coordinated Universal Time (UTC). That is, as if by passing `time-zone 0` to `encode-universal-time`. To decode the values consistently with this encoding, pass `time-zone 0` to `decode-universal-time`.

If the database contains times in a different timezone, then the integer `time-zone` needs to be adjusted by adding an appropriate multiple of 3600 before calling `decode-universal-time`.

### 23.6.3 DATE returned as string

Instead of universal time integers, you can obtain strings formatted by the database by modifying the `MyDate` database identifier, adding `:string` like this:

```
(sql:select [MyDate :string] :from [MyTable] :where [= [id] 1])
```

This avoids the overhead of converting DATEs to universal times and so may improve performance of your application.

See `select`, page 1634 for details.

### 23.6.4 Using universal time format

If the database is only accessed via Common SQL and you want to use the universal time date format, then you might consider using an INTEGER column containing universal time values instead of a DATE column.

## 23.7 SQL I/O recording

It is sometimes convenient to simply monitor the flow of commands to, and results from, a database. A number of functions are provided for this purpose.

The functions operate on two stream collections (*broadcast streams*) — one each for commands and results. They allow the recording to be started and stopped, checked, or recorded on further individual streams. By default, both commands and results recording is printed only to `*standard-output*`.

For details, see the reference pages for `start-sql-recording`, `stop-sql-recording`, `sql-recording-p`, `list-sql-streams`, `sql-stream`, `add-sql-stream` and `delete-sql-stream`.

## 23.8 Error handling in Common SQL

All errors generated by Common SQL are of type `sql-user-error` or `sql-database-error`. You can test for these conditions and their subtypes in your error handlers.

### 23.8.1 SQL condition classes

An `sql-user-error` is an error inside Lisp.

An `sql-database-error` is an error inside the database interface that Lisp uses.

The following are subclasses of `sql-database-error`:

`sql-database-data-error`

An error with the data given. It signifies an error that must be fixed for the code to work.

`sql-timeout-error`

## 23.9 Using MySQL

Signifies an error that is a result of other users using the same database. It means the code can work without change, once the other users stop using the database.

### `sql-connection-error`

An error with the connection to the RDBMS.

The following are subclasses of `sql-connection-error`:

#### `sql-timeout-error`

A timeout with some operation.

#### `sql-fatal-error`

An error which means that the connection is no longer usable.

**Note:** In general, the documentation for the various supported databases make it difficult to decide which error code should be made into which of the above condition class, and we probably get many of these wrong. If you find errors that seem to be signaled with the wrong condition class, please report them to Lisp Support, including the full printout of the condition, and we will fix it.

### 23.8.2 Database error accessors

Three functions are provided which access slots of `sql-database-error`, allowing you to discover more about the actual error that occurred.

`sql-error-error-id` and `sql-error-secondary-error-id` return primary and secondary error identifiers. If you use these, please read the detailed description in `sql-database-error`, page 1643.

`sql-error-database-message` is a string (maybe `nil`) returned by the foreign code.

## 23.9 Using MySQL

This section describes particular issues in Common SQL with MySQL databases.

### 23.9.1 Connection specification

See “Connecting to MySQL” on page 339 for information about MySQL specific extensions for the *connection-spec* passed to `connect`.

### 23.9.2 Case of table names and database names

MySQL is case sensitive on table names and database names when the server is on a Unix machine. MySQL does not automatically change raw names to uppercase as specified by the SQL standard. However, Common SQL is geared towards uppercasing all names, so this may cause some mismatches. In general, Common SQL uppercases strings, and uses symbol names, which are normally uppercase, as-is.

One solution, possible only if you control the naming of tables and databases, is to make them all have the same case. If this is uppercase, that suffices. If it is lowercase, you need to set the variable `lower_case_table_names` in the configuration of the server.

If you cannot make all the names the same case, you have to get the case right. This can be achieved in several ways:

1. Specify tables names using strings, for example:

```
(sql:select [*] :from ["TableNamewithVARIABLEcase"])
```

Note that this does not work in LispWorks 4.4 and previous versions.

2. Pass the Lisp string directly:

```
(sql:select [*] :from "TableNamewithVARIABLEcase")
```

Note that in this case the table name is passed to the database inside double quotes. That works only when the mode of the Common SQL connection contains `ANSI_QUOTES` (which is the default, see “SQL mode” on page 375 for details).

3. Specify table names as escaped symbols:

```
(sql:select [*] :from [|TableNamewithVARIABLEcase|])
```

4. Construct the whole query string and pass it to `query` rather than using `select`:

```
(sql:query "select * from TableNamewithVARIABLEcase")
```

### 23.9.3 Encoding (character sets in MySQL).

You can specify the encoding to be used by passing the `:encoding` argument to `connect`. Common SQL supports various encodings for MySQL as documented in `connect`, page 1533.

The default is to use the default for the particular MySQL installation.

### 23.9.4 SQL mode

Because Common SQL is geared towards ANSI SQL, by default it connects in ANSI mode. If another mode is required, it can be set at connection time.

For example, to make MySQL treat quotes as in ANSI without setting other ANSI features, do:

```
(sql:connect "me/mypassword/mydb"  
             :sql-mode "ANSI_QUOTES")
```

See the description of the `:sql-mode` argument to `connect`, page 1533 for details.

### 23.9.5 Meaning of the `:owner` argument to `select`

In the Common SQL MySQL interface, the value of the `select` keyword argument `:owner` is interpreted to select a database name.

### 23.9.6 Special considerations for iteration functions and macros

This section describes particular issues when fetching multiple records using Common SQL with MySQL databases.

#### 23.9.6.1 Fetching multiple records

The function `map-query` and the macros `do-query`, `simple-do-query` and `loop` with `each record` use internally `mysql-use-query`, which means that the underlying MySQL code brings the data from the server one record at a time. With a small number of records, it may be preferable to bring all the data immediately instead. This can be done by passing the argument `get-all`, as follows:

```
(sql:map-query nil 'print
  "select forname,surname from people"
  :get-all t)

(sql:do-query
  ((forname surname) "select forname,surname from people"
   :get-all t)
  body)

(sql:simple-do-query
  (list "select forname,surname from people"
    :get-all t)
  body)

(loop for (forname surname) being each record
  "select forname,surname from people"
  get-all t
  body)
```

### 23.9.6.2 Aborting queries which fetch many records

In the MySQL interface there is no way to abort a query when part way through it. When any of the iterations above stops before reaching its end, the underlying code retrieves all the records to the end of the query (though without converting them to Lisp objects). If the query found many records, that may be an expensive (that is, time consuming) operation.

It is possible to avoid this inefficiency by passing the argument *not-inside-transaction*. If *not-inside-transaction* is true then when a query is aborted, then LispWorks closes the database connection and reopens it, rather than retrieving all the remaining records.

```
(sql:map-query nil 'print
  "select forname,surname from people"
  :get-all t
  :not-inside-transaction t)
```

Note that this will lose any state associated with the connection, and so *not-inside-transaction* should only be used with care.

### 23.9.7 Table types

By default, `create-table` creates tables of the default type. This behavior can be overridden by the `connect` keyword arguments `:default-table-type`

## 23.9 Using MySQL

and `:default-table-extra-options`, and the `:type` and `:extra-options` keyword arguments to `create-table`.

If `type` is passed to `create-table` or `default-table-type` was passed to `connect`, it is used as the argument to the "keyword" `TYPE` in the SQL statement:

```
create table MyTable (column-specs) TYPE = type-value
```

If `extra-options` is passed to `create-table` or `default-table-extra-options` was passed to `connect`, it is appended in the end of the SQL statement above.

`connect` with `default-table-type` and `create-table` with `type` also accept the keyword argument `:support-transactions`. When `support-transactions` is true, these functions will attempt to make tables that support transactions. It does this by using the type `innodb`.

### 23.9.8 Rollback errors

The default value of the `connect` keyword argument `:signal-rollback-errors` is determined by the value of the `:default-table-type` argument. If `default-table-type` is `:support-transactions` or `"innodb"` or `"bdb"`, then the default value for `:signal-rollback-errors` is `t`, otherwise the default value is `nil`.

### 23.9.9 Types of values returned from queries

Common SQL uses the MySQL mechanism that returns values as strings.

By default, Common SQL converts these strings to the appropriate Lisp type corresponding to the column type (or more accurately, the type of the field in the query) according to Table 23.3

Table 23.3 MySQL type mapping

MySQL column type	Lisp Type	Meaning
All integer types	<code>integer</code>	
Double	<code>double-float</code>	
Single	<code>single-float</code>	

Table 23.3 MySQL type mapping

MySQL column type	Lisp Type	Meaning
Decimal	<code>rational</code>	
All String types	<code>string</code>	
All Binary types	<code>(array (unsigned-byte 8) *)</code>	
Date	<code>integer</code>	Universal time
Datetime	<code>integer</code>	Universal time
Timestamp	<code>integer</code>	Universal time
Time	<code>integer</code>	Number of seconds
Year	<code>integer</code>	Number of years

However, if you specify the result type as `:string`, this eliminates the conversion and the return value is simply the string retrieved by MySQL. For information about specifying the result type for a column (or multiple columns) in a query, see “Querying” on page 346.

Each of the five date-like types (that is, Date, Datetime, Timestamp, Time and Year) can have result type `:date`, `:date-string` or `:datetime-string` with the following effects:

`:date` This result type means a Universal time. This is the default except for Year.

`:date-string` A string with the format that MySQL uses for Date columns.

`:datetime-string` A string with the format that MySQL uses for Datetime columns.

### 23.10 Using Oracle

All the numeric types can have result type `:int`, `:single-float` or `:double-float`, causing the appropriate conversion. No check is made on whether the result is actually useful.

String types can have result type `:binary`, which returns an array.

#### 23.9.10 Autocommit

Common SQL sets `autocommit` to 0 when it opens a MySQL connection.

## 23.10 Using Oracle

This section describes particular issues in Common SQL with Oracle databases, apart from the LOB interface, which is described in “Oracle LOB interface” on page 380.

### 23.10.1 Connection specification

See “Connecting to Oracle” on page 338 for information about Oracle-specific interpretation of the `connection-spec` passed to `connect`.

### 23.10.2 Setting connection parameters

Oracle database connections have prefetch values which you can control via Common SQL. Alternatively you can allow the database default prefetch values to take effect.

You can set the default prefetch values for a connection by passing `:prefetch-rows-number` and `:prefetch-memory` keyword arguments to `connect`. The default value of `prefetch-rows-number` is 100 and the default value of `prefetch-memory` is #x100000 (meaning 1 MB of data).

You can also pass the value `:default` for either of these arguments. This means that Common SQL does not set the default. This is useful if Oracle itself provides a suitable default.

## 23.11 Oracle LOB interface

### 23.11.1 Introduction

The Common SQL Oracle LOB interface allows you to retrieve LOB locators and then perform operations on them. It is also possible to insert new empty LOBs.

#### 23.11.1.1 Retrieving LOB locators

This is done by normal `select` or `query` calls where the *selections* list names one or more columns that are of a LOB type. The LOB types are BLOB, CLOB, NCLOB, BFILE and CFILE.

The returned value is a LOB locator: an opaque Lisp object on which the `ora-lob-*` APIs (that is, those functions with names beginning with "ora-lob-") can be used. This LOB locator contains a pointer to an Oracle descriptor of type OCILobLocator\*. Note that there can be multiple LOB locator objects associated with the same LOB in the server, but a LOB locator uniquely identifies a LOB object.

It is possible to specify that the result object should be a stream either for input or output. Then the resulting stream (which will be of type `lob-stream`) can be used as a normal Lisp stream.

#### 23.11.1.2 Operating on LOB locators

This is done using the `ora-lob-*` functions. Most of these functions map directly to the underlying OCILob\* functions.

Note that when modifying a LOB locator, the corresponding record must be locked. See “Retrieving Lob Locators” on page 381 for details.

#### 23.11.1.3 Inserting empty LOBs

To add a new LOB object to the database, you must insert an empty LOB. The preferred way of doing this is to use the Oracle SQL functions EMPTY\_BLOB and EMPTY\_CLOB, which can be called by using the pseudo operator `sql-function`, like this:

### 23.11 Oracle LOB interface

```
(sql:insert-records :into [mytable]
    :values
        (list "name" [sql-function 'empty_blob]))
```

This code inserts a record with "name" and an empty BLOB. It is also possible to make an empty LOB by calling `ora-lob-create-empty`, and passing the empty LOB as a value to `insert-records` or `update-records`.

#### 23.11.2 Retrieving Lob Locators

When the selections list of a query that is used in `select`, `query`, `do-query`, `map-query`, `simple-do-query` or `loop .... for x being each record` contains a column of a LOB type, the results are LOB locator objects. For example, if the table definition is:

```
create table mytable {
    name varchar(200),
    image blob
}
```

Then doing

```
(sql:select [image] :from [mytable] :flatp t)
```

returns a list of LOB locators.

This example lists the size of the images in the table mytable:

```
(dolist (pair (sql:select [name] [image] :from [mytable]))
    (format t "~a has an image of size ~a~%" 
            (first pair) (sql:ora-lob-get-length (second pair)))
    (sql:ora-lob-free (second pair)))
```

or more efficiently

```
(sql:do-query ((name lob-locator)
                [sql:select [name] [image] :from [mytable]])
                (format t "~a has an image of size ~a~%" 
                        name (sql:ora-lob-get-length lob-locator)))
```

**Note:** The lifetime of the LOB locator objects differs between the functions that return a list of objects (`select` and `query`) and the iterative functions and macros (`do-query`, `simple-do-query`, `loop` and `map-query`). The iteration functions and macros free the LOB locators that they retrieve before proceeding to the next iteration. `select` and `query` do not free the LOB locators. Each

LOB locator stays alive until the application makes an explicit call to `ora-lob-free`, or until the database is closed by a call to `disconnect`.

### 23.11.3 Locking

When the LOB or its contents need to modified, the corresponding record must be locked (Oracle enforces this). The best way to lock a record is to pass `:for-update` when calling `select`. See `select`, page 1634 for details. For example, writing a line in the end of the log file of station number 573:

```
create table logfiles (stationid integer, logfiles clob)
    .. insert records ..

(sql:do-query ((log-stream)
    [select [log :output-stream] :from [logfiles]
     :where [= [stationid] 573] :for-update t])
    (file-position log-stream :end)
    (write-line "Add this line to the log" log-stream)
    (close log-stream) ; forces the output
  )
(sql:commit)
```

Note that any call to `commit` or `rollback` on the same connection removes the lock. If you want to modify the LOB later, you must lock it again. An efficient way to achieve this is to use the special token `ROWID`, which returns the `ROWID` in the database, because this does not involve searching on the server side. For example:

### 23.11 Oracle LOB interface

```
(let ((lobs-list
      (sql:select [lob-field] [rowid] ; get pairs of LOB
                  :from [mytable] ; locators and ROWIDs
                  :where [some-condition])))
    ... do something ...
    ... reach a point when we want to modify one
    ... of the LOBS above and have bound one of the
    ... pairs in the variable pair.
    (sql:select [1]
                :from [mytable] ; retrieve a constant
                :where
                  [= [rowid] (second pair)] ; get the right record
                  :for-update t) ; lock it
    (sql:ora-lob-write-buffer (car pair) ; modify the lob
                               offset
                               amount
                               buffer)
    (sql:commit) ; also unlock everything
  )
```

#### 23.11.4 Retrieving LOB Locators as streams

To retrieve LOB locators as streams, specify the type of retrieved object as `:input-stream` or `:output-stream` in the query. For example:

```
(sql:select [image :input-stream] :from [mytable] :flatp t)
```

returns a list of streams.

For example, to print the name of all images that start with some "magic number", that is a sequence of 4 specific bytes (#xf5 #x12 #x4e #x23):

```
(let ((array (make-array 4 :element-type '(unsigned-byte 8))))
  (sql:do-query ((name lob-stream)
                 [sql:select [name] [image :input-stream]
                           :from [mytable]])
    (when (and (read-sequence array lob-stream) 4)
      (eq (aref array 0) #xf5)
      (eq (aref array 0) #x12)
      (eq (aref array 0) #x4e)
      (eq (aref array 0) #x23))
      (print name))))
```

Closing the stream also frees the LOB object.

When using `:output-stream`, it is important to call `force-output` before trying to commit the changes, because the stream is buffered.

### 23.11.5 Attaching a stream to a LOB locator

It is possible to attach a stream to a LOB locator, passing the LOB locator as a `:lob-locator` argument to `(make-instance 'lob-stream ...)`. The value of the `:direction` argument must be `:input` or `:output`. By default, if the stream is closed the LOB locator is freed, unless the value of the initarg `:free-lob-locator-on-close` is passed as `nil`.

Operations via the stream can be mixed with direct operations on the LOB. However, because of the buffering, accessing the LOB contents will give non-obvious results, as other operations may not see something that was written to the stream because it is still in the stream buffer, or the stream may have already read some contents before they were overwritten. Use `force-output` or `clear-input` before accessing the LOB in other ways to avoid these problems.

It is possible to attach more than one stream to the same LOB locator, in both directions. Apart from the issue of the buffering described above, the streams can be used independently of each other. Note that if you want to close one of the streams and to continue to use the others or the LOB locator itself, you must pass `:free-lob-locator-on-close nil` when you make the stream.

The LOB locator to which a stream is attached can be found by using the reader `lob-stream-lob-locator`.

### 23.11.6 Interactions with foreign calls

You can define your own foreign calls and use them on the underlying OCI descriptors. For this, you need to access the OCI handles using `ora-lob-lob-locator`, and maybe `ora-lob-env-handle` and `ora-lob-svc-ctx-handle`. These accessors return foreign pointers that can be passed to foreign functions in the usual way.

When the foreign functions deal only with the data, rather than with LOB objects, use the functions `ora-lob-read-foreign-buffer`, `ora-lob-write-foreign-buffer` and `ora-lob-get-buffer`.

For example:

### 23.11 Oracle LOB interface

```
;;; You have a C function my_lob_processor
;;; int my_lob_processor(OCILobLocator *lob,
;;;                      OCISvcCtx *Context,
;;;                      int other_arg)

(fli:define-foreign-function my-lob-processor
  ((lob sql:p-oci-lob-locator)
   (env sql:p-oci-svc-ctx)
   (other-arg :int))
  :result-type :int)
```

Assuming you have the LOB locator in the variable *lob*, call the foreign function on it:

```
(my-lob-processor (sql:ora-lob-lob lob)
                  (sql:ora-lob-svc-ctx-handle lob)
                  36)
```

There are three handles in the LOB: the LOB descriptor itself, the environment and the context. The pointer types, the reader and the corresponding C type for each handle are shown in Table 23.4 below.

Table 23.4 Handles in the LOB locator

OCI handle	Reader	Pointer type	C type
LOB descriptor	ora-lob-lob-locator	p-oci-lob-locator or p-oci-file	OCILobLocator*
context	ora-lob-svc-ctx-handle	p-oci-svc-ctx	OCISvcCtx*
environment	ora-lob-env-handle	p-oci-env	OCIEnv*

The pointer type **p-oci-lob-locator** is used for internal LOBs (that is, BLOB, CLOB and NCLOB). The pointer type **p-oci-file** is used for file LOBs (CFILE and BFILE). For functions that take both, the type **p-oci-lob-or-file** is defined as the union of these two types

### 23.11.7 Determining the type of a LOB

The function `ora-lob-internal-lob-p` returns whether it is internal (that is BLOB, CLOB or NCLOB) or not (that is BFILE or CFILE). The function `ora-lob-element-type` returns the LISP element type that best corresponds to the LOB locator. This will be one of (`unsigned-byte 8`) for BLOB and BFILE, or `base-char` or `bmp-char` for CLOB, NCLOB and CFILE, depending on the charset of the LOB object.

It is possible to distinguish between CLOB and NCLOB by looking at the result of `ora-lob-char-set-form`. It returns 2 for NCLOB and 1 for CLOB.

### 23.11.8 Reading and writing from and to LOBs

One way of reading and writing is to use streams as described in the section “Retrieving LOB Locators as streams” on page 383. When large amounts of data are written (read) to (from) the LOB the direct interface may be useful. The direct interface is implemented by `ora-lob-read-foreign-buffer`, `ora-lob-read-buffer`, `ora-lob-write-foreign-buffer`, and `ora-lob-write-buffer`.

All the direct interfaces are more efficient if the buffer that is passed is static. That is always true for the `*-foreign-buffer` functions, but normally not true for Lisp objects. See the documentation for `make-array`, page 680. See also `ora-lob-get-buffer`.

The direct reading and writing methods can be used for "random" access, but they can also be used conveniently for efficient linear access, simply by passing `nil` as the `offset` parameter.

### 23.11.9 The LOB functions

Most of the LOB functions take an `errorp` argument, which is a boolean controlling what happens if an error occurs inside an OCI function. If `errorp` is true, an error is signaled. If `errorp` is false, the function returns an error object (of type `sql-database-error`).

All the LOB functions signal an error if the `lob-locator` argument given is not a LOB locator object as returned by `select` or `query`.

## 23.11 Oracle LOB interface

Many of the functions basically perform a call to the underlying OCI function. When the match is direct, this is mentioned in the function's manual page.

### 23.11.9.1 Querying functions

You can test whether a LOB locator is initialized, open or temporary with `ora-lob-locator-is-init`, `ora-lob-is-open` or `ora-lob-is-temporary`.

The predicate for internal LOBs is `ora-lob-internal-lob-p`.

`ora-lob-element-type` returns a Lisp element type corresponding to the LOB locator as described "Determining the type of a LOB" on page 386.

`ora-lob-lob-locator`, `ora-lob-env-handle` and `ora-lob-svc-ctx-handle` return foreign pointers to the various handles in the LOB mentioned in "Interactions with foreign calls" on page 384. To determine the best value for the size of a buffer use `ora-lob-get-chunk-size`.

`ora-lob-char-set-form` and `ora-lob-char-set-id` query the charset of a *lob-locator*.

The querying functions specifically for file LOBs are `ora-lob-file-exists`, `ora-lob-file-is-open` and `ora-lob-file-get-name`

You can obtain the current length of the LOB with `ora-lob-get-length`.

You can test two LOB locators for whether they point to the same LOB object with `ora-lob-is-equal`.

### 23.11.9.2 LOB management functions

You can create a LOB object with `ora-lob-create-empty`.

You can assign a LOB to another LOB locator with `ora-lob-assign`.

You can free a LOB locator with `ora-lob-free`.

### 23.11.9.3 Modifying LOBs

All the functions mentioned in this section are applicable to internal LOBs only, except `ora-lob-load-from-file`.

Before modifying a LOB, the corresponding record must be locked. See the discussion in “Locking” on page 382.

If you make several modifications to a LOB which has functional or domain indexes, it is useful to wrap several calls of modifying functions in a pair of `ora-lob-open` and `ora-lob-close`. That means that the indexes will be updated once (when `ora-lob-close` is called), which saves work. Note that after a call to `ora-lob-open`, `ora-lob-close` must be called before any call to `commit`.

To append the contents of one LOB to another, use `ora-lob-append`.

You can copy all or part of a LOB into another LOB using `ora-lob-copy`.

`ora-lob-load-from-file` loads the data from a file LOB into an (internal) LOB.

You can erase (that is, fill with the 0 byte or with Space character) all or part of a LOB using `ora-lob-erase`.

You can reduce the size of a LOB using `ora-lob-trim`.

If you need to make multiple updates to a LOB you can optionally create a transaction using `ora-lob-open` and `ora-lob-close` call. This may save work on the server side.

#### 23.11.9.4 File operations

These functions are used to modify the properties of file LOBs.

Open and close the file associated with a file LOB using `ora-lob-file-open` and `ora-lob-file-close`.

You can close all the files associated with a file LOB locator that have been opened through the database connection with `ora-lob-file-close-all`.

You can alter the directory and/or the file name for a file LOB locator by calling `ora-lob-file-set-name`.

#### 23.11.9.5 Direct I/O

The direct I/O functions perform input or output directly on the OCI handle, without the intervening layer of a stream. If you move large amounts of data

### 23.11 Oracle LOB interface

to or from the LOB, and in particular if you pass the data to or from foreign functions, the direct calls can be more efficient, and in some cases also more convenient to use. Note, however, that if you make many small modifications to the data, the `lob-stream` interface may be more efficient.

Note also that the difference in efficiency between the direct calls and the `lob-stream` interface is likely to be quite small compared to the time spent on network traffic.

If you make many modifications to a LOB, you should also consider wrapping the operations in a transaction created by a pair of calls to `ora-lob-open` and `ora-lob-close`.

You can read data from the LOB locator into a Lisp buffer or foreign buffer using `ora-lob-read-buffer` and `ora-lob-read-foreign-buffer` respectively.

Similarly `ora-lob-write-buffer` and `ora-lob-write-foreign-buffer` can be used to write buffer to a LOB.

You can obtain a buffer suitable for efficient I/O with foreign functions via `ora-lob-get-buffer`.

`ora-lob-read-into-plain-file` writes the contents of a LOB into a file.

`ora-lob-write-from-plain-file` writes the contents of a file into a LOB.

#### 23.11.6 Temporary LOBs

You can create a temporary LOB with `ora-lob-create-temporary`.

You can test whether a LOB is temporary with `ora-lob-is-temporary`.

You can free a temporary LOB locator if necessary with `ora-lob-free-temporary`, though temporary LOB locators are freed automatically when the database connection is closed by `disconnect`.

#### 23.11.7 Control of buffering

These functions control the internal buffering by the Oracle client: `ora-lob-enable-buffering`, `ora-lob-disable-buffering`, and `ora-lob-flush-buffer`. They have no interaction with any of the other functions above.

### 23.11.10 Fetching the contents of the LOBs directly

Sometimes it is useful to fetch the contents of a LOB directly. You can do that by specifying the type of the requested value as `:binary` for binary LOBs (BLOB and BFILE) or `:string` for character LOBs (CLOB, NCLOB, and CFILE). When you specify the type in this way, the fetched values are arrays of type `(unsigned-byte 8)` for `:binary` and strings for `:string`. For example:

```
(sql:select [blob_column] :from [a_table])
=>
a list of LOB locators

(sql:select [blob_column :binary] :from [a_table])
=>
a list of arrays
```

## 23.12 Using ODBC

### 23.12.1 Configuring unixODBC

On Unix, configure unixODBC in these files.

For the driver:

```
/etc/odbcinst.ini
```

For the datasource:

```
~/.odbc.ini
```

```
/etc/odbc.ini
```

### 23.12.2 Loading unixODBC

At load time do:

```
(require "odbc")
```

At run time on Unix, Common SQL automatically loads the unixODBC module from the location in the variable `sql::*odbc-foreign-modules*`. In LispWorks for Linux this variable initially has the value `("~/usr/lib/libodbc.so")`. Therefore if, for example, the run time machine unixODBC

## 23.12 Using ODBC

installed in

/usr/local/, at run time do:

```
(setq sql::*odbc-foreign-modules* '("/usr/local/lib/libodbc.so"))
(sql:connect "mydatabase" :database-type :odbc)
```

### 23.12.3 External format for ODBC strings

On Unix, the default external format for ODBC strings is :ascii. On Microsoft Windows it is win32:\*multibyte-code-ef\*.

### 23.12.4 Using non-ASCII strings on Microsoft SQL Server

When passing a SQL expression containing string literals to Microsoft SQL Server (which you can do via ODBC), if a string literal contains characters that the server's code page cannot represent, then the string literal needs to be marked as "Native" by prefixing it with the character 'N' before the opening quote. For example:

```
N'Greek'
```

Code pages always can always represent ASCII characters, but differ in what other characters can represent. The functions `string-needs-n-prefix` and `string-prefix-with-n-if-needed` are provided to check if a string needs prefixing.

Other SQL backends work with all strings regardless of the N syntax, but the syntax is allowed by most of them as well (and is standard SQL). However, SQLite and Microsoft Access (via ODBC) do not recognize the N syntax, and give an error. This means that static SQL expressions, which are generated before knowing which SQL backend is going to be used, cannot reliably use the N syntax. In addition, knowing exactly which strings need the N syntax requires knowledge of the code page in the server, and hence requires the database to be opened already when `string-needs-n-prefix` or `string-prefix-with-n-if-needed` are called.

The syntax described in “Symbolic SQL syntax” on page 358 generates static expressions when possible, and Lisp string values within them are processed independently of any database to produce string literals without the N syntax. This can be overridden by using the `string` pseudo-operator, which is described in “SQL string literals” on page 366, and can decide dynamically

whether to use the N syntax or not. Thus you should use the `string` pseudo-operator in any symbolic SQL syntax that may be used with Microsoft SQL Server and contains SQL string literals (including Lisp expressions that evaluate to strings) to ensure that it works on Microsoft SQL Server for all strings and is also portable.

If you want to work with Microsoft SQL Server and do not require portability to SQLite or Microsoft Access, then you can set `*use-n-syntax-for-non-ascii-strings*` to `t` to always use the N syntax. However, the N prefix changes the type of the string inside Microsoft SQL Server to "Unicode", which has a different collation to non-Unicode strings, so if you need the non-Unicode collation for strings that have codes in the server's code page then this may not be the right approach.

Another approach is to use `prepare-statement` with a bind-variable for the string, which works on all SQL backends without any additional code (because the string is not used as a literal in the SQL expression):

```
(setq *a-prepared-statement*
      (sql:prepare-statement [sql:select [name]
                             :from [sometable]
                             :where [= [nchar_column] [1]]]))
...
(sql:set-prepared-statement-variables *a-prepared-statement*
                                      (list a-non-ascii-string))
(sql:query *a-prepared-statement*)
```

The functions `update-records` and `insert-records` also do not use the values that they get as literals in SQL expressions when modifying a Microsoft SQL Server database, and therefore do not require additional code for the values. However, the `where` expression in `update-records` and the `query` expression in `insert-records` are used directly, so if they contain non-ASCII strings as literals then they will need to be modified for Microsoft SQL Server.

## 23.13 Using SQLite

This section describes particular issues in Common SQL with SQLite databases.

### 23.13.1 Connecting to SQLite

See “Connecting to SQLite.” on page 343 for information about SQLite-specific *connection-spec* and *sqlite-keywords* arguments to `connect`.

### 23.13.2 Types of retrieved fields in queries

By default, when doing queries (`select`, `query`, `map-query`, `do-query`, `simple-do-query`, `loop` with `each record` and `print-query`) the LispWorks checks the data type of each field it reads in each row, and fetches the data accordingly (using the C functions `sqlite3_column_*` like `sqlite3_column_int` in the SQLite3 library). Values of SQLite data types `NULL`, `INTEGER`, `REAL` and `TEXT` are mapped to Lisp objects of type `null`, `integer`, `double-float` and `string` respectively ("mapped" means returned from `select` or `query`, printed in `print-query`, or passed to your code in the other APIs). A value of data type `BLOB` is mapped to an array with element type `(unsigned-byte 8)` containing all of the bytes of the `BLOB`.

You can force the value to a specific type by specifying the type explicitly. This is done by specifying the type with the identifier, either using the symbolic SQL syntax (see “Enclosing database identifiers” on page 359) or using `sql-expression`. For `select` and `query` you can also use the keyword argument `:result-types`.

The types that LispWorks recognizes for SQLite are the common types: `:integer` (alias `:int`), `:string`, `:double-float` and `:binary`. These match the SQLite data types `INTEGER`, `TEXT`, `REAL` and `BLOB` respectively. When these keywords are used, LispWorks asks SQLite for a value of the corresponding data type, and converts it to the matching Lisp object type as above. Note that the value can also be `nil`, if the the value is `null` or cannot be converted to the requested Lisp object type.

Other possible values for the type are:

`:single-float`

LispWorks asks SQLite for a `REAL`, and coerces it to a `single-float`.

<code>nil</code>	Use the default behavior. Useful if you use <code>:result-types</code> and want to force the type of some of the fields but not all of them.
<code>:blob</code>	Returns a handle to the raw data of a BLOB, from which you can read the data using the APIs described in “Reading from blobs using a handle (sqlite-raw-blob) and modifying blobs (sqlite-blob)” on page 394. This allows more flexible access to BLOB values.  <code>:blob</code> cannot be used with <code>select</code> or <code>query</code> .

Note that SQLite does not support any kind of date data type.

When the value that is stored in the database does not match the value that it is asked for, the SQLite library converts the value to the required type, so you always get a value of the correct type, but not necessarily a useful value. See the documentation for SQLite for details: [https://www.sqlite.org/c3ref/column\\_blob.html](https://www.sqlite.org/c3ref/column_blob.html) "Result Values From a Query".

### 23.13.3 Tables containing a uniform type per column

SQLite allows the fields in each row to contain any supported type, rather than being constrained to the type specified for the column in the table definition.

When you connect to a database, you can use the SQLite-specific keyword `:uniform-type-per-column` in *sqlite-keywords* with value `t` to tell LispWorks that all of the values of a column returned by a query have the same data type.

When you do that, for fields where you do not specify the type explicitly, the LispWorks checks the type of the field in the first result row, and then uses it for the rest of the rows.

### 23.13.4 Reading from blobs using a handle (sqlite-raw-blob) and modifying blobs (sqlite-blob)

When the type of a field in a query is specified as `:blob`, the SQLite BLOB is mapped to an object of type `sqlite-raw-blob`. You can then read data from the SQLite BLOB using any the functions `copy-from-sqlite-raw-blob`,

### 23.13 Using SQLite

`replace-from-sqlite-raw-blob` or `sqlite-raw-blob-ref`. The function `sqlite-raw-blob-length` can be used to find the size of the BLOB (in bytes).

The `sqlite-raw-blob` is valid only within the dynamic extent of the function that is called from the Common SQL interface. If you try to read from a `sqlite-raw-blob` outside this dynamic context, an error of type `sql-user-error` will be signaled. You can use `sqlite-raw-blob-valid-p` to check if a blob is valid.

Using `sqlite-raw-blob` makes it more convenient to read the data when a BLOB contains elements larger than bytes, and makes it more efficient when you retrieve large BLOBs (a few kilobytes or more) but need only a small part of the data.

SQLite allows reading and writing of BLOBS (fields with type BLOB or TEXT) directly, which you can do using the `sqlite-blob` interface. The functions `sqlite-open-blob` and `sqlite-close-blob` are used to open and close a BLOB field, or the macro `with-sqlite-blob` can be used to do both. Once you have opened a BLOB, you call `replace-from-sqlite-blob` or `replace-into-sqlite-blob` to copy data to or from it. Note that the `sqlite-blob` is not thread-safe, so you must do all of the operations in a "single thread" context (either all in one thread, or serialized by a lock).

`sqlite-raw-blob` corresponds to the result of the C function `sqlite3_column_blob` (and `sqlite3_column_bytes` to obtain the size).  
`sqlite-blob` corresponds to the C structure `sqlite3_blob`.

#### 23.13.5 Values in Insert and Update.

When modifying a table in SQLite, either directly by using `insert-records` or `update-records`, or by executing a `prepared-statement` statement with bind-variables, the values that are passed are treated as follows:

In a `prepared-statement`, if the variable-type is `:string`, then the value is converted to a string.

The value is passed to the SQLite library as a SQLite data type based on the type of the value as follows:

```
(signed-byte 64)  
INTEGER
```

<code>float</code>	REAL
<code>string</code>	TEXT
<code>null</code>	NULL
Binary array	BLOB
<code>list</code>	See below

A binary array is an array with an integer or float element type. `bmp-string` and `base-string` are also binary arrays in some contexts, but they are treated as strings in this case (`text-string` is not a binary array).

In addition, the value can be a list, which is treated as follows:

- If the first element of the list is a binary array, including `bmp-string` or `base-string`, then the list must be of form `(array)`, `(array start)` or `(array start end)` and the bytes between `start` and `end` in `array` are inserted as a BLOB. If `start` is omitted, it defaults to 0. If `end` is omitted, it defaults to the length of `array`.

Note that `start` and `end` are denoted in elements rather than bytes, so the number of the bytes in the BLOB is  $(\star (- \text{end} \text{start}) \text{bytes-per-element})$ . Note also that, for arrays of more than one byte per element, the contents of the BLOB will depend on the byte order of the host machine.

Apart from allowing insertion of parts of arrays, this syntax also allows you to insert the character codes in a `bmp-string` and `base-string` as a BLOB, by passing the string as a list of one element.

- If the first element of the list is the keyword `:zeroblob`, then the second element is treated as a size, which must be a positive integer smaller than  $2^{31}$ , that is of type `(integer 0 #xfffffff)`. LispWorks inserts a zero blob of this size (using the C function `sqlite3_bind_zeroblob`).

Any value that does not match the description above, including integers out of range and lists that do not match the patterns described, cause an error (of type `sql-user-error`) to be signaled.

### 23.13.6 Accessing ATTACHED databases

ATTACHED databases in SQLite, that is databases that were attached using the SQLite ATTACH statement, are identified by their schema names. You can

### 23.13 Using SQLite

specify the schema name in the "[...]" syntax, for example, if you attach a file called "another-database" as follows:

```
(execute-command "ATTACH another-database as AttachedDB")
```

then you can read the contents of a table SomeTable inside "another-database" using AttachedDB as the "schema" name:

```
(select [*] :from [AttachedDB SomeTable])
```

The keyword **:owner** in Common SQL function specifies the schema to which the table(s) belong, for example, after the ATTACH above, you can obtain the list of tables inside another-database by using:

```
(sql:list-tables :owner "AttachedDB")
```

and use AttachedDB as the "owner" in **sql-expression**:

```
(select [*] :from (sql-expression :owner "AttachedDB"
                     :table "SomeTable"))
```

See [https://www.sqlite.org/lang\\_attach.html](https://www.sqlite.org/lang_attach.html) "ATTACH DATABASE" for details about attaching in SQLite.



# 24

---

# User Defined Streams

## 24.1 Introduction

A number of classes and functions are provided in the `stream` package that allow you to define your own input and output streams. You can use the standard Common Lisp I/O functions on these streams, and you can add methods specialized on your stream classes to provide specific implementations of other I/O functions. Note that some changes have been made to the standard I/O functions to allow for this. For example, `stream-element-type` is now a generic function. See Chapter 33, “The COMMON-LISP Package” for alterations to Common Lisp functions, and Chapter 48, “The STREAM Package” for more details on the API for user defined streams.

## 24.2 An illustrative example of user defined streams

In this chapter an example is provided to illustrate the main features of the `stream` package. In this example a stream class is defined to provide a wrapper for `file-stream` which uses the Unicode Line Separator instead of the usual ASCII CR/LF combination to mark the end of lines in the file. Methods are then defined, specializing on the user defined stream class to ensure that it handles reading from and writing to a file correctly.

### 24.2.1 Defining a new stream class

Streams can be capable of input or output (or both), and may deal with characters or with binary elements. The `stream` package provides a number of stream classes with different capabilities from which user defined streams can inherit. In our example the stream must be capable of input and output, and must read characters. The following code defines our stream class appropriately:

```
(defclass unicode-ls-stream
  (stream:fundamental-character-input-stream
   stream:fundamental-character-output-stream)
  ((file-stream :initform nil
                :initarg :file-stream
                :accessor ls-stream-file-stream)))
```

The new class, `unicode-ls-stream`, has `fundamental-character-input-stream` and `fundamental-character-output-stream` as its superclasses, which means it inherits the relevant default character I/O methods. We shall be overriding some of these with more relevant and efficient implementations later.

Note that we have also provided a `file-stream` slot. When making an instance of `unicode-ls-stream` we can create an instance of a Common Lisp file stream in this slot. This allows us to use the Common Lisp file stream functionality for reading from and writing to a file.

### 24.2.2 Recognizing the stream element type

We know that the stream will read from a file using `file-stream` functionality and that the stream element type will be `character`. The following defines a method on `stream-element-type` to return the correct element type.

```
(defmethod stream-element-type ((stream unicode-ls-stream))
  'character)
```

### 24.2.3 Stream directionality

Streams can be defined for input only, output only, or both. In our example, the `unicode-ls-stream` class needs to be able to read from a file and write to a file, and we therefore defined it to inherit from an input and an output stream class. We could have defined disjoint classes instead, one inheriting

from `fundamental-character-input-stream` and the other from `fundamental-character-output-stream`. This would have allowed us to rely on the default methods for the direction predicates.

However, given that we have defined one bi-directional stream class, we must define our own methods for the direction predicates. To allow this, the Common Lisp predicates `input-stream-p` and `output-stream-p` are implemented as generic functions.

```
(defmethod input-stream-p ((stream unicode-ls-stream))
  (input-stream-p (ls-stream-file-stream stream)))

(defmethod output-stream-p ((stream unicode-ls-stream))
  (output-stream-p (ls-stream-file-stream stream)))
```

The above code allows us to “trampoline” the correct direction predicate functionality from `file-stream`, using the `ls-stream-file-stream` accessor we defined previously.

#### 24.2.4 Stream input

The following method for `stream-read-char` reads a character from the stream. If the character read is a `#\Line-Separator`, then the method returns `#\Newline`, otherwise the character read is returned. `stream-read-char` returns `:eof` at the end of the file.

```
(defmethod stream:stream-read-char ((stream unicode-ls-stream))
  (let ((char (read-char (ls-stream-file-stream stream)
                        nil :eof)))
    (if (eql char #\Line-Separator)
        #\Newline
        char)))
```

There is no need to define a new method for `stream-read-line` as the default method uses `stream-read-char` repeatedly to read a line, and our implementation of `stream-read-char` ensures that this will work.

We also need to make sure that if a `#\Newline` is unread, it is unread as a `#\Line-Separator`. The following method for `stream-unread-char` uses the Common Lisp file stream function `unread-char` to achieve this.

```
(defmethod stream:stream-unread-char ((stream unicode-ls-stream)
                                       char)
  (unread-char (if (eql char #\Newline) #\Line-Separator char)
               (ls-stream-file-stream stream)))
```

Finally, although the default methods for `stream-listen` and `stream-clear-input` would work for our stream, it is faster to use the functions provided by `file-stream`, again using our accessor `ls-stream-file-stream`.

```
(defmethod stream:stream-listen ((stream unicode-ls-stream))
  (listen (ls-stream-file-stream stream)))

(defmethod stream:stream-clear-input ((stream unicode-ls-stream))
  (clear-input (ls-stream-file-stream stream)))
```

### 24.2.5 Stream output

The following method for `stream-write-char` uses `write-char` to write a character to the stream. If the character written to `unicode-ls-stream` is a `#\Newline`, then the method writes a `#\Line-Separator` to the file stream.

```
(defmethod stream:stream-write-char ((stream unicode-ls-stream)
                                       char)
  (write-char (if (eql char #\Newline)
                 #\Line-Separator
                 char)
              (ls-stream-file-stream stream)))
```

The default method for `stream-write-string` calls `stream-write-char` repeatedly to write a string to the stream. However, the following is a more efficient implementation for our stream.

```
(defmethod stream:stream-write-string ((stream unicode-ls-stream)
                                         string &optional (start 0)
                                         (end (length string)))
  (loop with i = start
        until (>= i end)
        do (let* ((newline (position #\Newline
                                      string :start i :end end))
                  (this-end (or newline end)))
            (write-string string (ls-stream-file-stream stream)
                         :start i :end this-end)
            (incf i this-end)
            (when newline
              (stream:stream-terpri stream)
              (incf i)))
        finally (return string)))
```

We do not need to define our own method for `stream-terpri`, as the default uses `stream-write-char`, and therefore works appropriately

To be useful, the `stream-line-column` and `stream-start-line-p` generic functions need to know the number of characters preceding a `#\Line-Separator`. However, since the LispWorks file stream records line position only by `\Newline` characters, this information is not available. Hence we define the two generic functions to return `nil`:

```
(defmethod stream:stream-line-column
  ((stream unicode-ls-stream))
  nil)

(defmethod stream:stream-start-line-p
  ((stream unicode-ls-stream))
  nil)
```

Finally, the methods for `stream-force-output`, `stream-finish-output` and `stream-clear-output` are “trampolined” from the standard `force-output`, `finish-output` and `clear-output` functions.

```
(defmethod stream:stream-force-output ((stream
                                         unicode-ls-stream))
  (force-output (ls-stream-file-stream stream)))

(defmethod stream:stream-finish-output ((stream
                                         unicode-ls-stream))
  (finish-output (ls-stream-file-stream stream)))
```

```
(defmethod stream:stream-clear-output ((stream
                                         unicode-ls-stream))
  (clear-output (ls-stream-file-stream stream)))
```

### 24.2.6 Instantiating the stream

Now that the stream class has been defined, and all the methods relevant to it have been set up, we can create an instance of our user defined stream to test it. The following function takes a filename and optionally a stream direction as its arguments and makes an instance of `unicode-ls-stream`. It ensures that the `file-stream` slot of the stream contains a Common Lisp `file-stream` capable of reading from or writing to a file given by the filename argument.

```
(defun open-unicode-ls-file (filename &key (direction :input))
  (make-instance 'unicode-ls-stream :file-stream
    (open filename
      :direction direction
      :external-format :unicode
      :element-type 'character)))
```

The following macro uses `open-unicode-ls-stream` in a similar manner to the Common Lisp macro `with-open-file`:

```
(defmacro with-open-unicode-ls-file ((var filename
                                         &key (direction :input))
                                         &body body)
  `(let (,(var (open-unicode-ls-file ,filename
                                         :direction ,direction)))
    (unwind-protect
      (progn ,@body)
      (close ,var))))
```

We now have the required functions and macros to test our user defined stream. The following code uses `config.sys` as a source of input to an instance of our stream, and outputs it to the file `unicode-ls.out`, changing all occurrences of `#\Newline` to `#\Line-Separator` in the process.

```
(with-open-unicode-ls-file (ss "C:\\unicode-ls.out"
                               :direction :output)
  (write-line "-- Encoding: Unicode; --" ss)
  (with-open-file (ii "C:\\config.sys") ; Don't edit this file!
    (loop with line = nil
          while (setf line (read-line ii nil nil))
          do (write-line line ss))))
```

After running the above code, if you load the file `C:\\unicode-ls.out` into an editor (for example, a LispWorks editor), you can see the line separator used instead of CR/LF. Most editors do not yet recognize the Unicode Line Separator character yet. In some editors it appears as a blank glyph, whereas in the LispWorks editor it appears as `<2028>`. In LispWorks you can use `Alt+X What Cursor Position` or `Ctrl+X =` to identify the unprintable characters.

You can also use the follow code to print out the contents of the new file line by line.

```
(with-open-unicode-ls-file (ss "C:\\unicode-ls.out")
  (loop while (when-let (line (read-line ss nil nil))
            (write-line line))))
```



# 25

---

# TCP and UDP socket communication and SSL

The interface for using sockets in LispWorks is in the "comm" module, and all the symbols are in the `comm` package, and documented in the "The COMM Package" on page 513.

To use it you need to require the module by

```
(require "comm")
```

## 25.1 Running a server that accepts connections

The function `start-up-server` starts a new thread which:

1. Creates a socket, then
2. Prepares it (that is, binds it to the address and port and does various other settings) and then
3. Waits for connections to it ("accepting connections")

When a connection is made, a programmer-supplied function is called with the new socket. Typically this function creates a stream of type `socket-stream` with this socket, and then uses the stream for communication through the socket using standard Common Lisp I/O functions.

## 25.2 Connecting to a server

The function `open-tcp-stream` connects to a server and returns a stream (of type `socket-stream`). The stream is then used for communication through the socket using the standard Lisp I/O functions.

`connect-to-tcp-server` can also be used, especially if you want to subclass `socket-stream`.

### 25.2.1 Examples

For examples illustrating simple write and read on a socket, see these files in `lib/7-1-0-0/examples`

```
capi/applications/chat.lisp
capi/applications/chat-client.lisp
```

## 25.3 Specifying the target for connecting and binding a socket

In general, each socket is bound to a local socket address, and is communicating with some other socket which has its own socket address. The local binding may be done implicitly by the system, but in many cases (in general, when it is a service) it needs to be bound to specific socket address. When connecting to another socket, or sending using UDP socket, the socket address of the other side is needed.

The socket address is always specified by a *hostspec* and *service*. *hostspec* is also referred to as "address" or "hostname" or "host", and the *service* is sometimes referred to as "port". In particular, the local *hostspec* and local *service* are called *local-address* and *local-port*.

*hostspec* specifies an IP address. It can be one of:

A string naming the host, for example "www.google.com".

Such a string is looked up by the system to find the actual IP address.

A string providing the IP address in standard format.

Example: "204.71.177.5" (IPv4)

Example: "2001:500:2f::f" (IPv6).

An integer specifying IPv4 address in network order.

Example: #xcc47B14B.

An `ipv6-address` object.

The functions `string-ip-address` and `ip-address-string` convert between strings that specify addresses and integers or `ipv6-address` objects. If you need to find the actual address from a string giving the host name, you need to look it up using `get-host-entry`. Normally you do not need to, because all the interface functions do it implicitly.

`service` specifies the port number to use. It can be either an integer, which explicitly specifies the port number, or a string, which is either a sequence of decimal digits specifying the port number or a port name that is looked up to find the port number. For example, for http connections the port number is 80. The function `get-service-entry` can be used to convert between port numbers and names.

When connecting a socket (for example by `open-tcp-stream`), `hostspec` and `service` are required arguments. When binding (for example `start-up-server`), `hostspec` (which is normally passed by the keyword argument `local-address`) can be `nil`, which means use the local host and allow any connections. `service` (which is normally passed by the keyword argument `local-port`) can be specified as 0 or `nil`, both values meaning that the operating system will select some appropriate port number.

If you have a `socket-stream` or a socket, you can find what socket address it is bound to by `socket-stream-address` or `get-socket-address`, and if it is connected, you can find what address it is connected to by `socket-stream-peer-address` or `get-socket-peer-address`.

## 25.4 Information about IP addresses

You can use the function `get-host-entry` to find the address of a domain name or the domain name of an address. It can also used to find multiple addresses and aliases.

You can use `get-socket-address`, `get-socket-peer-address` and `socket-stream-address` and `socket-stream-peer-address` to find the IP address of opened sockets.

You can use `get-default-local-ipv6-address` to find the local default IPv6 address.

You can use `get-ip-default-zone-id` to find the local default zone ID.

## 25.5 Waiting on a socket stream

The function `wait-for-input-streams` and `wait-for-input-streams-returning-first` are a convenient interface for waiting for input from socket streams. The standard I/O functions (`c1:read`, `c1:read-char` and so on) can also wait properly. You can also use `process-wait` and similar functions with `c1:listen` in the `wait-function`, but you will need to use `with-noticed-socket-stream`.

## 25.6 Special considerations

The host machine must be configured properly to handle IPv6 for the Lisp-Works interface to work with IPv6.

It is likely that all new machines can use IPv6.

### 25.6.1 IPv6 on Mac OS X

IPv6 addresses work properly on Mac OS X 10.6.

### 25.6.2 IPv6 on Windows XP

By default IPv6 addresses do not work on Microsoft Windows XP. To make it work on Windows XP, install the interface by executing this command in a console, as an administrator user:

```
netsh interface ipv6 install
```

This should not be needed on later versions of Microsoft Windows. Search for `netsh` on [technet.microsoft.com](http://technet.microsoft.com) for more information.

**Note:** LispWorks 7.0 and later versions do not support Windows XP.

## 25.7 Asynchronous I/O

The Asynchronous I/O API allows you to perform I/O operations that invoke a callback when they are complete, rather than synchronously calling a function that returns a value (like `c1:read-line`). This allows many operations to run in a single thread. When using this API, you have to hold all of the application's state in data structures so that the callback can determine how to proceed.

There are two parts to the API:

- the Wait-State-Collection API controls the overall progress of I/O.
- the Async-I/O-State API deals with individual I/O channels.

### 25.7.1 The wait-state-collection API

A `wait-state-collection` is an object that controls asynchronous I/O via an event loop. Each I/O channel is associated with a wait-state in the collection (see the “The Async-I/O-State API” on page 412 for how to add channels to a collection).

Make a `wait-state-collection` using `make-wait-state-collection`, wait for I/O to occur using `wait-for-wait-state-collection`, process the I/O using `call-wait-state-collection` and close the collection using `close-wait-state-collection`.

The function `loop-processing-wait-state-collection` simplifies processing I/O by repeatedly calling `wait-for-wait-state-collection` and `call-wait-state-collection`. It can be stopped by `wait-state-collection-stop-loop`. The function `create-and-run-wait-state-collection` makes a `wait-state-collection` and a process that runs it (using `loop-processing-wait-state-collection`). In many cases, `create-and-run-wait-state-collection` is the only function that you need to use.

To call a function in the process associated with a `wait-state-collection` you can use `apply-in-wait-state-collection-process` (but see also “Writing callbacks in Asynchronous I/O operations” on page 414).

For the `wait-state-collection` to actually do anything, it must have some “wait-states” associated with it. The primary way of associating “wait-states” with a `wait-state-collection` is to create an `async-io-state` associated

with it, see “The Async-I/O-State API” on page 412 below. The function `accept-tcp-connections-creating-async-io-states` also creates an associated "wait-state", which itself creates an `async-io-state` associated with the `wait-state-collection`. Note that new `async-io-states` can be added (and removed) dynamically to the `wait-state-collection` from any process while it is working.

See

```
(example-edit-file "async-io/driver")
```

### 25.7.2 The Async-I/O-State API

The Async-I/O-State API contains functions to create and close various kinds of asynchronous I/O channels and perform input and output operations on them. Currently "I/O channel" means a socket or a `socket-stream`.

Each channel has an associated `async-io-state` object, which is used to retain information about the channel between calls to the input and output functions. You can store your own information using the `async-io-state-user-info` accessor and give the object a name for debugging purposes using the `async-io-state-name` accessor.

An `async-io-state` is created by any of these functions:

`create-async-io-state`

Takes a socket (an integer) or a `socket-stream` and allows I/O on the socket.

`create-async-io-state-and-connected-tcp-socket`

Takes a socket address to connect to, creates a TCP socket and connects it, and allows I/O on it.

`accept-tcp-connections-creating-async-io-states`

Takes a service and creates a listening socket that accepts connection and create states which allow I/O on the accepted connections.

`create-async-io-state-and-udp-socket`

Creates a UDP socket and allows I/O on it.

**create-async-io-state-and-connected-udp-socket**

Takes a socket address, creates a UDP socket and connect it, and allows I/O on it.

Once an **async-io-state** is created for an object, the object itself should not be used directly for I/O in the same direction (read or write). The **async-io-state** can then be made active by one of **async-io-state-read-buffer**, **async-io-state-write-buffer**, **async-io-state-read-with-checking**, **async-io-state-receive-message**, **async-io-state-send-message** and **async-io-state-send-message-to-address**.

Each **async-io-state** is associated with a **wait-state-collection** when it is created. For the **async-io-state** to be active, the **wait-state-collection** must be active, which means there must be a process calling **wait-for-wait-state-collection** and **call-wait-state-collection**, possibly via **loop-processing-wait-state-collection**.

The functions **async-io-state-read-buffer** and **async-io-state-write-buffer** create an I/O operation that reads or writes a fixed amount of data in a buffer. The operation finishes when the *callback* is called, or when when an *abort-callback* is called (after being set up by **async-io-state-abort**).

The function **async-io-state-read-with-checking** creates an input operation that periodically invokes a *callback* to determine whether enough data has been received, by examining the internal buffer. You can call **async-io-state-discard** to indicate that part of the internal buffer has been processed (for example parsed and converted to some data structure). The operation finishes when **async-io-state-finish** is called inside the *callback*, or when an *abort-callback* is called (after being set up by **async-io-state-abort**).

The function **async-io-state-receive-message** creates an input operation that receives a message (using **recv** or **recvfrom**). The functions **async-io-state-send-message** and **async-io-state-send-message-to-address** create an I/O operation that sends a message (using **send** or **sendto**). These three functions are intended to be used with states created with UDP sockets.

While an input operation is ongoing, you cannot start another input operation with the same direction. While a write operation is ongoing, whether you can start another write operation depends on the keyword argument **:queue-output** which is used when the **async-io-state** is created. If **queue-input** was

`nil` (the default for TCP), then you cannot start another write operation while one is ongoing. If `queue-output` was supplied as non-`nil` (the default for UDP), you can start another write operation, and the operation gets queued and actually starts after all previously queued operations have finished.

When you no longer need the `async-io-state` you must close it by `close-async-io-state`. Normally, that would close the object of the `async-io-state` too. `close-async-io-state` can be told to leave the object alive, so you can do further I/O with it. However, if you have read using `async-io-state`, it may have buffered data which you will need to deal with by `async-io-state-buffered-data-length` and `async-io-state-get-buffered-data` (unless you can just ignore it).

An `async-io-state` can have a *name*, to help identifying it, mainly for debugging. The default names that different functions give help to identify the kind of object that the state has.

See

```
(example-edit-file "async-io/multiplication-table")
(example-edit-file "async-io/print-connection-delay")
(example-edit-file "async-io/udp")
```

### 25.7.3 Writing callbacks in Asynchronous I/O operations

All of the Asynchronous I/O operations take a *callback*, which is called when the operation finished. The callbacks are called inside the same process that processes the `wait-state-collection` (specifically, the process that called `call-wait-state-collection`, potentially via `loop-processing-wait-state-collection`). That means that until the callback returns, no further processing happens on the `wait-state-collection`, and hence on any of the other `async-io-states` that are associated with it. Therefore callbacks need to be reasonably fast and not hang.

In general, the callbacks should be creating the next I/O operations, to ensure that that operations on each state are sequential (see “Asynchronous I/O and multiprocessing” on page 415). If this is a reasonably simple operation you just do it, but if the data for the next operation make take a long time to prepare you probably want to avoid doing it in the context of the callback. Things

that may cause it to take a long time include heavy computation or access to external resources that may cause delays.

A general solution is to send the work to another process, which will do the work and on completion will do the next I/O operation by calling the read/write `async-io-state` function.

Another possible solution is to perform operations that can be fast using one `wait-state-collection`, and perform slow operations on (an)other `wait-state-collection(s)`. This way a slow callback will only impede other slow callbacks. For example you may be accepting connections on the "fast" `wait-state-collection`, but communicate with the accepted connection on a slow `wait-state-collection` (pass `:create-state nil` to `accept-tcp-connections-creating-async-io-states`, and in the callback use `create-async-io-state` with another `wait-state-collection`). You may also decide to do the communication using streams and synchronous I/O (pass `:create-state nil` and in the *callback* use `(make-instance 'socket-stream ...)` and send the result to another process).

#### 25.7.4 Asynchronous I/O and multiprocessing

Processing of the `wait-state-collection` is not thread-safe, and for each collection there must be only one process at any one time calling any of these functions:

- `loop-processing-wait-state-collection`
- `call-wait-state-collection`
- `wait-for-wait-state-collection`
- `close-wait-state-collection`

`wait-state-collection-stop-loop` is thread-safe, and can be called on any thread at any time.

Adding and removing states to/from the collection is thread-safe with respect to the collection, which means that the creation functions like `create-async-io-state` can be called in parallel with any function that access the same collection, including themselves and the processing functions above. The same applies to functions that remove the state from the collection (`close-async-`

`io-state`), though these are not thread-safe with respect to the state (see below).

Note that the functions that create states use other resources which may have their own limitations. Most notably, local ports can be used only once at any time with the same protocol and family, so if you try to bind to a specific local port (by passing `local-port` to any of the functions or non-zero `service` in `accept-tcp-connections-creating-async-io-states`), you have to make sure that you do not do it with a port that is currently in use. (Note that `accept-tcp-connections-creating-async-io-states` may try several times).

The functions that actually do the I/O are not thread-safe with respect to the `state` argument, but are thread-safe with respect to the collection that the state is associated with. That means that they can be called in parallel to any function that accesses the collection that the state is associated with, but cannot be called in parallel to another function that tries to do I/O on the same `state` and `direction`. Moreover, the read functions cannot be called while there is an ongoing read operation, and the write function can be called while another write operation is ongoing only if `queue-output` is non-nil when creating the state. The function `close-async-io-state` also cannot be called in parallel to any of the I/O functions.

Explicitly:

The reading functions `async-io-state-read-buffer`, `async-io-state-read-with-checking` and `async-io-state-receive-message` must not be called on the same `state` in parallel to any of themselves, or in the period between any call to any of themselves and the call to the `callback` in the case of `async-io-state-read-with-checking` or `async-io-state-receive-message`, or the call to `async-io-state-finish` in the case of `async-io-state-read-with-checking`, or `abort-callback`.

If `queue-output` was `nil` when the state was created (TCP default), the writing functions `async-io-state-write-buffer`, `async-io-state-send-message`, and `async-io-state-send-message-to-address` must not be called on the same `state` in parallel to any of themselves, or in the period between any call to any of themselves and the call to the `callback`, or `abort-callback`. If `queue-output` was non-nil when the `state` was created (UDP default), the writing functions can be called in parallel.

`close-async-io-state` must not be called on the same *state* in parallel to any of the reading or writing functions, or between a call to any of them at the end of their operation (the *callback*, `async-io-state-finish`, or the *abort-callback*).

The reading and writing functions are mutually thread-safe, that is any of the reading functions can be called in parallel to any of the writing functions.

The functions `async-io-state-abort` and `async-io-state-abort-and-close` are thread-safe, and be called at any time in parallel to any function.

`async-io-state-get-buffered-data` is not thread-safe, and must not be called in parallel to any other function that may modify the *state*.

`async-io-state-finish` and `async-io-state-discard` are not thread-safe, but can only be called inside the callback of `async-io-state-read-with-checking`, which will be always in the same process. The accessors of `async-io-state` are thread-safe.

In general, it is intended that you will cope with these thread-safe restrictions of I/O functions by calling them from the callbacks of the previous I/O operation, thus guaranteeing that the previous I/O operation finished. For example, if you need to write several buffers to a socket, you can call `async-io-state-write-buffer` with the first buffer, and with a callback that calls `async-io-state-write-buffer` with the next buffer. A natural place to put the information where to get the next buffer is the *user-info* of the `async-io-state`, which can be accessed using `async-io-state-user-info`. For example, assume you have an `async-io-state`, a list of buffers to send, and also on completion you want to call a function `finished` on some object:

```
(defun my-send-buffers (state buffers object)
  (setf (async-io-state-user-info state)
        (cons buffers object))
  (my-state-send-next-buffer state))

(defun my-state-send-next-buffer (state)
  (let ((info (async-io-state-user-info state)))
    (if-let (buffer (pop (car info)))
        (async-io-state-write-buffer
         state buffer
         #'(lambda (state buffer length)
             (declare (ignore buffer length))
             (my-state-send-next-buffer state)))
    (finished (cdr info)))))
```

In a real application the *user-info* is likely to be a more complex object.

If you make the *state* with *queue-output t*, you can simply write all the buffers in one go:

```
(defun my-send-buffers (state buffers object)
  (setf (async-io-state-user-info state) object)
  (loop for cons on buffers
        do
        (async-io-state-write-buffer
         state (car cons)
         :callback
         (if (cdr cons) ; if there are more buffers
             #'(lambda (state buffer length)
                 (declare (ignore buffer length))
                 (finished
                  (async-io-state-user-info state))))))
  ))))
```

## 25.8 Using SSL

The SSL interface allows you to use Secure Socket Layer (SSL) with Lisp objects of type `socket-stream` and `async-io-state`.

The interface is based on the OpenSSL code, and most of it is simply an FLI interface to OpenSSL functions. The main LispWorks specific code is the way OpenSSL is integrated with `socket-stream` and `async-io-state`.

The SSL interface is part of the "`comm`" module, so to load it you evaluate

```
(require "comm")
```

**Note:** In this section we assume that the current package uses the `comm` package. That is, `comm` package symbols may not be qualified explicitly.

### 25.8.1 Obtaining and installing the OpenSSL library

At the time of writing, OpenSSL is available as shown in Table 25.1:

Table 25.1 OpenSSL availability

Operating System	Availability of OpenSSL
Linux	Installed by default on most 32-bit and 64-bit distributions

Table 25.1 OpenSSL availability

Operating System	Availability of OpenSSL
Windows	32-bit and 64-bit libraries are available at <a href="http://www.slproweb.com/products/Win32OpenSSL.html">www.slproweb.com/products/Win32OpenSSL.html</a>
Mac OS X	32-bit and 64-bit libraries are installed by default.
FreeBSD	Installed by default and available via ports or pkg.
AIX	Installed by default
x86/x64 Solaris	Installed by default
SPARC Solaris	Installed by default on Solaris 10. For other versions, see the freeware from Sun at <a href="http://sunfreeware.com">sunfreeware.com</a> for both 32-bit and 64-bit.

### 25.8.1.1 Installing the OpenSSL library on Solaris

After installing (with pkgadd) you need to put the shared libraries `libcrypto.so` and `libssl.so` on the loader path. By default these are installed in `/usr/local/ssl/lib`.

To add the libraries to the loader path, either

- Add `/usr/local/ssl/lib` to the environment variable `LD_LIBRARY_PATH`, or
- Create links from `/usr/lib`.

### 25.8.1.2 How LispWorks locates the OpenSSL libraries

Since OpenSSL is not a standard on all machines yet, the location of the library or libraries varies. By default, `ensure-ssl` loads libraries as shown in Table 25.2, page 420.

Table 25.2 How LispWorks locates the OpenSSL libraries

Operating System	Libraries
Linux	<code>-lssl</code>
Windows	<code>libeay32.dll</code> <code>libssl32.dll</code>
FreeBSD	<code>-lcrypto -lssl</code>
Solaris	<code>-lssl</code>
AIX	<code>-lssl</code>
Mac OS X	<code>-lssl</code>
Others	<code>nil</code>

On machines where the path is unknown or is incorrect, you must set the path by calling `set-ssl-library-path`, or by passing the path as the *library-path* argument to `ensure-ssl`. In particular, if you want to use the Windows OpenSSL 1.1 libraries from the page that is mentioned in the table “OpenSSL availability” on page 418, then the library names have changed and you will have to set the path. With the download from that page from September 2017, the names need to be:

```
64-bit      ("libssl-1_1-x64.dll"
              "libcrypto-1_1-x64.dll")
32-bit      ("libssl-1_1.dll"
              "libcrypto-1_1.dll")
```

### 25.8.2 Creating a stream with SSL

There are three ways to make a `socket-stream` with SSL processing:

- Call `(make-instance 'socket-stream :ssl-ctx ...)`
- Call `open-tcp-stream` with the `:ssl-ctx` keyword.
- Call `attach-ssl` on a `socket-stream`.

These calls implicitly load the OpenSSL library and seed the Pseudo Random Number Generator (PRNG).

For example:

```
(open-tcp-stream some-url 443 :ssl-ctx t)
```

### 25.8.3 Using Asynchronous I/O with SSL

There are three ways to make an `async-io-state` with SSL processing:

- Call `create-async-io-state-and-connected-tcp-socket` with the `:ssl-ctx` keyword.
- Call `accept-tcp-connections-creating-async-io-states` with the `:ssl-ctx` keyword.
- Call `async-io-state-attach-ssl` on an `async-io-state`.

These calls implicitly load the OpenSSL library and seed the Pseudo Random Number Generator (PRNG).

### 25.8.4 Keyword arguments for use with SSL

The keyword arguments `:ssl-ctx`, `:ssl-side`, `:ctx-configure-callback`, `:ssl-configure-callback` and `:handshake-timeout` can be passed to create and configure socket streams and `async-io-states` with SSL processing. The various interface calls for creating and configuring SSL streams and

async-io-states accept these keyword arguments as shown in Table 25.3, page 422.

Table 25.3 SSL configuration keywords

Keyword and Interface call	:ssl-ctx	:ssl-side	:ctx-configure-callback	:ssl-configure-callback	:handshake-timeout
<b>socket-stream make-instance</b>	Yes	Yes	Yes	Yes	Yes
<b>open-tcp-stream</b>	Yes	No	Yes	Yes	Yes
<b>attach-ssl</b>	Yes	Yes	Yes	Yes	Yes
<b>make-ssl-ctx</b>	Yes	Yes	No	No	Yes
<b>accept-tcp-connections-creating-async-io-states</b>	Yes	Yes	Yes	Yes	Yes
<b>create-async-io-state-and-connected-tcp-socket</b>	Yes	No	Yes	Yes	Yes
<b>async-io-state-attach-ssl</b>	Yes	Yes	Yes	Yes	Yes

(**make-instance 'socket-stream ...**) and **open-tcp-stream**, when **ssl-ctx** is non-nil, call **attach-ssl** and pass it all the arguments. **accept-tcp-connections-creating-async-io-states** and **create-async-io-state-and-connected-tcp-socket** when **ssl-ctx** is non-nil attach the ssl similar to the way **async-io-state-attach-ssl** does.

`:ssl-ctx` specifies that SSL should be used, and also specifies the SSL\_CTX object to use. See the OpenSSL manual entry for `SSL_CTX_new` for details of making a SSL\_CTX. The value of `ssl-ctx` can be:

A symbol

Together with `ssl-side`, this symbol specifies which protocol to use. `ssl-ctx` can be one of:

- 1) `t` or `:default`, meaning use the default. Currently this is the same as `:v23`.
- 2) One of `:v2`, `:v3`, `:v23` or `:tls-v1`. These are mapped to the `SSLv2_*`, `SSLv3_*`, `SSLv23_*`, `TLSv1_*` methods.

LispWorks makes a new SSL\_CTX object and uses it and frees it when the stream or state is closed. The interface calls also make an SSL object, uses it and frees it when the stream or state is closed.

A foreign pointer of type `ssl-ctx-pointer`

This corresponds to the C type `SSL_CTX*`. This is used and is not freed when the stream is closed. The interface calls also make an SSL object, use it and free it when the stream is closed. The foreign pointer maybe a result of a call to `make-ssl-ctx`, but it can also be a result of your code, provided that it points to a valid SSL\_CTX and has the type `ssl-ctx-pointer`.

A foreign pointer of type `ssl-pointer`

This corresponds to the C type `SSL*`. This specifies the SSL to use in the interface calls. This may be a result of a call to `ssl-new`, but can also be a result of your code, provided that it points to a valid SSL object and has the type `ssl-ctx-pointer`. The SSL is used and is not freed when the stream is closed.

When you pass a `ssl-ctx-pointer` or a `ssl-pointer` foreign pointer, these must have already been set up correctly and you are responsible for freeing them when they are no longer required.

`:ssl-side` specifies which side the stream is. The value `ssl-side` can be one of `:client`, `:server` or `:both`. `open-tcp-stream` and `create-async-io-state-and-connected-tcp-socket` do not take this keyword and always use `:client`. For the other calls this argument defaults to `:server`. The value of `ssl-side` is used in three cases:

- When a new SSL\_CTX object is created, it is used to select the method:  
`:client => *_client_method`  
`:server => *_server_method`  
`:both => *_method`
- When `ssl-ctx` is of type `ssl-ctx-pointer`, it checks that the side of `ssl-ctx` and `ssl-side` are not conflicting. If one is `:client` and the other is `:server`, they conflict and an error is signaled.
- When a new SSL object is created, when `ssl-side` is either `:client` or `:server`, LispWorks calls `ssl-set-connect-state` or `ssl-set-accept-state` respectively.

When a new SSL object is created, `ssl-side` is `:client` and `handshake-timeout` is greater than 0, a handshake is performed immediately.

If `ssl-ctx` is of type `ssl-pointer` then `ssl-side` is ignored.

`:ctx-configure-callback` specifies a callback, a function which takes a foreign pointer of type `ssl-ctx-pointer`. This is called immediately after a new SSL\_CTX is created. If the value of `ssl-ctx` is not a symbol, `ctx-configure-callback` is ignored.

`:ssl-configure-callback` specifies a callback, a function which takes a foreign pointer of type `ssl-pointer`. This is called immediately after a new SSL is created. If the value of `ssl-ctx` is a `ssl-pointer`, `ssl-configure-callback` is ignored.

When a handshake is performed immediately (`ssl-side` is `:client` and `ssl-ctx` is not a `ssl-ctx-pointer`), `handshake-timeout` specifies the time in seconds to wait for the handshake to complete. If `handshake-timeout` is `nil` (the default) then it waits forever. If the handshake fails or times out, it is an error situation: for the synchronous interface (stream) an error is signaled, and for the asynchronous interface the callback is called with an error indicator (see the spe-

cific functions for details). Note that `handshake-timeout 0` (or negative) prevents the handshake.

In typical usage, you will create few `ssl-ctx-pointer` objects (maybe only one), configure them as appropriate for your application and the machine that it runs on, and then use one of these as `ssl-ctx` in all of your calls. If some connections need special configuration, you will use `ssl-configure-callback` to configure the `ssl-pointer` of this connection. Sometimes when you open a connection as a client it may be sufficient to pass a symbol for `ssl-ctx`. Passing an `ssl-pointer` as `ssl-ctx` is for special cases.

### 25.8.5 Attaching SSL to an existing socket

You can attach SSL to an existing `socket-stream` by calling `attach-ssl` on the stream. The `socket-stream` SSL keyword arguments are processed by `attach-ssl` as described in “Keyword arguments for use with SSL” on page 421.

Detach SSL from a `socket-stream` and shut down the SSL with `detach-ssl`.

For full descriptions see `attach-ssl`, page 554 and `detach-ssl`, page 575.

You can attach SSL to an existing `async-io-state` by calling `async-io-state-attach-ssl` on the state, and detach it using `async-io-state-detach-ssl`.

Notes:

After an object (stream or state) has been detached, you can attach SSL to it again.

Detaching frees any automatically generated SSL objects in the same way that closing a stream or state does.

The SSL objects are attached to the `socket-stream` or `async-io-state`, rather than to the socket. Therefore if you want to move a socket to another object then you need to attach it again.

For example, if you have attached SSL to an `async-io-state` and then want to change to synchronous communication, you need to close the `async-io-state` by `close-async-io-state` with `keep-alive true` (effectively detach the

SSL), and then call `make-instance` with `socket-stream` with the socket plus `SSL-CTX` and any other necessary arguments.

To move the other way, from synchronous to asynchronous, use `replace-socket-stream-socket` with `socket nil` to disconnect the socket from the stream (which effectively calls `detach-ssl`), call `create-async-io-state` with the socket, and then call `async-io-state-attach-ssl` on the new `async-io-state`.

### 25.8.6 OpenSSL interface

The configuration interface contains mostly FLI function definitions that map directly to OpenSSL calls. See below for a list of those provided.

There are also some functions to make common cases simpler. These are `read-dhparams`, `pem-read`, `set-ssl-ctx-options`, `set-ssl-ctx-password-callback`, and `set-ssl-ctx-dh`.

#### 25.8.6.1 OpenSSL constants

The Lisp constants `SSL_FILETYPE_ASN1` and `SSL_FILETYPE_PEM` representing file types are provided.

#### 25.8.6.2 Naming conventions for direct OpenSSL calls

This section describes the mapping between OpenSSL function names and the corresponding Lisp names.

#### 25.8.6.3 Mapping C names to Lisp names

For functions that map directly to OpenSSL calls, the convention is to create the LISP name from the C name by replacing underscores by hyphens.

#### 25.8.6.4 Mapping Lisp names to C names

To find the C name from the LISP function name:

1. the hyphens need to be replaced by underscores, and
2. the initial SSL or SSL\_CTX has to be in uppercase, and

3. the rest has to be lowercase, except that
4. the following phrases are cased specially, like this: "RSAPrivateKey", "DSH", "ASN1", "CA", "PrivateKey"

### 25.8.7 Direct calls to OpenSSL

The following functions map directly to the OpenSSL functions. Check the OpenSSL documentation for details.

Where an OpenSSL function takes an `SSL*` or `SSL_CTX*`, the Lisp function's argument must be a foreign pointer of type `ssl-pointer`, `ssl-ctx-pointer` or `ssl-cipher-pointer`. Where an OpenSSL function takes a `char*` or `int`, the Lisp function's argument must be a string or integer. Where an OpenSSL function takes other kinds of pointers, the Lisp function's argument must be a foreign pointer. The return values are integers or foreign pointers unless stated otherwise.

If an error occurs in one of these functions, an error code is returned. They do not signal any Common Lisp conditions and so you should check the return value carefully.

Table 25.4 Direct calls to OpenSSL

Lisp function	Return values
<code>ssl-add-client-ca</code>	
<code>ssl-cipher-get-bits</code>	First value is number of bits the cipher actually uses. Second value is number of bits the algorithm of the cipher can use (which may be higher).
<code>ssl-cipher-get-name</code>	string. e.g. "DHE-RSA-AES256-SHA"
<code>ssl-cipher-get-version</code>	string. e.g. "TLSv1/SSLv3"
<code>ssl-clear-num-renegotiations</code>	

Table 25.4 Direct calls to OpenSSL

Lisp function	Return values
<code>ssl-ctrl</code>	
<code>ssl-ctx-add-client-ca</code>	
<code>ssl-ctx-add-extra-chain-cert</code>	
<code>ssl-ctx-ctrl</code>	
<code>ssl-ctx-get-max-cert-list</code>	
<code>ssl-ctx-get-mode</code>	
<code>ssl-ctx-get-options</code>	
<code>ssl-ctx-get-read-ahead</code>	
<code>ssl-ctx-get-verify-mode</code>	integer
<code>ssl-ctx-load-verify-locations</code>	
<code>ssl-ctx-need-tmp-rsa</code>	
<code>ssl-ctx-sess-set-cache-size</code>	
<code>ssl-ctx-sess-get-cache-size</code>	
<code>ssl-ctx-sess-set-cache-mode</code>	
<code>ssl-ctx-sess-get-cache-mode</code>	
<code>ssl-ctx-set-client-ca-list</code>	
<code>ssl-ctx-set-max-cert-list</code>	
<code>ssl-ctx-set-mode</code>	
<code>ssl-ctx-set-options</code>	
<code>ssl-ctx-set-read-ahead</code>	
<code>ssl-ctx-set-tmp-rsa</code>	
<code>ssl-ctx-set-tmp-dh</code>	
<code>ssl-ctx-use-certificate-chain-file</code>	

Table 25.4 Direct calls to OpenSSL

Lisp function	Return values
<code>ssl-ctx-use-certificate-file</code>	
<code>ssl-ctx-use-privatekey-file</code>	
<code>ssl-ctx-use-rsaprivatekey-file</code>	
<code>ssl-get-current-cipher</code>	<code>ssl-cipher-pointer</code> Can be a null pointer.
<code>ssl-get-max-cert-list</code>	
<code>ssl-get-mode</code>	
<code>ssl-get-options</code>	
<code>ssl-get-verify-mode</code>	integer
<code>ssl-get-version</code>	string "TLSv1", "SSLv2" or "SSLv3"
<code>ssl-load-client-ca-file</code>	
<code>ssl-need-tmp-rsa</code>	
<code>ssl-num-renegotiations</code>	
<code>ssl-session-reused</code>	
<code>ssl-set-accept-state</code>	None
<code>ssl-set-client-ca-list</code>	
<code>ssl-set-connect-state</code>	None
<code>ssl-set-max-cert-list</code>	
<code>ssl-set-mode</code>	
<code>ssl-set-options</code>	
<code>ssl-set-tmp-rsa</code>	
<code>ssl-set-tmp-dh</code>	
<code>ssl-total-renegotiations</code>	

Table 25.4 Direct calls to OpenSSL

Lisp function	Return values
<code>ssl-use-certificate-file</code>	
<code>ssl-use-rsaprivatekey-file</code>	
<code>ssl-use-privatekey-file</code>	

If you need OpenSSL functionality that is not provided here, you can define your own foreign functions via the LispWorks Foreign Language Interface.

If you do this, an important point to note is that on Microsoft Windows, the `:calling-convention` must be `:cdecl` (it defaults to `:stdcall`). If using OpenSSL suddenly causes mysterious crashes, the *calling-convention* in your foreign function definitions is the first thing to check.

### 25.8.8 Using SSL objects directly

The C objects SSL and SSL\_CTX are represented in LispWorks by foreign pointers with type `ssl-pointer` and `ssl-ctx-pointer`, which correspond to the C types SSL\* and SSL\_CTX\*. These foreign types should be used for any foreign function that takes or returns these C types, and must be used when passing a foreign pointer as the value of the `:ssl-ctx` argument.

Making SSL objects is a way of getting access to them to perform configuration, but, especially in the case of the SSL\_CTX, it is a useful way to avoid repeated calls to the configuration routines which may be time consuming. For example, if we have defined a function `configure-a-ctx`, and we want to read once every 60 seconds from some URL, we can write:

```
(loop (with-open-stream
          (str (comm:open-tcp-stream some-url 443 :ssl-ctx t
                                      :ctx-configure-callback
                                      'configure-a-ctx))
            (read-something str))
      (sleep 60))
```

This will cause `configure-a-ctx` to be called each time. If it is expensive, we can call it only once by changing the code to:

```
(let ((ctx (comm:make-ssl-ctx :ssl-side :client)))
  (configure-a-ctx ctx)
  (loop (with-open-stream
          (str (comm:open-tcp-stream some-url 443 :ssl-ctx ctx))
          (read-something str))
        (sleep 60))
  (comm:destroy-ssl-ctx ctx))
```

The SSL objects could be made either by `make-ssl-ctx` or `ssl-new` or by user code that calls the C functions `SSL_CTX_new` and `SSL_new`. `destroy-ssl-ctx` frees the `SSL_CTX` object. To free an SSL object you would call `destroy-ssl`. See the manual entries for full descriptions of these functions.

Alternatively, the SSL objects can be obtained from a `socket-stream` by calling `socket-stream-ssl` or `socket-stream-ctx` and from an `async-io-state` by calling `async-io-state-ssl` or `async-io-state-ssl1`. You can also find the `ssl-side` value that was passed to the interface call that created the SSL objects by calling `socket-stream-ssl-side` or `async-io-state-ssl-side`.

### 25.8.9 Initialization

All the functions that make a `SSL_CTX` first call `ensure-ssl`, so normally you do not need to initialize the library. If your code makes a `SSL_CTX` itself (that is, not by calling any of the LispWorks interface functions), it needs to initialize the library first. Normally that should be done by an explicit call to `ensure-ssl`, which loads the SSL library and calls `SSL_library_init` and `SSL_load_error_strings`, and also does some LispWorks specific initializations. If your code must do the initialization, `ensure-ssl` should still be called with the argument `:already-done t`, which tells it that the library is already loaded and initialized.

### 25.8.10 Errors in SSL

If there are errors inside SSL, LispWorks will signal an error of type `ssl-condition`, which is a subclass of `socket-error`.

The condition can be one of the types `ssl-x509-lookup`, `ssl-closed`, `ssl-error` and `ssl-failure`. See the manual pages for details of these condition classes.

### 25.8.11 Examples of using the socket stream SSL interface

See the example files in:

```
(example-edit-file "ssl/")
```

## 25.9 Socket streams with Java sockets and SSL on Android

Socket streams can now be implemented on top of Java Objects, instead of native sockets. The main purpose of this is to allow using SSL in LispWorks for Android Runtime, because OpenSSL is not available on Android. It may also be useful where you have a Java socket from some source and want to communicate through it using a Lisp stream.

The function `switch-open-tcp-stream-with-ssl-to-java` is called automatically before delivery for Android by `deliver-to-android-project`. That causes `open-tcp-stream`, when it is called with `ssl-ctx` non-nil, to use Java sockets instead of operating system sockets.

The function `open-tcp-stream-using-java` can be used to force using a Java socket.

You can also explicitly create a stream using Java sockets by passing a Java socket to `(make-instance 'comm:socket-stream ...)` or by setting the socket in an existing stream using `(setf comm:socket-stream-socket)` or `replace-socket-stream-socket`.

Socket streams with Java sockets are limited, mainly because `cl:listen` cannot be used reliably with them. Specifically, when `cl:listen` returns `t` it is guaranteed that reading will not hang, but when `cl:listen` returns `nil` it does not mean that there is nothing to read. They also do not have a zero timeout: the shortest timeout is 1 millisecond. That means that it is impossible to check whether reading from the stream will hang. The best that you can do is to set the `read-timeout` to a short time, and then try to read.

There is also no write timeout.

The Asynchronous I/O interface and the server side (`start-up-server`) do not work at the moment with Java sockets. If you want to create a service with Java sockets, you will need to implement the listening part using Java methods. Once a socket is accepted, you can pass it to `(make-instance 'comm:socket-stream ...)` to do the actual communication.

When using Java sockets, the SSL configuration arguments `ctx-configure-call-back` and `ssl-configure-call-back`, as well as the `write-timeout` and `ipv6`, are ignored. The `ssl-ctx` is ignored when passed to `c1:make-instance`, and when passed to `open-tcp-stream` or `open-tcp-stream-using-java` it is interpreted as a boolean, specifying whether to use SSL or not. The only way to configure the socket, and more importantly the SSL settings, is by passing a socket factory (a Java object of class `javax.net.SocketFactory`) to `open-tcp-stream-using-java`. The application needs to set up and configure this factory using Java methods. By default, `open-tcp-stream` and `open-tcp-stream-using-java` use the default factory (which they get by the method "`getDefault`" on `javax.net.SocketFactory` or `javax.net.ssl.SSLSocketFactory`). Thus configuring the default factories affects what they do.

`c1:listen` is unreliable because the only way to check whether there is input on a Java socket is to use the Java method "`available`" on the input stream of the Java socket (that is, the result of the method "`getInputStream`"). The "`available`" method is documented as unreliable, and experimentally it is indeed unreliable on SSL sockets (on plain sockets it seems to work properly). If you know that in the implementation that you use the method "`available`" on an input stream of a socket is reliable, then you can trust `c1:listen` on socket streams with Java sockets.

Using Java sockets requires the LispWorks Java interface running Java Virtual Machine (JVM). On Android there is always a running JVM. On other architectures the JVM must be initialized by `init-java-interface`. To load the LispWorks Java interface, do

```
(require "java-interface")
```

When using Java sockets and SSL, the default behavior is to verify the host-name (not done on the ordinary sockets). To do that it relies on classes from `httpclient` from `apache.org`, so `httpclient` must be in the class path for using Java sockets with SSL. `httpclient` is always available on Android. See `open-tcp-stream-using-java` for details of the verification process.

### 25.9.1 Android-specific points

On Android, the OpenSSL library is not available, so if the module "comm" was loaded, `deliver-to-android-project` switches to using Java sockets

for SSL streams. These streams have problems with `c1:listen`, discussed above. In principle, if you can find OpenSSL library for Android you can switch it back by calling `switch-open-tcp-stream-with-ssl-to-java` with `nil`, and use SSL in the usual way. You need to use `set-ssl-library-path` to tell the system where to find the library.

Android does not allow doing socket operations on the GUI threads (since Honeycomb SDK), and doing such operations would give a `java-exception` error with exception `NetworkOnMainThreadException`. That applies to `socket-stream` where the socket is a Java socket. However, it is always a bad idea to do socket operations on the GUI thread, so you should not do socket operations in the GUI thread with ordinary sockets either.

# 26

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# Internationalization: characters, strings and encodings

## 26.1 Introduction

LispWorks uses Unicode internally in its representation of character objects. All Unicode characters can be represented in strings, though 8-bit and 16-bit strings are also provided for efficiency when characters beyond the Latin-1 range (up to code `#xffff`) or the BMP (Basic Multilingual Plane, up to code `#xffffffff`) respectively are not needed.

Character and string data can be input and output in various encodings (external formats).

## 26.2 Unicode support

Character implementation in LispWorks covers the full range of the Unicode standard.

`cl:char-code-limit` is `#x110000`, which covers exactly the Unicode range. The surrogate code points (codes `#xd800` to `#xdffff`) are illegal as character codes.

`cl:code-char` accepts integers from 0 below `cl:char-code-limit`. Other values cause an error. For codes in the surrogate range it returns `nil`. Reading characters from streams and converting characters from foreign strings can generate characters in all the range (depending on the external-format used),

and can never generate character objects corresponding to surrogate code points.

`text-string` and `simple-text-string` take 32 bits per character and can store the full range of Unicode characters.

`simple-char` is now a synonym for `c1:character`, and is deprecated.

16-bit characters and 16-bit strings are implemented by types `bmp-char` and `bmp-string` and `simple-bmp-string` (BMP is Basic Multilingual Plane, the first plane (0 - #xffff) of Unicode). You may want to use `bmp-string` to minimize memory usage if you have an application with many 16-bit strings. That will work provided all the characters you ever use have codes less than `#x10000`. If all of the codes are below 256, you can use `base-string` instead.

**Note:** Character bits and font attributes are not supported. To deal with bits, use Gesture Spec objects (see `make-gesture-spec` and `coerce-to-gesture-spec`).

## 26.3 Character and String types

### 26.3.1 Character types

LispWorks supports all the characters in the Unicode range `[0, #x10ffff]`, excluding the surrogate range `[#xd800, #xdfff]`. Note that character objects corresponding to surrogate code points may be produced by some APIs in LispWorks, but not by the interfaces that you should normally use to generate characters and strings in Common Lisp (that is `c1:code-char`, reading from a stream, converting from a foreign string, loading and storing from or to strings).

The following subtypes of character are defined:

<code>base-char</code>	Characters with <code>c1:char-code</code> less than <code>base-char-code-limit</code> (256).
<code>bmp-char</code>	Characters with <code>c1:char-code</code> less than <code>#x10000</code> (BMP stands for Basic Multilingual Plane in Unicode).
<code>character</code>	All characters.

### 26.3.2 Compatibility notes

In LispWorks 6.1 and earlier versions, characters with codes up to #x10000 are supported, and surrogate code points are allowed.

`bmp-char` was new in LispWorks 7.0, and matches the range of characters in LispWorks 6.1 and earlier versions, except that surrogate code points are no longer valid.

In LispWorks 6.1 and earlier versions there is `simple-char` which is now a synonym for `c1:character`. Using `c1:character` is preferable and portable.

In LispWorks 6.1 and earlier versions character bits attributes are supported, and also some characters represent keyboard gestures. These are no longer supported.

### 26.3.3 Character Syntax

All simple characters have names that consist of `u+` followed by the code of the character in hexadecimal, for example `#\U+764F` is `(code-char #x764F)`.

The hexadecimal number must be 4-6 characters, for example `#\U+a0` is illegal. Use `#\U+00a0` instead.

Additionally, Latin-1 characters have names derived from the ISO10646 name, for example:

```
(char-name (code-char 190))
=>
"Vulgar-Fraction-Three-Quarters"
```

Names are also provided for space characters:

```
(name-char "Ideographic-Space")
=>
#\Ideographic-Space
```

Note that surrogate characters, that is the inclusive range `[#xd800, #xdfff]` are not acceptable, and trying to read such a character, for example `#\U+d835`, produces an error.

### 26.3.4 Compatibility notes

In LispWorks 6.1 and earlier versions you can specify bits in character names. This is illegal in LispWorks 7.0 and later.

In LispWorks 6.1 and earlier versions character codes are limited to less than `#x10000`, and surrogate code points are allowed.

### 26.3.5 String types

String types are supplied which are capable of holding each of the character types mentioned above. The following string types are defined:

`base-string` holds any `base-char`.

`bmp-string` holds any `bmp-char`.

`text-string` holds any `cl:character` (see “Character types” on page 436).

**Compatibility note:** `bmp-string` was new in 7.0. In LispWorks 6.1 and earlier versions there is `augmented-string`, this is now a synonym for `text-string` and is deprecated.

In LispWorks 6.1 and earlier versions, `text-string` could hold characters with codes less than `#x10000`.

The types above include non-simple strings - those which are displaced, adjustable or with a fill-pointer.

The Common Lisp type `string` itself is dependent on the value of `*default-character-element-type*` according to the rules for string construction described in “String Construction” on page 441. For example:

```

CL-USER 1 > (set-default-character-element-type 'base-char)
BASE-CHAR

CL-USER 2 > (coerce (list #\Ideographic-Space) 'string)

Error: #\Ideographic-Space is not of type BASE-CHAR.
1 (abort) Return to level 0.
2 Return to top loop level 0.

Type :b for backtrace or :c <option number> to proceed.
Type :bug-form "<subject>" for a bug report template or :? for
other options.

CL-USER 3 : 1 > :a

CL-USER 4 > (set-default-character-element-type 'character)
CHARACTER

CL-USER 5 > (coerce (list #\Ideographic-Space) 'string)
" "

```

The following types are subtypes of `cl:simple-string`. Note that in the names of the string types, 'simple' refers to the string object and does not mean that the string's elements are `simple-chars`.

<code>simple-base-string</code>	holds any <code>base-char</code> .
<code>simple-bmp-string</code>	holds any <code>bmp-char</code> .
<code>simple-text-string</code>	holds any <code>cl:character</code> .

The Common Lisp type `simple-string` itself is dependent on the value of `*default-character-element-type*` according to the rules for string construction described in "String Construction" on page 441.

### 26.3.5.1 String types at run time

The type `string` (and hence `simple-string`) is defined by ANSI Common Lisp to be a union of all the character array types. This makes a call like

```
(coerce s 'simple-string)
```

ambiguous because it needs to select a concrete type (such as `simple-base-string` or `simple-text-string`).

When LispWorks is running with `*default-character-element-type*` set to `base-char`, it expects that you will want strings with element type `base-char`, so functions like `coerce` treat references to `simple-string` as if they were `(simple-array base-char (*))`.

If you call `set-default-character-element-type` with a larger character type, then `simple-string` becomes a union of the array types that are sub-types of that character type.

### 26.3.5.2 String types at compile time

The compiler always does type inferencing for `simple-string` as if `*default-character-element-type*` was set to `character`.

For example, when you declare something to be of type `simple-string`, the compiler will never treat it as `simple-base-string`. Therefore calls like

```
(schar (the simple-string x) 0)
```

will work whether `x` is a `simple-base-string`, `simple-bmp-string` or `simple-text-string`.

## 26.4 String accessors

`schar` works on any simple string object. However, for efficient string access when a simple string type is known, the following specialized accessors are provided:

<code>sbchar</code>	for <code>simple-base-string</code> .
<code>stchar</code>	for <code>simple-text-string</code> .

For `simple-bmp-string` there is no explicit accessor, but you can get the optimized access by declaring it as `simple-bmp-string`, and do the access using `cl:schar`.

You can also use declarations to optimize the access to `simple-base-string` and `simple-text-string`. In the case of `simple-base-string`, that means using only Common Lisp symbols, so it is fully portable.

## 26.5 String Construction

LispWorks constructs strings of a suitable type where sufficient information is available. Failing that, strings are constructed of type according to the value of `*default-character-element-type*`.

### 26.5.1 Default string construction

If the value of `*default-character-element-type*` is `base-char` then:

```
(make-string 3)
```

returns a `simple-base-string` and

```
(coerce sequence 'simple-string)
```

attempts to construct a `simple-base-string`. This will signal an error if any element of `sequence` is not a `base-char`.

If the value of `*default-character-element-type*` is `cl:character` then

```
(make-string 3)
```

returns a `simple-text-string` and

```
(coerce sequence 'simple-string)
```

attempts to construct a `simple-text-string`. This will signal an error if any element of `sequence` is not a `cl:character`.

Other string constructors also take their default from `*default-character-element-type*`. For instance, `with-output-to-string` and `make-string-output-stream` will construct a stream with element type determined by this variable and generate a string of the same element type.

Also the string reader will always construct a string of type determined by `*default-character-element-type*`, unless it sees a character of a larger type, in which case a suitable string is constructed. For example:

```
CL-USER 1 > (set-default-character-element-type 'character)
CHARACTER
```

```
CL-USER 2 > (type-of "ABC")
SIMPLE-TEXT-STRING
```

**Compatibility note:** In LispWorks 6.0 and earlier versions, the string reader would not always obey `*default-character-element-type*`, due to a bug.

### 26.5.2 String construction with known type

The parameter `*default-character-element-type*` merely provides the default behavior. If enough information is supplied, then a string of suitable type is constructed. For instance, the form:

```
(make-string 3 :initial-element #\Ideographic-Space)
```

constructs a string of a type that can hold its elements, regardless of the value of `*default-character-element-type*`.

Likewise, `format nil`, `princ-to-string`, `prin1-to-string` and `write-to-string` will return a string whose element type can hold all characters that are written.

Functions that have a sequence type specifier as an argument, such as `concatenate`, use it as described in “String types” on page 438.

### 26.5.3 Controlling string construction

The initial value of `*default-character-element-type*` is `base-char`, to avoid programs that only require 8-bit strings needlessly creating larger string objects. If your application uses Unicode characters beyond the Latin-1 range (characters of type `extended-char`) then you should consider which of the following two approaches to use:

- Ensure that all strings which may hold `extended-chars` are constructed explicitly with the appropriate type. This is the conservative approach, allowing you to avoid allocation of 16-bit strings where these are not required. Note that you can use the specialized accessors such as `stchar` for strings of type `simple-text-string`.
- Change the default so that by default 16-bit strings are allocated. Do this by:

```
(set-default-character-element-type 'cl:character)
```

Bear in mind that this is a global setting which affects default string construction for the entire system. It could be called from a user interface, depending on whether the user needs to handle `extended-chars`.

**Note:** Do not attempt to bind or set directly the variable `*default-character-element-type*`. Instead, call `set-default-character-element-type`.

#### 26.5.4 String construction on Windows systems

When LispWorks for Windows starts up on a OS with a non-Latin-1 code page, it calls

```
(set-default-character-element-type 'cl:character)
```

so that by default, newly constructed strings can contain the data likely to be returned from the OS or user input.

If you know your string only needs to contain 8-bit data, then you can create it explicitly with element type `base-char`.

Conversely if you know that a string may need to contain 16-bit data even on a Latin-1 code page system, then you should create it explicitly with element type `bmp-char` (or `cl:character` if 32-bit data is needed).

## 26.6 External Formats

External formats are two-way translations from Lisp's internal encoding to an external encoding. They can be used in file I/O, and in passing and receiving string data in foreign function calls.

An external format is named in LispWorks by an *external format specification* (*ef-spec*). An ef-spec is a symbol naming the external format, or a list with such a name as its first element followed by parameter/value pairs.

LispWorks has a number of predefined external formats:

`win32:code-page`

The Windows code page with identifier given by the `:id` parameter. Implemented only on Windows.

`:latin-1` ISO8859-1.

`:latin-1-terminal`

As Latin-1, except that if a non-Latin-1 character is output, it is written as <xxxx> where xxxx is the hexadecimal character code and does not signal error.

<b>:latin-1-safe</b>	As Latin-1, except that if a non-Latin-1 character is output, it is written as ? and does not signal error.
<b>:macos-roman</b>	The Mac OS Roman encoding.
<b>:ascii</b>	ASCII.
<b>:unicode</b>	<b>:utf-16</b> with default native byte order. See “16-bit External formats guide” on page 445 for details and variants.  <b>Compatibility note:</b> In LispWorks 6.1 and earlier versions, <b>:unicode</b> encodes 16-bit characters reading.
<b>:utf-8</b>	The UTF-8 encoding of Unicode.
<b>:utf-16</b>	The UTF-16 encoding of Unicode with big-endian byte order. See “16-bit External formats guide” on page 445 for details and variants.
<b>:utf-32</b>	The UTF-32 encoding of Unicode with big-endian byte order.  <b>Note:</b> There is a <b>:utf-32</b> external format corresponding to each of the <b>:utf-16</b> variants.
<b>:bmp</b>	Reads and writes 16-bit characters with native byte order. See “16-bit External formats guide” on page 445 for details and variants.
<b>:jis</b>	JIS. The encoding data is read from a file <code>uni2jis</code> and is pre-built into LispWorks.  <b>Note:</b> <code>uni2jis</code> is provided by way of documentation in the directory <code>lib/7-1-0-0/etc/</code> . It is also used at run time by the function <code>cl:char-name</code> .
<b>:euc-jp</b>	EUC-JP. The encoding data is read from a file <code>uni2jis</code> and is pre-built into LispWorks.
<b>:sjis</b>	Shift JIS.
<b>:windows-cp936</b>	

Windows code page 936. The encoding data is read from a file `windows-936-2000.ucm` and is pre-built into LispWorks.

**Note:** `windows-936-2000.ucm` is provided by way of documentation in the directory `lib/7-1-0-0/etc/`. It is not read at run time.

`:gbk` A synonym for `:windows-cp936`.

`:koi8-r` The KOI8-R (RFC 1489) encoding.

## 26.7 16-bit External formats guide

### 26.7.1 Unicode

In LispWorks 6.1 and earlier versions the external format `:unicode` is actually "raw UCS-2", that is reading and writing only 16-bit characters (including character objects corresponding to surrogate code points). The `:unicode` format now maps to `:utf-16` with the native endianness (by default). This interprets surrogate code points (`#xd800` to `#xdffff`) differently: the old `:unicode` would read these as if they are actual characters, while `:utf-16` and hence the new `:unicode` will try to interpret them as encoding supplementary characters (codes `#x10000` to `#x10ffff`). The latter behavior is probably what you need, so in most cases there is no need to replace usage of `:unicode`. There is no external format which interprets surrogate code points as characters now, but you can use any of the `:bmp` formats with `:use-replacement t` to read 16-bit characters without giving an error, although this does not exactly match the input, because surrogate code points are translated by the replacement character. The only format that can read anything without any loss is `:latin-1`.

Note that `:unicode` differs from `:utf-16` by the default byte order that it uses: `:utf-16` defaults to big-endian (matching the Unicode standard), while `:unicode` defaults to the native byte order.

## 26.7.2 UTF-16

There are now several UTF-16 external formats. There are more than one because UTF-16 is actually two different encodings: UTF-16 big-endian and UTF-16 little-endian.

`:utf-16-native` and `:utf-16-reversed` are the actual implementation formats. They implement UTF-16 with the native byte order (`:utf-16-native`) or the reversed byte order (`:utf-16-reversed`)

`:utf-16be` and `:utf-16le` implement the big-endian (`:utf-16be`) and little-endian (`:utf-16le`) UTF-16. The system maps these formats to `:utf-16-native` or `:utf-16-reversed` as appropriate, depending on the byte order of the computer.

`:utf-16` implements the UTF-16 standard, defaulting to UTF-16BE unless there is a BOM (Byte Order Mark).

In general, you will need to decide which of these to use depending on the circumstances.

## 26.7.3 BMP

There are now a few BMP external formats, which read and write only 16-bit characters (characters in the range `0` to `#xffff`, excluding the surrogate range `#xd800` to `#xdffff`).

`:bmp-native` and `:bmp-reversed` are the actual implementation formats. They implement reading 16-bit characters with the native byte order (`:bmp-native`) or the reversed byte order (`:bmp-reversed`). These formats never read supplementary characters. When they encounter a surrogate code point, they either signal an error or replace it by the replacement character, depending on the parameter `:use-replacement`.

`:bmp` implements 16-bit character reading and writing, defaulting to the native one.

**Notes:** In LispWorks 6.1 and earlier versions, the `:unicode` external format is similar to `:bmp` now, but handles surrogate code points as if they represent

characters. In LispWorks 7.0 and later `:unicode` maps to `:utf-16`, and there is no external format that reads surrogate code points as characters.

## 26.8 External Formats and File Streams

The `:external-format` argument of `open` and related functions should be an ef-spec, where the name can be `:default`. The symbol `:default` is the default value.

If you know the format of the data when doing file I/O, you should definitely specify *external-format* explicitly, in the ef-spec syntax described in this section.

### 26.8.1 Complete external format ef-specs

An ef-spec is "complete" if and only if the name is not `:default` and the parameters include `:eol-style`.

All external formats have an `:eol-style` parameter. If *eol-style* is not explicit in an ef-spec a default is used. The allowed values are

- `:lf` This is the default on non-Windows systems, meaning that lines are terminated by Linefeed.
- `:crlf` This is the default on Windows, meaning that lines are terminated by Carriage-Return followed by Linefeed.
- `:cr` Lines are terminated by Carriage-Return.

### 26.8.2 Using complete external formats

If `open` or `with-open-file` gets a complete `:external-format` argument then, it is used as is. For example, this form opens an ASCII linefeed-terminated stream:

```
(with-open-file (ss "C:/temp/ascii-lf"
                     :direction :output
                     :external-format
                     '(:ascii :eol-style :lf))
  (stream-external-format ss))
=>
(:ASCII :EOL-STYLE :LF)
```

If you know the encoding of a file you are opening, then you should pass the appropriate `:external-format` argument.

### 26.8.3 Guessing the external format

If `open` or `with-open-file` gets a non-complete `:external-format` argument `ef-spec` then the system decides which external format to use by calling the function `guess-external-format`.

The default behavior of `guess-external-format` is as follows:

1. When `ef-spec`'s name is `:default`, this finds a match based on the file-name; or (if that fails), looks in the Emacs-style (-\*) attribute line for an option called `ENCODING` or `EXTERNAL-FORMAT` or `CODING`; or (if that fails), chooses from amongst likely encodings by analysing the bytes near the start of the file, or (if that fails) uses a default encoding. Otherwise `ef-spec`'s name is assumed to name an encoding and this encoding is used.
2. When `ef-spec` does not include the `:eol-style` parameter, it then also analyzes the start of the file for byte patterns indicating the end-of-line style, and uses a default end-of-line style if no such pattern is found.

The file in this example was written by a Windows program which writes the Byte Order Mark at the start of the file, indicating that it is Unicode encoded. The routine in step 1 above detects this:

```
(set-default-character-element-type 'character)
=>
CHARACTER

(with-open-file (ss "C:/temp/unicode-notepad.txt")
  (stream-external-format ss))
=>
(:UNICODE :LITTLE-ENDIAN T :EOL-STYLE :CRLF)
```

The behavior of `guess-external-format` is configurable via the variables `*file-encoding-detection-algorithm*` and `*file-eol-style-detection-algorithm*`. See the manual pages for details.

### 26.8.3.1 Example of using UTF-8 by default

To change the default for all file access via `open`, `compile-file` and so on, you can modify the value of `*file-encoding-detection-algorithm*`.

For example given the following definition:

```
(defun utf-8-file-encoding (pathname ef-spec buffer length)
  (declare (ignore pathname buffer length))
  (system:merge-ef-specs ef-spec :utf-8))
```

then this makes it use UTF-8 as a fallback:

```
(setq system:*file-encoding-detection-algorithm*
      (substitute 'utf-8-file-encoding
                   'system:locale-file-encoding
                   system:*file-encoding-detection-algorithm*))
```

and this forces it to always use UTF-8:

```
(setq system:*file-encoding-detection-algorithm*
      '(utf-8-file-encoding))
```

### 26.8.3.2 Example of using UTF-8 if possible

The example in “Example of using UTF-8 by default” on page 449 will use UTF-8 even if the file is known to contain bytes that cannot be in this encoding. As an alternative way to use UTF-8 when possible, you can modify the value of `*specific-valid-file-encodings*`.

For example:

```
(pushnew :utf-8 system:*specific-valid-file-encodings*)
```

### 26.8.4 External formats and stream-element-type

The `:element-type` argument in `open` and `with-open-file` defaults to the value of `*default-character-element-type*`.

If `element-type` is not `:default`, checks are made to ensure that the resulting stream’s `stream-element-type` is compatible with its external format:

1. If `direction` is `:input` or `:io`, the `element-type` argument must be a supertype of the type of characters produced by the external format.

2. If *direction* is :output or :io, the *element-type* argument must be a subtype of the type of characters accepted by the external format

If the *element-type* argument does not satisfy these requirements, an error is signaled.

If *element-type* is :default the system chooses the `stream-element-type` on the basis of the external format.

### 26.8.5 External formats and the LispWorks Editor

The LispWorks Editor uses `open` with `:element-type :default` to read and write files. On reading a file, the external format is remembered and used when saving the file. On writing a Unicode (UTF-16) file, the Byte Order Mark is written.

It is possible to insert characters in the Editor (for example by pasting clipboard text) which are not supported by the chosen external format. This will lead to errors on attempt to save the buffer. You can handle this by setting the external format appropriately.

See the *LispWorks Editor User Guide* for more details.

### 26.8.6 Byte Order Mark

The Unicode Byte Order Mark (BOM) is treated as whitespace in the default readtable. This allows the Lisp reader to read a 16-bit (UTF-16 or BMP encoded) file regardless of whether the BOM is present. See “16-bit External formats guide” on page 445 for more information.

Some editors including Microsoft Notepad and the LispWorks editor write the BOM when writing a file with 16-bit (UTF-16 or BMP) encoding.

## 26.9 External Formats and the Foreign Language Interface

External formats can be used to pass and receive string data via the FLI. See the section on string types in the *LispWorks Foreign Language Interface User Guide and Reference Manual*.

## 26.10 Unicode character and string functions

This section lists functions which compare characters and strings similarly to `cl:char-equal`, `cl:string-greaterp` and so on, but which use Unicode's simple case folding rules.

There are also predicates for properties of characters in Unicode's "general category", corresponding to `cl:alpha-char-p`, `cl:both-case-p` and so on.

### 26.10.1 Unicode case insensitive character comparison

The functions `unicode-char-equal`, `unicode-char-not-equal`, `unicode-char-lessp`, `unicode-char-not-lessp`, `unicode-char-greaterp` and `unicode-char-not-greaterp` compare characters similarly to `cl:char-equal` etc, but using Unicode's simple case folding rules.

### 26.10.2 Unicode case insensitive string comparison

The functions `unicode-string-equal`, `unicode-string-not-equal`, `unicode-string-lessp`, `unicode-string-not-lessp`, `unicode-string-greaterp` and `unicode-string-not-greaterp` compare strings similarly to `cl:string-equal` etc, but using Unicode's simple case folding rules.

### 26.10.3 Unicode character predicates

The predicates `unicode-alphanumeric-p`, `unicode-alpha-char-p`, `unicode-lower-case-p`, `unicode-upper-case-p` and `unicode-both-case-p` test for properties of a character in Unicode's "general category".



# 27

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# LispWorks' Operating Environment

This chapter describes the interfaces which provide information about the environment in which LispWorks is running. This includes the operating system, the file system, the physical location of the LispWorks executable, and the arguments it was passed on startup.

## 27.1 The Operating System

The Common Lisp function `software-type` returns a generic name for the Operating System. The Common Lisp function `software-version` returns information about the version of the Operating System.

In particular `software-type` cannot be used to distinguish between different versions of Windows, whereas `software-version` allows you to identify variants such as Windows Vista, Windows 7, Windows 8, Windows 10 and so on. See the manual pages for details.

## 27.2 Site Name

The Common Lisp functions `short-site-name` and `long-site-name` can be configured using `setf`:

```
(setf (long-site-name) "LispWorks Ltd"  
      (short-site-name) "LW")
```

## 27.3 The Lisp Image

The function `lisp-image-name` returns the namestring of the full path of the LispWorks executable or dynamic library (DLL). For example, the directory of the image can be found using:

```
(pathname-location (lisp-image-name))
```

To create a new executable or DLL, typically after loading patches, modules and application code, use `save-image` or `deliver`.

**Note:** Microsoft Windows supports Long and Short forms of paths. You may need to convert a namestring using `long-namestring` or `short-namestring`.

## 27.4 The Command Line

The command line used to run LispWorks can be found using the variable `*line-arguments-list*`. The value is a list of strings containing the executable name followed by any other command line arguments, in the order they were passed.

For example, if your application needs to behave differently when passed an argument `-foo`, use the following test:

```
(member "-foo" sys:*line-arguments-list* :test 'string=)
```

### 27.4.1 Command Line Arguments

The following command line options are supported by the system.

**-build** *build-script*

Typically this is used for the purpose of building another image.

*build-script* can name a file to be loaded on startup. This file will be the build script which loads your code and calls `save-image` or `deliver`. LispWorks quits after loading the file. If an error is signaled while loading the file, a backtrace is displayed and LispWorks quits.

*build-script* can also be `-`, a single minus sign. Passing `-build -` causes LispWorks to read and execute a build script from stdin. This is useful if you want to embed a build script within a shell script that runs LispWorks, for example:

```
lispworks-7-1-0-x86-linux -build - <<END
(write-line "This is the build script.")
END
```

Note that this technique using `<<END` does not work on Microsoft Windows.

An image run with `-build` runs itself, and not the default saved session if you created one. See “Saved sessions” on page 182 for information on saved sessions.

`-build` calls `load-all-patches` automatically. There is no harm if your build script also calls `load-all-patches`.

**-environment** Start the LispWorks IDE development environment automatically, even in an image saved with (`save-image ... :environment nil`)

**-eval form** Evaluates the Lisp form *form* before loading initialization files.

If *form* requires multiprocessing, then change it to push a process specification onto `*initial-processes*`. This will delay evaluation until multiprocessing has started, either by the `-multiprocessing` command line options or because LispWorks was saved to start multiprocessing.

**-env** A synonym for `-environment`.

**-display display**

Sets the X display to use when starting a LispWorks GUI on X Windows.

**-IIOPHost host**

Controls the host name in placed in IORs. See *Developing Component Software with CORBA* for details.

**-IIOPnumeric**

IORs contain a host name which is the numeric IP address obtained by reverse lookup of the machine name. See *Developing Component Software with CORBA* for details.

**-init *init-file*** *init-file* names a file to be loaded on startup after *siteinit-file*.

The file is user's own LispWorks initialization file, containing code that by default is loaded when LispWorks is started. It is useful for loading initializations that should not be done for all users.

Initially the default is to load the file "`~/.lispworks`" where ~ expands to the user's home directory as described in "Configuration and initialization files" on page 178.

Your default initialization file can be set in the LispWorks IDE. See "Setting Preferences" in the *LispWorks IDE User Guide* for details.

If *init-file* is not found, an error is signaled. To suppress loading of a user initialization file, pass **-init -**.

**-load *file*** Loads the file *file* before loading initialization files.

**-lw-no-redirection**

Makes the supplied image run itself, and not the default saved session if you created one. See "Saved sessions" on page 182 for information on saved sessions.

**-multiprocessing**

Initializes multiprocessing on startup. See Chapter 19, "Multiprocessing".

**-no-restart-function**

Suppresses the execution of a restart function on startup. Restart functions can be supplied when saving an image to automatically invoke application code. This argument suppresses that behavior. See `save-image`, page 1001.

**-ORBport *orbport***

*orbport* specifies a port number for the LispWorks ORB. The special value 0 allows the system to pick a port.

**--relocate-image *BaseAddress***

Causes the image to relocate at *BaseAddress* on supported platforms, as described in “Startup relocation” on page 459. This can be useful on a system where libraries are mapped in address space that LispWorks would otherwise use as it grows. If the image is saved, then on restart without `--relocate-image`, it will locate itself automatically at *BaseAddress*.

**Compatibility note:** In LispWorks 5.0 and earlier versions, to be effective, `--relocate-image` must be the first argument on the LispWorks command line. This restriction does not apply in LispWorks 7.1.

**--reserve-size *ReserveSize***

Specifies the reserve size on supported platforms, as described in “Startup relocation” on page 459.

**-siteinit *siteinit-file***

*siteinit-file* names a file to be loaded on startup. The file is the LispWorks site initialization file, containing code that by default is loaded when LispWorks is started by any user in that installation. The default is to load the file that is the result of evaluating

`(sys:lispworks-file "config/siteinit.lisp")`.

If *siteinit-file* is not found, an error is signaled. To suppress loading of a site initialization file, pass `-siteinit -`.

### 27.4.2 Accessing environment variables

Use `environment-variable` get and set the value of an environment variable in the environment table of the OS process that called LispWorks.

To remove FOO from the environment table do:

```
(setf (lw:environment-variable "FOO") nil)
```

## 27.5 Address Space and Image Size

There are two factors that affect the maximum size of the Lisp image: the size of real memory, and the layout of memory. On most platforms you can relocate LispWorks to avoid clashes with other software as described in “Startup relocation” on page 459.

### 27.5.1 Size of real memory

If LispWorks becomes significantly larger than the size of the real memory, then paging will be the main activity and LispWorks will not function effectively.

### 27.5.2 Layout of memory

This is Operating System-dependent:

On Solaris, 32-bit LispWorks is mapped at `#x10000000`. In principle it can grow to almost `#x80000000` (the libraries are at higher addresses).

For the other platforms and for 64-bit LispWorks, see the discussion in “Startup relocation” on page 459.

### 27.5.3 Reporting current allocation

The simplest way to see the current Lisp allocation is to call `(room t)`.

To obtain values representing the current total allocation, call `room-values`.

## 27.6 Startup relocation

On startup, LispWorks normally maps its heap at the address where it was mapped when the image was saved. It maps more memory close to this when needed. This may cause memory clashes with other software, but such clashes may be avoided by relocating LispWorks.

32-bit LispWorks is relocatable on Microsoft Windows, Intel Macintosh, Linux, x86/x64 Solaris, FreeBSD and AIX. 64-bit LispWorks is relocatable on all supported platforms. The discussion in this section is applicable to all relocatable implementations.

On Microsoft Windows and Macintosh, LispWorks detects memory clashes and avoids them automatically. On these platforms there is no need to explicitly relocate LispWorks. The other relocatable implementations - LispWorks (32-bit) for Linux, LispWorks (64-bit) for Linux, LispWorks (32-bit) for FreeBSD, LispWorks (64-bit) for FreeBSD, LispWorks (32-bit) for x86/x64 Solaris, LispWorks (64-bit) for x86/x64 Solaris, LispWorks (64-bit) for SPARC/Solaris, LispWorks (32-bit) for AIX and LispWorks (64-bit) for AIX - cannot safely detect memory clashes. Relocation may therefore be useful in these implementations.

### 27.6.1 How to relocate LispWorks

Relocate LispWorks by passing two parameters: the base address and the reserve amount. Both are optional. The interpretation of these parameters is very different between 64-bit LispWorks and 32-bit LispWorks.

To relocate a LispWorks executable, pass one or both of these command line arguments:

**--relocate-image *BaseAddress***

The base address, interpreted as a hexadecimal number  
by calling `strtol(BaseAddress, NULL, 16)`)

**--reserve-size *ReserveSize***

The reserve size, interpreted as a hexadecimal number  
by calling `strtol(ReserveSize, NULL, 16)`)

On all relocatable platforms, a LispWorks dynamic library or Windows DLL can be relocated by calling `InitLispWorks` with second and/or third argument non-zero.

On non-Windows platforms, you can add the appropriate call to `InitLispWorks` in wrappers written in C and added to the dynamic library by passing *dll-added-files* to `save-image` or `deliver`. There is no such option in LispWorks for Windows.

The startup relocation takes some time, normally less than 0.1 seconds on a modern machine. If the relocation address is fixed and known, this startup overhead can be eliminated by relocating the image before calling `save-image` or `deliver`.

### 27.6.2 Startup relocation of 32-bit LispWorks

32-bit LispWorks on x86 platforms maps its heap in one continuous block, and then grows upwards from the top. When it reaches a region that it cannot use, it can skip it. On Windows and Macintosh this skipping is safe, because LispWorks can safely detect regions of memory that it cannot use. On other x86 platforms, both the initial mapping and the further growth cannot safely detect when they overwrite some other code.

`BaseAddress` (passed on command line with `--relocate-image` or as the second argument to `InitLispWorks`) tells LispWorks where to map the heap. On Windows and Macintosh, if the address is already used the heap will be mapped elsewhere. On other platforms, the mapping always works, and may destroy what is already mapped at that address.

`ReserveSize` (passed on command line with `--reserve-size` or as the third argument to `InitLispWorks`) tells LispWorks how much additional memory to reserve. Reservation is properly supported on Windows and Macintosh, though the actual reserved size can be smaller if it fails to reserve as much as was requested. On platforms that do not support reservation (that is, not Windows or Macintosh), the reservation is done by using `mmap` with protection `PROT_NONE`.

For a description of the memory layout on each platform, see “Memory layout” on page 140.

### 27.6.3 Startup relocation of 64-bit LispWorks

The size of address space that 64-bit LispWorks can use is limited by the size of internal tables to a "span" of  $2^{44}$  (16TB). The span always starts at 0.

Inside this span LispWorks can use any address. However, to avoid clashes with other software, it uses memory only in some defined range.

Startup relocation means changing this range. `BaseAddress` (passed on command line with `--relocate-image` or as the second argument to `InitLispWorks`, rounded up to  $2^{28}$ ) is the start of the range. `ReserveSize` (passed on command line with `--reserve-size` or as the third argument to `InitLispWorks`) is the size of the range. The default of the size of the range is  $2^{40}$ .

If the entire heap is within the new range, nothing else is done. If some part of the heap is outside the new range, the heap is relocated.

The range in each 64-bit LispWorks implementation starts at `#x4000000000` (256 GB).

#### 27.6.3.1 Linux

On old Linux systems LispWorks (64-bit) for Linux has range 192 GB, ending at `#x7000000000`, because old Linux systems cannot map above `#x8000000000` and put the dynamic libraries just below that limit (at least in some configurations). Since LispWorks uses the address space sparsely, it will run out of memory with less virtual memory, probably around 150 GB to 160 GB. If more memory is required, the range can be extended downwards, and possibly some distance upwards too. If other software uses memory in the range from `#x4000000000` to `#x7000000000`, LispWorks should be relocated (potentially just by decreasing the range) to avoid memory clashes.

Modern Linux systems have a much larger address space and the default size of the LispWorks range is `#x4000000000` (4TB).

#### 27.6.3.2 SPARC Solaris

In LispWorks (64-bit) for SPARC Solaris the default range is 768 GB, ending at `#x1000000000`. If other software uses memory in this range, the range for LispWorks should be decreased to avoid memory clashes.

### 27.6.3.3 Windows, Macintosh and AIX

In LispWorks (64-bit) for Windows, LispWorks (64-bit) for Macintosh and LispWorks (64-bit) for AIX the size of the range is `#x3c0000000000` (3.75TB). Since these platforms properly support reservation, there should not be any reason to change the range. The only time when this is needed is when other software insists on using some address in this range and does not relocate automatically.

## 27.7 Calling external programs

You can call an external program using `call-system`, `call-system-showing-output` and `open-pipe`.

You can call C programs using the FLI. See the *LispWorks Foreign Language Interface User Guide and Reference Manual*.

On Microsoft Windows a COM/Automation interface is provided. See the *LispWorks COM/Automation User Guide and Reference Manual*. There is also a DDE interface - see Chapter 22, “Dynamic Data Exchange”.

On Mac OS X an Objective-C API is provided. See the *LispWorks Objective-C and Cocoa Interface User Guide and Reference Manual*.

### 27.7.1 Interpreting the exit status

`call-system` returns the exit status of the process it created, and potentially a signal number. Similarly `pipe-exit-status` can query the exit status and signal number associated with a process that was created by `open-pipe`.

On Unix-like systems when using a string as the command with a typical shell, the exit status is the exit status of the command that is executed. If it is an actual executable (rather than a built-in command) it is the exit status of the process that invoked by this executable. That is not always reliable. In a typical shell you can precede the last command by the word `exec` to cause the shell to replace itself by the executable, and then the return value is guaranteed to be from the executable. On Microsoft Windows and when not using string as a command, there is only one process and the exit status is the exit status of this process.

On Unix-like systems, on normal exit the exit status is the argument that was passed to the C function `exit` (or `_exit`) or the value returned from the main function, and the signal number is `nil`. To interpret the normal exit status you need to know what the process does. Normally 0 means success. If the process exited as a result of a signal then the second return value gives the number of the signal.

On Windows, the exit status is either the argument to `ExitProcess` or `TerminateProcess`, the return value of `main` or `WinMain`, or an exception value.

## 27.8 Snapshot debugging of startup errors

When an error occurs during initialization (for example, because of code in an initialization file) and the image is configured to start the LispWorks IDE, by default it catches the error, starts the IDE and displays the error in a snapshot debugger.

You should note that because this is a snapshot, you cannot actually continue or abort or return from a frame. The snapshot debugger is simply a tool to help debugging the error.

The behavior is controlled by the variable `*debug-initialization-errors-in-snap-shot*`.

## 27.9 System message log

The system message log is used by the system to produce messages that indicate that something is not as expected, where this is not an error. You can manipulate the log with `set-system-message-log`.

## 27.10 Exit status

You can return a process exit status to the Operating System when LispWorks or a delivered LispWorks application quits.

Do this by passing a `status` value to the function `quit`. For example:

```
(quit :status 42)
```

## 27.11 Creating a new executable with code preloaded

There are two ways to create a new executable with your code preloaded.

- To write a copy of the currently running image to disk, use `save-image`, page 1001. The saved image requires a development license key to run.
- To create a runtime image, removing unused code to make the image smaller, call `deliver`. For more details see the *LispWorks Delivery User Guide*.

For example of how to use `save-image`, see the section "Saving and testing the configured image" in the *LispWorks Release Notes and Installation Guide*.

See "Code signing in saved images" on page 181 for information about code signing your new executable.

## 27.12 User Preferences

LispWorks provides an API for setting and querying persistent per-user settings in a platform-dependent registry.

### 27.12.1 Location of persistent settings

On Microsoft Windows the preferences are stored in the HKEY\_CURRENT\_USER branch of the Windows registry. (LispWorks also offers a general Windows registry API, described in "Accessing the Windows registry" on page 468.)

On non-Windows the preferences are stored in subdirectories of the user's home directory.

To implement preferences for your LispWorks application, you will need to define a registry path using (`setf product-registry-path`) and read it using `product-registry-path`.

### 27.12.2 Accessing persistent settings

Get and set preferences under the product path at run time with `user-preference` and (`setf user-preference`).

### 27.12.3 Example using user preferences

Define a registry path:

```
(setf (sys:product-registry-path :deep-thought)
      ('("Software" "My Company" "Deep Thought")))
```

Store a preference for the current user:

```
(setf (user-preference "Answers"
                        "Ultimate Question"
                        :product :deep-thought)
      42)
```

Retrieve a preference for the current user, potentially in a subsequent session:

```
(user-preference "Answers" "Ultimate Question"
                :product :deep-thought)
```

## 27.13 File system interface

### 27.13.1 Fast access to files in a directory

`fast-directory-files` gives a faster way to access files than `directory`, especially in situations when you need to filter based on simple features such as size and access time, or filter based on the name in a more complex way than `directory` can.

Instead of creating a list of pathnames and returning it, `fast-directory-files` traverses the files and calls a callback function on each file with its name and an opaque handle, which is referred to as *fdf-handle*. From this handle, you can retrieve the size, last-access time and last-modify time, and query whether the file is a directory, whether it is a link (for platforms other than Windows), and whether it is writable. The implementation makes the access to the *fdf-handle* much faster than doing the same by calling `directory` and then calling `cl:file-write-date` and similar functions on the result.

When the callback returns non-nil, `fast-directory-files` collects the file-name, otherwise it ignores it. Hence the callback can be used both as a filter and to actually do some work. In many cases, the callback will always return nil, and the call will be used just to map the callback on the file for the "side-effects" of the callback.

`fast-directory-files` is restricted to one directory level, that is it cannot deal with wild directories.

## 27.14 Special locations in the file system

This section describes interfaces allowing you to identify and access various special locations in the file system.

### 27.14.1 The home directory

This section describes the implementation of the Common Lisp function `cl:user-homedir-pathname`.

On Unix-based systems, the home directory is looked up using the C function `getpwuid`.

On Microsoft Windows systems, `cl:user-homedir-pathname` uses the environment to construct its result. It uses the values of the environment variables HOMEDRIVE and HOMEPATH, if both are defined. If at least one of environment variables HOMEDRIVE and HOMEPATH is not defined, then a pathname `#P"C:/users/login-name"` is returned. These environment variables should be correctly set before LispWorks starts. However it is possible to change the values in Lisp using

```
(setf environment-variable)
```

On Android `cl:user-homedir-pathname` returns the result of calling `"android.os.Environment.getExternalStoragePublicDirectory"` with the value of `android.os.Environment.DIRECTORY_DOCUMENTS`.

### 27.14.2 Special Folders

On Microsoft Windows, Mac OS X and Android there are various special folders used for application data and user data. Here are some examples of the folder for application data which is shared between all users.

Windows 10, Windows 8, Windows 7 and Windows Vista

`C:\ProgramData`

Windows XP (now unsupported)

```
C:\Documents and Settings\All Users.WIN-
DOWS\Application Data
```

Mac OS X

```
/Library/Application Support
```

Android

The result of calling `getExternalFilesDir` on the application context with `null`.

The locations and folder names can differ between versions of the operating system, therefore it is useful to have a system-independent way to get the path at run time. The function `get-folder-path` can be used to retrieve the path to special folders. Directory pathnames corresponding to each of the examples above can be obtained by calling:

```
(sys:get-folder-path :common-appdata)
```

Here is another example of differences between operating systems. On Windows 7 and Windows Vista:

```
(sys:get-folder-path :my-documents)
=>
#P"C:/Users/dubya/Documents/"
```

On Mac OS X:

```
(sys:get-folder-path :my-documents)
=>
#P"/u/ldisk/dubya/Documents/"
```

See `get-folder-path` for more details.

On Microsoft Windows there is a profile folder for each user. You can find the profile path for the current user with the function `get-user-profile-directory`.

### 27.14.3 Temp files

A "temp file" is a file in the "temp directory" which is guaranteed to be new. Its name contains a random element.

Create a temp file by calling either of the functions `open-temp-file` and `create-temp-file`. For example:

On Microsoft Windows:

```
(create-temp-file :prefix "LW")
=>
#P"C:/DOCUME~1/dubya/LOCALS~1/Temp/LW383vwVfZN.tmp"
```

On Linux:

```
(create-temp-file :prefix "LW")
=>
#P"/tmp/LWladokNa.tmp"
```

The function `set-temp-directory` allows you to set the "temp directory", that is the default directory used for temp files.

## 27.15 Accessing the Windows registry

There is an API for accessing the registry on Microsoft Windows. It is available only in LispWorks for Windows. All of its symbols are in the `win32` package.

Create and delete keys with the functions `create-registry-key` and `delete-registry-key`. Open a key for reading and/or writing with `open-registry-key` and close it with `close-registry-key`, or wrap your registry operation inside the macro `with-registry-key`.

Query the registry with `registry-key-exists-p`, `enum-registry-value`, `collect-registry-values`, `collect-registry-subkeys`, `query-registry-key-info`, `query-registry-value`, and `registry-value`. Write to the registry with `set-registry-value` or `(setf registry-value)`.

For example, this function returns the name, progid and filename for each of the installed ActiveX controls:

```
(defun collect-control-names (&key insertable
                                (max-name-size 256)
                                (max-names most-positive-fixnum) )
  (win32:collect-registry-subkeys
   "CLSID"
   :root :root
   :max-name-size max-name-size
   :max-names max-names
   :value-function
   #'(lambda (hKeyClsid ClassidName)
       (win32:with-registry-key
        (hkeyX ClassidName :root hKeyClsid :errorp nil)
        (when (and
                (win32:registry-key-exists-p "Control"
                                              :root hkeyX)
                (if insertable
                    (win32:registry-key-exists-p "Insertable"
                                                  :root hkeyX)
                    t))
        (when-let
            (progid (win32:query-registry-value "ProgID" nil
                                                 :root hkeyX
                                                 :errorp nil))
            (values
             (list
              (win32:query-registry-value nil nil
                                         :root hkeyX)
              progid
              (win32:query-registry-value "InprocServer32" nil
                                         :root hkeyX
                                         :errorp nil)))
        t))))))
```

## 27.16 Pathname comparison on Mac OS X

Comparing pathnames using `equal` and `equalp` is case-sensitive on the Macintosh. This can lead to occasional unexpected mismatch of pathnames, because the HFS+ filesystem is usually case-insensitive (some Macintosh file systems are case-sensitive).



# 28

---

## Miscellaneous Utilities

This chapter describes miscellaneous functionality which does not belong in other chapters.

### 28.1 Object addresses and memory

In general, you cannot rely on the addresses of Lisp objects, because the Garbage Collector moves objects. The functions described in this section are intended for debugging only.

You can find the current address of a Lisp object as an integer by `object-address`. You can get the pointer of an object (current address plus any tagging) by `object-pointer`. This is what is normally used when printing objects unreadably. You can find which object is currently at some address by using `pointer-from-address`.

You can find the size of a heap object by using `find-object-size`. However, many Lisp objects are made of multiple heap objects, and typically the "root" heap object (the one that the Lisp pointer points to) is relatively small, so for these objects `find-object-size` returns a meaningless value. It is actually useful only for vectors that are simple (not with fill pointer or adjustable or displaced) and structures. It also gives meaningful values for integers, floats and conses.

## 28.2 Optimized integer arithmetic and integer vector access

This section describes ways to perform certain operations as efficiently as possible, including vector access and raw 32-bit arithmetic. Additionally in 64-bit LispWorks, raw 64-bit arithmetic is possible.

### 28.2.1 Typed aref vectors

You can make vectors of certain element types which allow the most efficient access possible when compiled with suitable optimize qualities.

To do this:

1. Make a vector with `make-typed-aref-vector`.
2. Access the vector using `typed-aref` and `(setf typed-aref)` with a `type` argument of `double-float`, `float`, `single-float`, `int32`, `(unsigned-byte n)` or `(signed-byte n)` where  $n = 8, 16$  or  $32$ .  
Additionally, in 64-bit LispWorks the types `(unsigned-byte 64)` and `(signed-byte 64)` are supported.
3. Compile the access with `safety 0` (and for float types, `float 0`) and a constant `type`.

See `typed-aref` for more details and examples.

Efficient access to foreign arrays is also available. See `fli:foreign-typed-aref` in the *LispWorks Foreign Language Interface User Guide and Reference Manual*.

### 28.2.2 Fast 32-bit arithmetic

The INT32 API provides a way to perform optimal raw 32-bit arithmetic. Note that, unlike Lisp integer types, this is modulo  $2^{32}$  like the C `int` type.

The INT32 symbols are all in the `system` package.

The Lisp type `int32` reads 32 bits of memory, like `(signed-byte 32)`, but the data is in `int32` format for use with the INT32 API.

### 28.2.2.1 Optimized and unoptimized INT32 code

When optimized correctly, the intermediate `int32` objects are not constructed.

In unoptimized code, sequences of operations like

```
(sys:int32+ (sys:int32- a b) (sys:int32- c d))
```

will generate intermediate `int32` objects for the results of the subtraction, but the compiler can optimize these away because it knows that the function `int32+` consumes `int32` objects.

**Note:** the INT32 API is not designed to optimize `sys:int32` objects passed as arguments.

### 28.2.2.2 The INT32 API

The INT32 API contains the type `int32`, a vector type `simple-int32-vector` and accessor, functions to convert `int32` to and from integer, some constant `int32` values, and a full range of operators for mod  $2^{32}$  arithmetic.

You can find all these by evaluating

```
(apropos "INT32" "SYSTEM" t)
```

For details for each, see the entries starting with `int32` in Chapter 49, “The SYSTEM Package”.

### 28.2.2.3 INT32 Optimization

The optimization works safely but without boxing when possible. You need

```
(optimize (float 0))
```

to get the optimization. This `float` level affects whether INT32 operations are optimized. This declaration must be placed at the start of a function (not on an inner `let` or `locally` form).

In this example the `safety` level assures a second optimization in `fli:foreign-typed-aref`:

```
(defun incf-signed-byte-32 (ptr index)
  (declare (optimize (safety 0) (float 0))
           (type fixnum index))
  (setf (fli:foreign-typed-aref 'sys:int32 ptr index)
        (sys:int32-1+ (fli:foreign-typed-aref 'sys:int32
                                              ptr index)))
  ;; return ptr, since otherwise the int32 would
  ;; need to be boxed to return it
  ptr)
```

### 28.2.3 Fast 64-bit arithmetic

The INT64 API provides a way to perform optimal raw 64-bit arithmetic. Note that, unlike Lisp integer types, this is modulo  $2^{64}$  like the C `long long` or `int64` types.

The INT64 symbols are all in the `system` package.

The Lisp type `int64` reads 64 bits of memory, like `(signed-byte 64)`, but the data is in `int64` format for use with the INT64 API.

#### 28.2.3.1 Optimized and unoptimized INT64 code

When optimized correctly, the intermediate `int64` objects are not constructed.

In unoptimized code, sequences of operations like

```
(sys:int64+ (sys:int64- a b) (sys:int64- c d))
```

will generate intermediate `int64` objects for the results of the subtraction, but the compiler can optimize these away because it knows that the function `int64+` consumes `int64` objects.

**Note:** the INT64 API is not designed to optimize `sys:int64` objects passed as arguments.

#### 28.2.3.2 The INT64 API

The INT64 API contains the type `int64`, a vector type `simple-int64-vector` and accessor, functions to convert `int64` to and from integer, some constant `int64` values, and a full range of operators for mod  $2^{64}$  arithmetic.

You can find all these by evaluating

```
(apropos "INT64" "SYSTEM" t)
```

For details for each, see the entries starting with `int64` in Chapter 49, “The SYSTEM Package”.

### 28.2.3.3 INT64 Optimization

INT64 optimization occurs only in 64-bit LispWorks. The INT64 API is not optimized in 32-bit LispWorks.

The optimization works safely but without boxing when possible. You need

```
(optimize (float 0))
```

to get the optimization. This `float` level affects whether INT64 operations are optimized. This declaration must be placed at the start of a function (not on an inner `let` or `locally` form).

In this example the `safety` level assures a second optimization in `fli:foreign-typed-aref`:

```
(defun incf-signed-byte-64 (ptr index)
  (declare (optimize (safety 0) (float 0))
           (type fixnum index))
  (setf (fli:foreign-typed-aref 'sys:int64 ptr index)
        (sys:int64-1+ (fli:foreign-typed-aref 'sys:int64
                                              ptr index)))
  ;; return ptr, since otherwise the int64 would
  ;; need to be boxed to return it
  ptr)
```

### 28.2.4 Integer vector access

`octet-ref` and `base-char-ref` (and their setters) are provided to allow efficient access to simple vectors of element type (`unsigned-byte 8`) or `base-char` (that is, `simple-base-strings`) in the same code.

Other vector types are accepted, but for these specific string and binary vector types `octet-ref` and `base-char-ref` match what `aref` and `(setf aref)` do except that they always take and return the same value/result type, and they are also more efficient than `aref`.

Use `octet-ref` and `base-char-ref` according to whether you work with elements of type `integer` or `base-char`.

## 28.3 Transferring large amounts of data

You can write Lisp data in a binary format to a file using `dump-forms-to-file` or `with-output-to-fasl-file` with `dump-form`. The file can then be loaded by `load-data-file`.

This allows you to transfer large amounts of data without using the Lisp printer and reader, which is much more efficient and robust.

## 28.4 Rings

Ring objects can be used to hold Lisp objects (elements) and provide stack-like behavior. Each ring is limited to a maximum number of elements and can be rotated. You can control the insertion point where elements get added and removed, and iterate across the elements.

For more information about rings, start at `make-ring`.

## 28.5 Conditional throw and checking for catch in the dynamic environment

In some situations it may be useful to check whether there is a specific catch in the dynamic scope, and throw if there is such a catch. The function `find-throw-tag` and the macro `throw-if-tag-found` can be used in these circumstances.

## 28.6 Checking for a dynamic binding

Use `symbol-dynamically-bound-p` to test whether a symbol is dynamically bound in the current environment.

# 29

---

## 64-bit LispWorks

This chapter summarizes the technical differences between 64-bit LispWorks and 32-bit LispWorks. Both are ANSI Common Lisp implementations and support the same language extensions and libraries, so in many ways they behave the same. However the programmer should be aware of the differences mentioned here.

### 29.1 Introduction

64-bit LispWorks has a larger address space, subject to physical memory. The maximum heap sizes are shown in Table 29.1.

You can make larger arrays and the `fixnum` type is much larger than in 32-bit LispWorks. The values of various Common Lisp architectural constants reflect this, as shown in Table 29.2.

Other differences in 64-bit LispWorks are noted in the remaining sections of this chapter.

## 29.2 Heap size

In principle 64-bit LispWorks can grow to almost 16 TB but it is intentionally limited to a defined range in order to avoid clashes with other software as shown in Table 29.1.

Table 29.1 Default range for 64-bit LispWorks heap

Platform	Default range	Notes
Intel-based Macintosh	#x4000000000 to #x4000000000 (3.75 TB)	
PowerPC Macintosh	#x4000000000 to #x4000000000 (3.75 TB)	
old Linux	#x4000000000 to #x7000000000 (192 GB)	Effective limit around 160 GB.
modern Linux	#x4000000000 to #x4400000000 (4 TB)	
Windows	#x4000000000 to #x4000000000 (3.75 TB)	
Solaris	#x4000000000 to #x100000000000 (768 GB)	

In contrast, 32-bit LispWorks has a maximum heap size of 1.5-3.0 GB depending on platform.

Normally 64-bit LispWorks for Linux automatically adjusts its default heap size on startup according to whether it runs on "old Linux" or "new Linux". On old systems, LispWorks sets the end of its range to `x7000000000`. On new systems, it sets the end to `#x4400000000`, thus giving a range of 4 TB. However, if the size is given explicitly by command line argument `--reserve-size` or `InitLispWorks` in a dynamic library, then this overrides the automatic adjustment.

LispWorks is relocatable on all supported platforms as described in "Startup relocation of 32-bit LispWorks" on page 460 and "Startup relocation of 64-bit LispWorks" on page 461.

## 29.3 Architectural constants

Common Lisp constants have the values shown in Table 29.2

Table 29.2 Architectural constants

Constant	32-bit LispWorks	64-bit LispWorks
<code>most-positive-fixnum</code>	$2^{29} - 1$	$2^{60} - 1$
<code>array-dimension-limit</code>	67108337 (almost $2^{26}$ )	$2^{29} - 1$
<code>array-total-size-limit</code>	$2^{26}$	$2^{29} - 1$

**Note:** In 32-bit LispWorks 5.0, `array-total-size-limit` is  $2^{29} - 1$ , which is wrong.

## 29.4 Speed

64-bit LispWorks is generally faster than 32-bit LispWorks.

We would be interested to see comparative performance data from your application if it runs on both 32-bit and 64-bit LispWorks.

## 29.5 Memory Management and cl:room

Memory layout and the garbage collector (GC) differ significantly between the two implementations.

For the details see “Memory Management in 32-bit LispWorks” on page 135 and “Memory Management in 64-bit LispWorks” on page 146.

The output of `room` differs between 64-bit and 32-bit LispWorks.

## 29.6 Greater allocation expected in 64-bit LispWorks

In 64-bit LispWorks pointers are 8 bytes, whereas in 32-bit LispWorks pointers are 4 bytes. Since many objects contain pointers, most programs will allocate more in 64-bit LispWorks, typically at least 50% or more.

A program containing mostly strings would not show this difference, since strings are more comparable in size between the two implementations.

You can use `find-object-size` to find the size of an object.

## 29.7 Float types

In 64-bit LispWorks `single-floats` are immediate objects, and `short-float` is the same type as `single-float`.

In 32-bit LispWorks `single-floats` are boxed objects, and `short-float` is disjoint from other float types.

## 29.8 External libraries

Third party libraries loaded into 64-bit LispWorks must be 64-bit. Availability of a suitable library is therefore a possible issue when porting your LispWorks application to 64-bit.

Third party libraries loaded into 32-bit LispWorks must be 32-bit.

# 30

---

## Self-contained examples

This chapter enumerates the set of examples in the LispWorks library relevant to the content of this manual. Each example file contains complete, self-contained code and detailed comments, which include one or more entry points near the start of the file which you can run to start the program.

To run the example code:

1. Open the file in the Editor tool in the LispWorks IDE. Evaluating the call to `example-edit-file` shown below will achieve this.
2. Compile the example code, by `Ctrl+Shift+B`.
3. Place the cursor at the end of the entry point form and press `Ctrl+X Ctrl+E` to run it.
4. Read the comment at the top of the file, which may contain further instructions on how to interact with the example.

### 30.1 COMM examples

#### 30.1.1 SSL examples

This section lists the example files illustrating the use of SSL in socket streams, described in detail in “Using SSL” on page 418:

```
(example-edit-file "ssl/ssl-server")
(example-edit-file "ssl/ssl-client")
(example-edit-file "ssl/ssl-certificates")
```

### 30.1.2 Asynchronous I/O examples

This section lists the example files illustrating the Asynchronous I/O API, described in detail in “Asynchronous I/O” on page 411:

```
(example-edit-file "async-io/driver")
(example-edit-file "async-io/multiplication-table")
(example-edit-file "async-io/print-connection-delay")
(example-edit-file "ssl/async-io-client")
(example-edit-file "async-io/udp")
```

## 30.2 Streams examples

```
(example-edit-file "streams/buffered-stream")
```

## 30.3 DDE examples

This section lists the example files illustrating Dynamic Data Exchange (DDE) on Microsoft Windows, described in detail in “Dynamic Data Exchange” on page 321:

```
(example-edit-file "dde/lispworks-ide")
(example-edit-file "dde/server-dispatching")
(example-edit-file "dde/server-dispatching-client")
```

## 30.4 Parser generator examples

```
(example-edit-file "parser-generator/expression-parser")
```

## 30.5 Examples for save-image in a Mac OS X application

## bundle

This section lists the example files illustrating how you can create an application bundle while saving an image on Mac OS X. See “Saving a LispWorks image” on page 179 for details of the process:

```
(example-edit-file "configuration/macos-application-bundle")
(example-edit-file "configuration/save-macos-application")
```

**Note:** These examples are provided as a starting point for programmers who need to modify their own bundle-creation code. LispWorks for Macintosh has documented functions `create-macos-application-bundle` and `save-image-with-bundle` which you should use unless you need different functionality.

## 30.6 Miscellaneous examples

A minimal example of parsing XML:

```
(example-edit-file "misc/xml-parser")
```

Code for using ASDF in the LispWorks IDE, described in more detail in “Using ASDF” on page 311:

```
(example-edit-file "misc/asdf-integration")
```



# 31

---

## The CLOS Package

This chapter describes the LispWorks extensions to CLOS, the Common Lisp Object System.

The LispWorks Meta Object Protocol mostly conforms to chapters 5 & 6 of AMOP. Manual pages for symbols with different functionality from AMOP are in this chapter, and the differences are discussed in Chapter 18, “The Metaobject Protocol”.

		<i>Function</i>
Summary		Breaks to the debugger when a new instance of a class is accessed. Note that this function is deprecated.
Package		<code>clos</code>
Signature		<code>break-new-instances-on-access <i>class-designator</i> &amp;key <i>read</i> <i>write</i> <i>slot-names</i> <i>when</i> <i>process</i> <i>trace-output</i> <i>entrycond</i> <i>eval-before</i> <i>before</i> <i>backtrace</i> =&gt; <i>t</i></code>
Arguments		<i>class-designator</i> The class to trap.
Values		Returns <i>t</i> .

Description	Causes a break when new instances of the class given by <i>class-designator</i> are accessed, according to the keyword arguments.
	The keyword arguments control which type of access cause a break and are interpreted as described for <code>trace-on-access</code> .
	<b>Note:</b> this function is deprecated. You should now call <code>trace-new-instances-on-access</code> with <code>:break t</code> instead.
See also	<code>trace-new-instances-on-access</code>

	<i>Function</i>
<b>break-on-access</b>	
Summary	Breaks to the debugger when an instance of a class is accessed. Note that this function is deprecated.
Package	<code>clos</code>
Signature	<code>break-on-access instance &amp;key read write slot-names when process trace-output entrycond eval-before before backtrace =&gt; t</code>
Arguments	<code>instance</code> A CLOS instance.
Values	Returns <code>t</code> .
Description	A useful debugging function which causes access to <i>instance</i> to break to the debugger. Accesses include calls to <code>slot-value</code> and also accessor functions defined by the class of <i>instance</i> . Other instances of the same class are unaffected.  The keyword arguments control which type of access cause a break and are interpreted as described for <code>trace-on-access</code> .  You can remove the break by calling <code>unbreak-on-access</code> .  A common use of this function is to find where a slot is being changed in a complex program.

**Note:** this function is deprecated. You should now call `trace-on-access` with `:break t` instead.

See also [trace-on-access](#)

## class-extra-initargs

## *Generic Function*

Summary	Extends the valid initialization arguments of a class.	
Package	clos	
Signature	<code>class-extra-initargs prototype =&gt; initargs</code>	
Arguments	<code>prototype</code>	A class prototype.
Values	<code>initargs</code>	A list of additional initialization arguments.
Description	<p>The generic function <code>class-extra-initargs</code> lets you extend the set of valid initialization arguments for a class and its subclasses. <code>initargs</code> should be a list of symbols. Each symbol becomes a valid initarg for the class. By default in a non-delivered LispWorks image, <code>make-instance</code> and other CLOS initializations (see <code>set-clos-initarg-checking</code>) check that initargs passed to them are valid.</p> <p>The extra initargs are used for <code>make-instance</code>, <code>reinitialize-instance</code>, <code>update-instance-for-redefined-class</code> and <code>update-instance-for-different-class</code>.</p>	
Notes	<p><code>class-extra-initargs</code> is useful only in complex cases. In most cases other ways of extending the set of valid initargs are simpler and clearer, such as the <code>:extra-initargs</code> class option, described in <code>defclass</code>.</p>	
Example	<p>In this session an illegal initarg <code>:my-keyword</code> is passed, causing <code>make-instance</code> to signal an error.</p>	

Then `:my-keyword` is added as an extra initarg, after which `make-instance` accepts it.

```
CL-USER 38 > (defclass my-class () ((a :initform nil)))
#<STANDARD-CLASS MY-CLASS 113AAA2F>

CL-USER 39 > (make-instance 'my-class :my-keyword 8)

Error: MAKE-INSTANCE is called with unknown keyword
:MY-KEYWORD among the arguments (MY-CLASS :MY-KEYWORD
8) {no keywords allowed}
  1 (continue) Ignore the keyword :MY-KEYWORD
  2 (abort) Return to level 0.
  3 Return to top loop level 0.

Type :b for backtrace, :c <option number> to proceed,
or :? for other options

CL-USER 40 : 1 > :a

CL-USER 41 > (defmethod clos:class-extra-initargs
                ((x my-class))
                '(:my-keyword))
#<STANDARD-METHOD CLOS:CLASS-EXTRA-INITARGS (MY-CLASS)
1137C763>

CL-USER 42 > (make-instance 'my-class :my-keyword 8)
#<MY-CLASS 11368963>
```

See also      `compute-class-potential-initargs`  
`defclass`  
`make-instance`  
`set-clos-initarg-checking`

## compute-class-potential-initargs

## Generic Function

Summary      Computes the valid initargs of a class.

Package      `clos`

Signature      `compute-class-potential-initargs class => initargs`

Arguments	<i>class</i>	A class.
Values	<i>initargs</i>	A list of symbols, or <code>t</code> .
Description	<p>The generic function <code>compute-class-potential-initargs</code> is called to compute the initialization arguments of a class. This set of valid initargs is used by <code>make-instance</code> when its arguments are checked.</p> <p><i>class</i> is the class passed to <code>make-instance</code>. That is, <code>compute-class-potential-initargs</code> specializes on the metaclass.</p> <p><i>initargs</i> is either a list of valid initargs, or <code>t</code> meaning that any initialization argument is allowed.</p> <p>There is a supplied method on <code>t</code>, which returns <code>nil</code>.</p> <p>The other supplied method is on <code>standard-class</code>. This consults the Relevant Methods, which are the applicable methods of <code>make-instance</code>, <code>allocate-instance</code>, <code>initialize-instance</code> and <code>shared-initialize</code>. If any of the Relevant Methods have a lambda list containing <code>&amp;allow-other-keys</code> then <i>initargs</i> is <code>t</code>. Otherwise <i>initargs</i> is a list containing:</p> <ul style="list-style-type: none"> <li>• all the <code>&amp;key</code> arguments from Relevant Method lambda lists, and</li> <li>• the initargs of the slots of <i>class</i> and its superclasses, and</li> <li>• any extra initargs specified via the class option <code>:extra-initargs</code> (see <code>defclass</code> for details of this), and</li> <li>• any extra initargs returned by <code>class-extra-initargs</code>.</li> </ul> <p>The list <i>initargs</i> contains no duplicates, and the result of <code>compute-class-potential-initargs</code> is cached so that it is not recomputed unless one of the Relevant Methods, the class or its class precedence list is altered.</p>	

See also      `class-extra-initargs`  
`make-instance`  
`set-clos-initarg-checking`

## **compute-discriminating-function**                          *Generic Function*

Summary      Returns the discriminating function.

Package      `clos`

Signature      `compute-discriminating-function gf => result`

Arguments      `gf`                          A generic function.

Values      `result`                          A function.

Description      The generic function `compute-discriminating-function` returns the discriminator as specified in AMOP.

However, there are two discrepancies with the AMOP behavior:

- The discriminating function does not `compute-applicable-methods-using-classes`, since this is not implemented.
- `add-method` does not call `compute-discriminating-function`. Instead, it is called when the generic function is called. This is more efficient than calling `compute-discriminating-function` each time `add-method` is called.

## **compute-effective-method-function-from-classes**                          *Generic Function*

Summary      Returns the effective method function.

Package      `clos`

Signature	<code>compute-effective-method-function-from-classes gf classes =&gt; em-function</code>	
Arguments	<i>gf</i>	A generic function.
	<i>classes</i>	A list of class metaobjects.
Values	<i>em-function</i>	A function or <code>nil</code> .
Description	<p>The generic function <code>compute-effective-method-function-from-classes</code> is called by LispWorks to compute the effective method function when <i>gf</i> is called with required argument types specified by <i>classes</i>. If <i>em-function</i> is <code>nil</code>, then <code>no-applicable-method</code> is called. Otherwise, <i>em-function</i> may be cached by the generic function and is called with the arguments supplied to the generic function.</p> <p>The default method for <code>compute-effective-method-function-from-classes</code> implements the standard generic function behavior of finding the applicable methods and using the method combination to construct a function that calls them.</p> <p>In order for <code>compute-effective-method-function-from-classes</code> to be called and the result cached, there must be methods specializing on the "interesting" arguments. For the standard behavior, this is trivially true, but if you want to implement other behavior then you need to define dummy methods even if they are never called.</p>	
Example	<p>A "computed" generic function that returns a value based on a form chosen from the classes of the arguments rather than the methods. Note the dummy method which is specialized on null.</p>	

```

(defclass computed-generic-function (standard-generic-
function)
  ((computer :initarg :computer
             :accessor computed-generic-function-
computer))
  (:metaclass funcallable-standard-class))

(defmethod clos:compute-effective-method-function-from-
classes
  ((gf computed-generic-function)
   classes)
  (apply (computed-generic-function-computer gf) gf
classes))

(defmacro define-computed-generic-function (name
lambda-list

specializers
                           &body body)
  `(dspec:def (define-computed-generic-function ,name)
     (defgeneric ,name ,lambda-list
       (:generic-function-class computed-generic-
function)
       (:method ,(loop for arg in lambda-list
                      collect
                      (if (member arg specializers)
                          `,(arg null)
                          arg))))
     (setf (computed-generic-function-computer #' ,name)
           #'(lambda (,name ,@(loop for arg in lambda-
list
                           collect
                           (if (member arg
specializers)
                               arg
                               (gensym)))) ,@body))
          ',name))

(define-computed-generic-function aaaa (x y) (x)
  (let ((something (compute-something aaaa x)))
    #'(lambda (x y)
        (declare (ignore y))
        (format nil "Something for ~a is ~a" x
something)))

(defun compute-something (gf class)

```

```
(format nil "~a--a"
        (generic-function-name gf)
        (class-name class)))
```

See also

## copy-standard-object

*Function*

Summary	Creates a new copy of a CLOS object.	
Package	<code>clos</code>	
Signature	<code>copy-standard-object source =&gt; target</code>	
Arguments	<code>source</code> A <b>standard-object</b> , but not a <b>funcallable-standard-object</b> .	
Values	<code>target</code> A <b>standard-object</b> , but not a <b>funcallable-standard-object</b> .	
Description	<p>The function <code>copy-standard-object</code> creates a new copy of the CLOS object <code>source</code>. <code>source</code> must be of type <b>standard-object</b>, excluding <b>funcallable-standard-object</b> and its subclasses, in particular it cannot be of type <b>generic-function</b>. The copying is shallow, that is only the actual values are copied, as if by</p>	

```
(dolist (slot instance-slots)
        (setf (slot-value target slot)
              (slot-value source slot)))
```

assuming no definition that affects what `slot-value` and `(setf slot-value)` do. However, `copy-standard-object` bypasses the `slot-value` mechanism and is much faster.

`copy-standard-object` should be used on instances of user-defined classes which do not inherit from system-defined

classes (other than `standard-object`). If *source* is an instance of a system-defined class (or a subclass of a system-defined class) then *target* cannot be used as a functional object, but its slot values can be read safely. That may be useful for debugging.

See also      `replace-standard-object`

## `funcallable-standard-object` *Class*

Package      `clos`

Superclasses    `function`  
`standard-object`

Subclasses     `generic-function`

Description     The metaclass `funcallable-standard-object` provides the default `:direct-superclasses` for instances of `funcallable-standard-class` and its subclasses.

`funcallable-standard-object` is implemented as described in AMOP except for a different order in the class precedence list.

In AMOP the class precedence list is

```
(funcallable-standard-object standard-object
function t)
```

whereas in LispWorks the class precedence list is

```
(funcallable-standard-object function
standard-object t)
```

LispWorks is like this to be compliant with the rules in the ANSI Common Lisp Standard.

The AMOP class precedence list implies a class precedence for `generic-function` which violates the last sentence in

ANSI Common Lisp 4.2.2 Type Relationships. See [www.lisp-works.com/reference/HyperSpec/Body/04\\_bb.htm](http://www.lisp-works.com/reference/HyperSpec/Body/04_bb.htm).

## process-a-class-option

### *Generic Function*

Summary	Describes how the value of a class option is parsed.	
Package	<code>clos</code>	
Signature	<code>process-a-class-option metaclass option value =&gt; initargs</code>	
Arguments	<code>metaclass</code>	The metaclass of the class being parsed.
	<code>option</code>	The <code>defclass</code> option name.
	<code>value</code>	The tail of the <code>defclass</code> option form.
Values	<code>initargs</code>	A plist of initargs describing the option.
Description	<p>The generic function <code>process-a-class-option</code> describes how the value of a class option is parsed. It is called at <code>defclass</code> macroexpansion time. By default LispWorks parses class options as defined in AMOP, but you need to supply a method if you need class options with different behavior.</p> <p><code>initargs</code> should be a plist of class initargs and values. These are added to any other initargs for the class.</p>	
Example	<pre>(defclass m1 (standard-class)   ((title :initarg :title)))</pre>	
	For single-valued, evaluated title option, add a method like this:	

```
(defmethod clos:process-a-class-option
  ((class m1)
   (name (eql :title))
   value)
  (unless (and value (null (cdr value)))
    (error "m1 :title must have a single value."))
  (list name (car value)))

(defclass my-titled-class ()
  ()
  (:metaclass m1)
  (:title "Initial Title"))
```

If the value is not to be evaluated, the method would look like this:

```
(defmethod clos:process-a-class-option
  ((class m1)
   (name (eql :title))
   value)
  (unless (and value (null (cdr value)))
    (error "m1 :title must have a single value."))
  `,(name ',value))
```

Now suppose we want an option whose value is a list of titles:

```
(defclass m2 (standard-class)
  ((titles-list :initarg :list-of-possible-titles)))
```

If the titles are to be evaluated, add a method like this:

```
(defmethod clos:process-a-class-option
  ((class m2)
   (name (eql :list-of-possible-titles))
   value)
  (list name `(list ,@value)))
```

Or, if the titles should not be evaluated, add a method like this:

```

(defmethod clos:process-a-class-option
  ((class m2)
   (name (eql :list-of-possible-titles))
   value)
  (list name `',value))

(defclass my-multi-titled-class ()
  ()
  (:metaclass m2)
  (:list-of-possible-titles
   "Initial Title 1"
   "Initial Title 2"))

```

See also      **defclass**  
**process-a-slot-option**

## process-a-slot-option

## *Generic Function*

Summary      Describes how a **defclass** slot option is parsed.

Package      **clos**

Signature      **process-a-slot-option metaclass option value already-processed-other-options slot => processed-options**

Arguments      *metaclass*      The metaclass of the class being parsed.

*option*      The slot option name.

*value*      The value of the slot option.

*already-processed-other-options*

                A plist of initargs for non-standard options  
that have been processed already.

*slot*      The whole slot description.

Values      *processed-options*

                A plist of initargs.

Description	<p>The generic function <code>process-a-slot-option</code> describes how the value of a slot option is parsed. It is called at <code>defclass</code> macroexpansion time. By default LispWorks parses slot options as defined in AMOP, but you need to supply a method if you need slot options with different behavior.</p> <p><i>processed-options</i> should be a plist of slot initargs and values containing those from <i>already-processed-other-options</i> together with initargs for <i>option</i> as required. These are added to any other initargs for the slot.</p>
-------------	---

Example	<pre>(defclass extended-class (standard-class) ())  (defmethod clos:process-a-slot-option     ((class extended-class) option value      already-processed-options slot)   (if (eq option :extended-slot)       (list* :extended-slot              value              already-processed-options)       (call-next-method)))  (defclass extended-direct-slot-definition     (clos:standard-direct-slot-definition)   ((extended-slot :initarg :extended-slot :initform     nil)))  (defmethod clos:direct-slot-definition-class     ((x extended-class) &amp;rest initargs)   'extended-direct-slot-definition)  (defclass test ()   ((regular :initform 3)    (extended :extended-slot t :initform 4))   (:metaclass extended-class))</pre>
---------	--

To add a slot option `:special-reader` whose value is a non-evaluated symbol naming a reader:

```
(defmethod clos:process-a-slot-option
  ((class my-metaclass) option value
   already-processed-options slot)
  (if (and (eq option :special-reader)
            (symbolp value))
      (list* :special-reader
             `',(value already-processed-options)
             (call-next-method)))
  )
```

To allow repeated :special-reader options which are combined into a list:

```
(defmethod clos:process-a-slot-option
  ((class my-metaclass) option value
   already-processed-options slot)
  (if (and (eq option :special-reader) (symbolp value))
      (let ((existing (getf
                       already-processed-options
                       :special-reader)))
        (if existing ; this is a quoted list of symbols
            (progn
              (setf (cdr (last (cadr existing))) (list
value)))
              already-processed-options)
            (list* :special-reader
                   `'(),value)
                   already-processed-options)))
      (call-next-method)))
  )
```

See also      **defclass**  
**process-a-class-option**

## replace-standard-object *Function*

Summary      Replaces the values in a CLOS object's slots by the values of slots from another object.

Package      **clos**

Signature      **replace-standard-object target source => target**

Arguments	<i>source, target</i>	A <b>standard-object</b> , but not a <b>funcallable-standard-object</b> .
Description		<p>The function <b>replace-standard-object</b> replaces the values in the slots of the CLOS object <i>target</i> by the values of slots from the CLOS object <i>source</i>.</p> <p>Only slots with allocation type <b>:instance</b> are copied from <i>source</i> to <i>target</i>.</p> <p><i>source</i> and <i>target</i> must be of type <b>standard-object</b>, excluding <b>funcallable-standard-object</b> and its subclasses, in particular they cannot be of type <b>generic-function</b>. Moreover both must be of the same class, that is:</p> <pre>(eq (class-of target) (class-of source)) =&gt; t</pre> <p>The replacement is shallow, that is only the actual values are copied, as if by</p> <pre>(dolist (slot instance-slots)   (setf (slot-value target slot)         (slot-value source slot)))</pre> <p>assuming no definition that affects what <b>slot-value</b> and <b>(setf slot-value)</b> do. However, <b>replace-standard-object</b> bypasses the <b>slot-value</b> mechanism and is much faster.</p> <p><b>replace-standard-object</b> should be used on instances of user-defined classes which do not inherit from system-defined classes (other than <b>standard-object</b>). It should never be used on instances of system-defined classes and their subclasses.</p>
See also		<b>copy-standard-object</b>

	<i>Function</i>
Summary	Switches initarg checking on or off in <code>make-instance</code> , <code>reinitialize-instance</code> , <code>change-class</code> and so on.
Package	<code>clos</code>
Signature	<code>set-clos-initarg-checking on =&gt; on</code>
Arguments	<code>on</code> A generalized boolean.
Description	<p>The function <code>set-clos-initarg-checking</code> provides control over whether CLOS checks initialization arguments.</p> <p>Initializations affected include:</p> <ul style="list-style-type: none"> <li>• Calls to <code>make-instance</code></li> <li>• Calls to <code>reinitialize-instance</code></li> <li>• Calls to <code>change-class</code></li> <li>• <code>call-next-method</code> to <code>update-instance-for-redefined-class</code> with extra keywords.</li> </ul> <p>Calling <code>set-clos-initarg-checking</code> with a true value of <code>on</code> causes the above initializations to check their initargs. This is the initial state of LispWorks.</p> <p>Initarg checking is switched off globally and dynamically by</p> <pre>(set-clos-initarg-checking nil)</pre>
Notes	<ol style="list-style-type: none"> <li>1. The effect of calling <code>set-clos-initarg-checking</code> can be overridden in a runtime by the <code>deliver</code> keyword argument <code>:clos-initarg-checking</code>. See the <i>LispWorks Delivery User Guide</i> for details.</li> <li>2. <code>set-clos-initarg-checking</code> supersedes <code>set-make-instance-argument-checking</code>.</li> </ol>
See also	<code>class-extra-initargs</code> <code>compute-class-potential-initargs</code>

```
deliver
make-instance
```

## **set-make-instance-argument-checking** *Function*

Summary	Switches CLOS initarg checking on or off. This function is deprecated.	
Package	<b>clos</b>	
Signature	<b>set-make-instance-initarg-checking</b> <i>on</i> => <i>on</i>	
Arguments	<i>on</i>	A boolean.
Description	The deprecated function <b>set-make-instance-initarg-checking</b> switches CLOS initarg checking on or off.	
Notes	<b>set-make-instance-initarg-checking</b> is deprecated. It is an alias for <b>set-clos-initarg-checking</b> .	
Compatibility notes	<ol style="list-style-type: none"> <li>1. In LispWorks 6.1 and later versions <b>set-make-instance-initarg-checking</b> affects CLOS initializations other than <b>make-instance</b>. For clarity, you should now use <b>set-clos-initarg-checking</b> instead.</li> <li>2. In LispWorks 6.0 <b>set-make-instance-initarg-checking</b> affects only <b>make-instance</b>.</li> </ol>	
See also	<b>set-clos-initarg-checking</b>	

## **slot-boundp-using-class** *Generic Function*

Summary	Implements <b>slot-boundp</b> .
Package	<b>clos</b>

Signature	<code>slot-boundp-using-class <i>class object slot-name</i> =&gt; <i>result</i></code>	
Arguments	<i>class</i>	A class metaobject, the class of <i>object</i> .
	<i>object</i>	An object.
	<i>slot-name</i>	A slot name.
Values	<i>result</i>	A boolean.
Description	<p>The generic function <code>slot-boundp-using-class</code> implements the behavior of the <code>slot-boundp</code> function.</p> <p>The implementation is as described in AMOP, except that the third argument is the slot name, and not a slot definition metaobject. The primary methods specialize on <code>t</code> for this argument.</p>	
See also	<a href="#"><code>slot-makunbound-using-class</code></a> <a href="#"><code>slot-value-using-class</code></a>	

## **slot-makunbound-using-class** *Generic Function*

Summary	Implements <code>slot-makunbound</code> .	
Package	<code>clos</code>	
Signature	<code>slot-makunbound-using-class <i>class object slot-name</i> =&gt; <i>object</i></code>	
Arguments	<i>class</i>	A class metaobject, the class of <i>object</i> .
	<i>object</i>	An object.
	<i>slot-name</i>	A slot name.
Values	<i>object</i>	The <i>object</i> argument.
Description	<p>The generic function <code>slot-makunbound-using-class</code> implements the behavior of the <code>slot-makunbound</code> function.</p>	

The implementation is as described in AMOP, except that the third argument is the slot name, and not a slot definition metaobject. The primary methods specialize on `t` for this argument.

See also      `slot-boundp-using-class`  
                  `slot-value-using-class`

## **slot-value-using-class** *Generic Function*

Summary	Implements <code>slot-value</code> .	
Package	<code>clos</code>	
Signature	<code>slot-value-using-class class object slot-name =&gt; value</code> <code>(setf slot-value-using-class) value class object slot-name</code> <code>=&gt; value</code>	
Arguments	<code>class</code>	A class metaobject, the class of <i>object</i> .
	<code>object</code>	An object.
	<code>slot-name</code>	A slot name.
Values	<code>value</code>	The value of the slot named by <i>slot-name</i> .
Description	<p>The generic function <code>slot-value-using-class</code> implements the behavior of the <code>slot-value</code> function.</p> <p>The implementation is as described in AMOP, except that the third argument is the slot name, and not a slot definition metaobject. The primary methods specialize on <code>t</code> for this argument.</p> <p><b>Note:</b> by default, standard slot accessors are optimized to not call <code>slot-value-using-class</code>. This can be overridden with the <code>:optimize-slot-access</code> class option. See <code>defclass</code> for details.</p>	

See also `defclass`  
`slot-boundp-using-class`  
`slot-makunbound-using-class`

## trace-new-instances-on-access *Function*

Summary Traces new instances of a given class, based on access modes.

Package `clos`

Signature `trace-new-instances-on-access class-designator`  
`&key read write slot-names break when process trace-output`  
`entrycond eval-before before backtrace => t`

Arguments `class-designator` The class to trace.

Values Returns `t`.

Description Causes new instances of the class given by `class-designator` to be traced for the access modes given by `read`, `write` and `slot-names`.

The keyword arguments control which type of access are traced, and provide preconditions for tracing, code to run before access, and how to print any trace output. They are interpreted as described for `trace-on-access`.

This function, when used with the `:break` keyword, replaces the deprecated function `break-new-instances-on-access`.

Example `(trace-new-instances-on-access 'capi:display-pane :slot-names nil)`

Suppose you have a bug whereby the slot `bar` of an instance of your class `foo` is incorrectly being set to a negative integer value. You could cause entry into the debugger at the point where the slot is set incorrectly by evaluating this form:

```
(clos:trace-new-instances-on-access
  'foo
  :slot-names '(bar)
  :read nil
  :when '(and (integerp (car *traced-arglist*))
              (< (car *traced-arglist*) 0)))
  :break t)
```

and running your program.

See also

**break-new-instances-on-access**  
**untrace-new-instances-on-access**  
**trace-on-access**

## trace-on-access *Function*

Summary	Invokes the trace facilities when an instance of a class is accessed.	
Package	clos	
Signature	<b>trace-on-access</b> <i>instance</i> & <b>key</b> <i>read</i> <i>write</i> <i>slot-names</i> <i>break</i> <i>when</i> <i>process</i> <i>trace-output</i> <i>entrycond</i> <i>eval-before</i> <i>before</i> <i>backtrace</i> => <i>t</i>	
Arguments	<i>instance</i>	A CLOS instance.
	<i>read</i>	A generalized boolean.
	<i>write</i>	A generalized boolean.
	<i>slot-names</i>	A list of symbols, or t.
	<i>break</i>	A generalized boolean.
	<i>when</i>	A form.
	<i>process</i>	A form.
	<i>trace-output</i>	A form.
	<i>entrycond</i>	A form.
	<i>eval-before</i>	A list of forms.

<i>before</i>	A list of forms.
<i>backtrace</i>	A keyword, <code>t</code> or <code>nil</code> .
Values	Returns <code>t</code> .
Description	<p>A useful debugging function which causes access to <i>instance</i> to invoke the trace facilities. Accesses include calls to <code>slot-value</code> and accessor functions defined by the class of <i>instance</i>.</p> <p>The keyword arguments control which type of access are traced, and provide preconditions for tracing, code to run before access, and how to print any trace output. They are similar to those supported by the <code>trace</code> macro (but note that these CLOS symbols are functions, so the keyword values are evaluated immediately, unlike in <code>trace</code>).</p> <p><i>read</i> controls whether reading slots is traced. The default is <code>t</code>.</p> <p><i>write</i> controls whether writing slots is traced. The default is <code>t</code>.</p> <p><i>slot-names</i> controls which slots to trace access for. It can be a list of symbols which are the slot-names. The default value, <code>t</code>, means trace access to all slots.</p> <p><i>break</i> controls whether the debugger is entered when a traced slot in <i>instance</i> is accessed. When <code>nil</code>, the debugger is not invoked and messages are printed to <code>*trace-output*</code>. The default value is <code>nil</code>.</p> <p><i>when</i> is evaluated during slot access to determine whether any tracing should occur. The default value is <code>t</code>.</p> <p><i>process</i> is evaluated during slot access to determine whether any tracing should occur in the current process. The form should evaluate to either <code>nil</code> (meaning trace in all processes), a string naming the process in which tracing should occur (see <code>process-name</code>, <code>find-process-from-name</code>), or a list of strings naming the processes in which tracing should occur. The default value is <code>nil</code>.</p>

*trace-output* is evaluated during slot access to determine the stream on which to print tracing messages. If this is `nil` then the value of `*trace-output*` is used. The default value is `nil`.

*entrycond* is evaluated during slot access to determine whether the default tracing messages should be printed.

*eval-before* is a list of forms which are evaluated during slot access.

*before* is a list of forms which are evaluated during slot access. The first value returned by each form is printed.

*backtrace* controls what kind of backtrace to print. If this is `nil` then no backtrace is printed, and this is the default value. Otherwise it can be any of the following values:

- `:quick` Like the `:bq` debugger command.
- `t` Like the `:b` debugger command.
- `:verbose` Like the `:b :verbose` debugger command.
- `:bug-form` Like the `:bug-form` debugger command.

Other instances of the same class are unaffected and you can remove the trace by calling `untrace-on-access`.

The variable `*traced-arglist*` is bound to a list of arguments for the slot access during evaluation of the options above, that is (*instance slot-name*) when reading a slot and (*new-value instance slot-name*) when writing a slot.

A common use of this function is to find where a slot is being changed in a complex program.

This function, when called with `:break t`, replaces the deprecated function `break-on-access`.

#### See also

`untrace-on-access`  
`trace-new-instances-on-access`  
`break-on-access`

## **unbreak-new-instances-on-access** *Function*

Summary	Removes the trapping installed by <code>break-new-instances-on-access</code> . Note that this function is deprecated.
Package	<code>clos</code>
Signature	<code>unbreak-new-instances-on-access class-designator =&gt; t</code>
Arguments	<code>class-designator</code> The class whose trap you want to remove.
Values	Returns <code>t</code> .
Description	Removes the trapping installed by <code>break-new-instances-on-access</code> . Note that this function is deprecated. You should now use <code>untrace-new-instances-on-access</code> instead.
See also	<code>untrace-new-instances-on-access</code>

## **unbreak-on-access** *Function*

Summary	Removes the trapping installed by <code>break-on-access</code> . Note that this function is deprecated.
Package	<code>clos</code>
Signature	<code>unbreak-on-access instance</code>
Arguments	<code>instance</code> A class instance
Values	Returns <code>t</code> .
Description	Removes any break installed on <code>instance</code> by <code>break-on-access</code> . See <code>untrace-on-access</code> for details.
	<b>Note:</b> this function is deprecated. You should now use <code>untrace-on-access</code> instead.

See also      **untrace-on-access**

### **untrace-new-instances-on-access**                          *Function*

Summary      Removes the tracing installed by **trace-new-instances-on-access**.

Package      **clos**

Signature      **untrace-new-instances-on-access** *class-designator* => t

Arguments      *class-designator*    The class whose trap you want to remove.

Values      Returns t.

Description      Removes the tracing installed by **trace-new-instances-on-access**.

See also      **trace-new-instances-on-access**  
**untrace-on-access**

### **untrace-on-access**                          *Function*

Summary      Removes the tracing installed by **trace-on-access**.

Package      **clos**

Signature      **untrace-on-access** *instance* => t

Arguments      *instance*                A class instance

Values      Returns t.

Description      Removes any trace installed on *instance* by **trace-on-access**.

See also      **trace-on-access**  
                 **untrace-new-instances-on-access**



# 32

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## The COMM Package

This chapter provides reference entries for the functions in the `comm` package.

The `comm` package provides the TCP/IP interface. TCP/IP sockets can be used to communicate between processes and machines and the mechanism allows LispWorks to connect to or implement a server. It also allows using Secure Sockets Layer (SSL) processing in the socket.

The `comm` package also provides the Asynchronous I/O API including UDP sockets as described in “Asynchronous I/O” on page 411.

An overview of this functionality is in Chapter 25, “TCP and UDP socket communication and SSL”.

Before the interface can be used the module “`comm`” must be loaded using

```
(require "comm")
```

<code>accept-tcp-connections-creating-async-io-states</code>	<i>Function</i>
--	-----------------

Summary	Starts accepting TCP connections to a port within a <code>wait-state-collection</code> .
---------	--

Package	<code>comm</code>
---------	-------------------

Signature	<pre>accept-tcp-connections-creating-async-io-states collection service connection-function &amp;key init-function init-timeout backlog address nodelay keepalive ipv6 create-state name queue- output handle-name user-info ssl-ctx ssl-side ctx-configure-callback ssl-configure-callback handshake-timeout ssl-error-callback =&gt; accepting-handle</pre>
Arguments	<p><i>collection</i>      A <code>wait-state-collection</code>.</p> <p><i>service</i>        An integer, a string or <code>nil</code>.</p> <p><i>connection-function</i></p> <p>                    A function designator.</p> <p><i>init-function</i>    <code>nil</code> or a function designator.</p> <p><i>init-timeout</i>     <code>nil</code> or a non-negative real number.</p> <p><i>backlog</i>        <code>nil</code> or a positive integer.</p> <p><i>address</i>        An integer, an <code>ipv6-address</code> object, a string or <code>nil</code>.</p> <p><i>nodelay</i>        A generalized boolean.</p> <p><i>keepalive</i>      A generalized boolean.</p> <p><i>ipv6</i>            The keyword <code>:any</code>, <code>nil</code>, <code>t</code> or the keyword <code>:both</code>.</p> <p><i>create-state</i>    A boolean.</p> <p><i>queue-output</i>    A boolean.</p> <p><i>name</i>            A Lisp object.</p> <p><i>handle-name</i>    A Lisp object.</p> <p><i>user-info</i>       A Lisp object.</p> <p><i>ssl-side</i>       One of the keywords <code>:client</code>, <code>:server</code> or <code>:both</code>.</p> <p><i>ssl-ctx</i>        A symbol or a foreign pointer.</p>

*ctx-configure-callback*

A function designator or `nil`. The default value is `nil`.

*ssl-configure-callback*

A function designator or `nil`. The default value is `nil`.

*handshake-timeout*

A `real` or `nil` (the default).

*ssl-error-callback*

A function designator..

Values      *accepting-handle* An `accepting-handle` object.

Description    The function `accept-tcp-connections-creating-async-io-states` starts accepting TCP connections to the port service within the `wait-state-collection` collection.

*service* is interpreted as described in “Specifying the target for connecting and binding a socket” on page 408.

Each time a connection is made, *connection-function* is called with two arguments: *accepting-handle* and (by default) a new `async-io-state` for the connected socket. The function typically calls `async-io-state-read-buffer`, `async-io-state-write-buffer` or `async-io-state-read-with-checking` to start performing I/O. The keyword `:create-state` can be used to tell `accept-tcp-connections-creating-async-io-states` not to create the state and instead pass the socket itself. This is useful when you want to do the I/O “somewhere else”, either by creating a `socket-stream` and using ordinary read/write functions on it, or using a different `wait-state-collection`. The default value of *create-state* is `t`.

If *init-function* is non-nil, it is called after the listening socket has been bound to the service. *init-function* should take one argument: *socket*. *socket* is the socket used by the server, which can be used to determine the bound port number by calling `get-socket-address`.

If the port number specified by *service* is already in use, then `accept-tcp-connections-creating-async-io-states` periodically tries to bind to the port number for up to 1 minute (or *init-timeout* seconds if this is non-nil).

*queue-output* controls what happens if you try to perform a write operation on any of the states that `accept-tcp-connections-creating-async-io-states` creates while another write operation is in progress on the same state. When *queue-output* is `nil`, such an operation will cause an error. When *queue-output* is non-nil, the second write operation is queued and actually executed later. The default value of *queue-output* is `nil`.

The result *accepting-handle* is an object of type `accepting-handle`, which is the same object that will be passed to the *connection-function*. It can be used to stop accepting and closing the socket by `close-accepting-handle`, and also retrieving the socket.

*handle-name* and *user-info* are stored in the `accepting-handle` object. The *user-info* is not touched in any way by the system, and it is intended for you to pass information to the *connection-function*. *handle-name* is used when printing the handle, but is not accessed otherwise.

When *ssl-ctx* is non-nil, `accept-tcp-connections-creating-async-io-states` always creates an `async-io-state` (ignoring *create-state*), and attaches SSL to it. *ssl-side*, *ssl-ctx*, *ctx-configure-callback*, *ssl-configure-callback* and *handshake-timeout* are interpreted as described in “Keyword arguments for use with SSL” on page 421.

`ssl-error-callback` defaults to `error`. It is called when there is any error while attaching SSL to the new socket. Such errors can be either the result of an error in the configuration functions, or (more commonly) an error during the SSL handshake. `ssl-error-callback` is called from the thread of the `wait-state-collection` that was passed to `accept-tcp-connections-creating-async-io-states`. The socket is discarded before `Sssl-error-callback` is called.

For details of `backlog`, `address`, `nodelay`, `keepalive` and `ipv6`, see `start-up-server`.

The default value of `nodelay` is `t`.

The default value of `ipv6` is `:any`.

The default value of `name` is a string "Listening".

**Notes** `accept-tcp-connections-creating-async-io-states` binds the socket synchronously, that is when it returns successfully the socket is already bound. However, if it already started accepting connections. If you need to access the socket after binding and before starting to accept connections, use the `init-function` argument.

**See also** `create-async-io-state`  
`create-async-io-state-and-connected-tcp-socket`  
“The Async-I/O-State API” on page 412  
`accepting-handle`  
`accepting-handle-local-port`  
`close-accepting-handle`

	<i>Type</i>
<b>accepting-handle</b>	
<b>Summary</b>	The type of object returned by <code>accept-tcp-connections-creating-async-io-states</code> .
<b>Package</b>	<code>comm</code>

Signature	<code>accepting-handle</code>
Description	<p><code>accepting-handle</code> is the type of the object that is returned by <code>accept-tcp-connections-creating-async-io-states</code> and is passed as the first argument to the <i>connection-function</i> of <code>accept-tcp-connections-creating-async-io-states</code>.</p> <p>The handle contains the collection with which it is associated, the underlying socket, and the <i>user-info</i> and <i>handle-name</i> that were passed to <code>accept-tcp-connections-creating-async-io-states</code>.</p>
See also	<code>accept-tcp-connections-creating-async-io-states</code> <code>close-accepting-handle</code> <code>accepting-handle-socket</code> <code>accepting-handle-collection</code> <code>accepting-handle-local-port</code> <code>accepting-handle-user-info</code> <code>accepting-handle-name</code>

	<i>Function</i>
Summary	Returns the collection associated with an accepting handle.
Package	<code>comm</code>
Signature	<code>accepting-handle-collection accepting-handle =&gt; result</code>
Arguments	<code>accepting-handle</code> An <code>accepting-handle</code> .
Values	<code>result</code> A collection or <code>nil</code> .
Description	The function <code>accepting-handle-collection</code> returns the collection associated with <code>accepting-handle</code> .

*accepting-handle* has to be an accepting handle, currently that means the result of `accept-tcp-connections-creating-async-io-states`.

*result* is the collection that was supplied to `accept-tcp-connections-creating-async-io-states`, but for a closed handle *result* is `nil`.

See also      `accepting-handle`  
                 `accept-tcp-connections-creating-async-io-states`

## **accepting-handle-name** *Function*

Summary      Returns the name associated with an accepting handle.

Package      `comm`

Signature      `accepting-handle-name accepting-handle => name`

Arguments      *accepting-handle* An `accepting-handle`.

Values      *name*      A Lisp object.

Description      The function `accepting-handle-name` returns the name associated with the accepting handle *accepting-handle*, which is the *handle-name* argument to `accept-tcp-connections-creating-async-io-states`.

This name is used when printing the handle, so its printed representation should be reasonably short. Otherwise it is not restricted.

See also      `accepting-handle`  
                 `accept-tcp-connections-creating-async-io-states`

## **accepting-handle-local-port** *Function*

Summary	Returns the local port number to which the socket in an <b>accepting-handle</b> was bound.	
Package	<b>comm</b>	
Signature	<b>accepting-handle-local-port</b> <i>accepting-handle</i> => <i>port-number</i>	
Arguments	<i>accepting-handle</i> An object of type <b>accepting-handle</b> .	
Values	<i>port-number</i>	An integer.
Description	The function <b>accepting-handle-local-port</b> returns the local port number to which the socket in the <b>accepting-handle</b> <i>accepting-handle</i> was bound.	
See also	<a href="#"><b>accepting-handle</b></a> <a href="#"><b>accept-tcp-connections-creating-async-io-states</b></a>	

## **accepting-handle-socket** *Function*

Summary	Returns the socket associated with an accepting handle.	
Package	<b>comm</b>	
Signature	<b>accepting-handle-socket</b> <i>accepting-handle</i> => <i>result</i>	
Arguments	<i>accepting-handle</i> An <b>accepting-handle</b> .	
Values	<i>result</i>	A socket or <b>nil</b> .
Description	The function <b>accepting-handle-socket</b> returns the socket associated with <i>accepting-handle</i> .	

*accepting-handle* has to be an accepting handle, currently that means the result of `accept-tcp-connections-creating-async-io-states`.

*result* is the socket that was created by `accept-tcp-connections-creating-async-io-states`, but for a closed handle *result* is `nil`.

Notes	The socket "belongs" to the handle, and cannot be used for communication by other code. You can use accessors like <code>get-socket-address</code> on it.
See also	<code>accepting-handle</code> <code>accept-tcp-connections-creating-async-io-states</code>

## **accepting-handle-user-info** *Function*

Summary	Returns the <i>user-info</i> associated with an accepting handle.	
Package	<code>comm</code>	
Signature	<code>accepting-handle-user-info accepting-handle =&gt; result</code>	
Arguments	<i>accepting-handle</i> An <code>accepting-handle</code> .	
Values	<i>result</i>	A Lisp object.
Description	<p>The function <code>accepting-handle-user-info</code> returns the <i>user-info</i> associated with the handle <i>accepting-handle</i>, which is the <i>user-info</i> argument to <code>accept-tcp-connections-creating-async-io-states</code>.</p> <p>The system does nothing with the <i>user-info</i>, and its purpose is to allow you to pass information to the <i>connection-function</i> of <code>accept-tcp-connections-creating-async-io-states</code>.</p>	

See also      **accepting-handle**  
**accept-tcp-connections-creating-async-io-states**

## apply-in-wait-state-collection-process                          *Function*

Summary	Applies a function in the process that is associated with a <b>wait-state-collection</b> .							
Package	<b>comm</b>							
Signature	<b>apply-in-wait-state-collection-process</b> <i>collection</i> <i>function</i> <i>&amp;rest args</i>							
Arguments	<table> <tr> <td><i>collection</i></td><td>A <b>wait-state-collection</b>.</td></tr> <tr> <td><i>function</i></td><td>A function designator.</td></tr> <tr> <td><i>args</i></td><td>Lisp objects.</td></tr> </table>		<i>collection</i>	A <b>wait-state-collection</b> .	<i>function</i>	A function designator.	<i>args</i>	Lisp objects.
<i>collection</i>	A <b>wait-state-collection</b> .							
<i>function</i>	A function designator.							
<i>args</i>	Lisp objects.							
Description	<p>The function <b>apply-in-wait-state-collection-process</b> applies <i>function</i> to the arguments <i>args</i> in the process that is associated with <i>collection</i>.</p> <p>A process is associated with <i>collection</i> when it calls <b>wait-for-wait-state-collection</b>, typically from <b>loop-processing-wait-state-collection</b>. Normally only one process will do this for each individual <b>wait-state-collection</b>.</p> <p><b>apply-in-wait-state-collection-process</b> is asynchronous. It sends an appropriate message to the process or <i>collection</i>, and returns immediately, even if it is called from that process. The application happens at an undefined time inside the scope of call to <b>call-wait-state-collection</b> for <i>collection</i>.</p> <p>There is no documented return value.</p>							

#### See also

```
call-wait-state-collection  
loop-processing-wait-state-collection  
wait-state-collection
```

## async-io-state

## *System Class*

**Summary** A class of objects that can be used to perform asynchronous I/O.

## Package comm

Description Instances of the system class `async-io-state` can be used to perform asynchronous I/O.

See also [async-io-state-collection](#)  
[async-io-state-max-read](#)  
[async-io-state-name](#)  
[async-io-state-object](#)  
[async-io-state-old-length](#)  
[async-io-state-read-status](#)  
[async-io-state-read-timeout](#)  
[async-io-state-write-status](#)  
[async-io-state-write-timeout](#)  
[async-io-state-user-info](#)  
“The Async-I/O-State API” on page 10

## async-io-state-abort

## *Function*

**Summary** Stops I/O and callbacks on an `async-io-state` and calls an abort callback.

## Package comm

**Signature**      **async-io-state-abort** **async-io-state** **abort-callback** &  
optional  
**direction**

Arguments	<code>async-io-state</code>	An <code>async-io-state</code> .
	<code>abort-callback</code>	A function designator.
	<code>direction</code>	One of the keywords <code>:input</code> , <code>:output</code> and <code>:io</code> .
Values	None.	
Description	<p>The function <code>async-io-state-abort</code> stops further I/O and calls to any callbacks for direction <code>direction</code> in <code>async-io-state</code> and asynchronously calls <code>abort-callback</code> with the same arguments that the callback for a running operation would be called, except when <code>direction</code> is <code>:io</code>, when the callback is called with the state only.</p> <p>The default value of <code>direction</code> is <code>:input</code>.</p> <p>If by the time <code>abort-callback</code> is called there is no active operation, then <code>abort-callback</code> is called with <code>async-io-state</code> and <code>nil</code> for the other arguments.</p> <p>If <code>async-io-state-abort</code> is called while a callback is running, its effect is delayed until the callback returns.</p> <p><code>abort-callback</code> can do what the other callbacks can do. In particular, it can reuse <code>async-io-state</code>, and when it aborts <code>async-io-state-read-with-checking</code> it can decide how much of the buffered data to discard by calling <code>async-io-state-discard</code>.</p>	
Notes	<p>Due to the asynchronous delay between the time that <code>async-io-state-abort</code> is called and the time that <code>abort-callback</code> is called, the callback of the operation may have already been called, so if the <code>abort-callback</code> does anything except closing <code>async-io-state</code> it will normally have to check the state's <code>async-io-state-read-status</code>.</p>	
See also	<p><code>async-io-state-abort-and-close</code>  “The Async-I/O-State API” on page 412</p>	

	<i>Function</i>
Summary	Aborts any I/O on an <code>async-io-state</code> , closes it and optionally calls a callback.
Package	<code>comm</code>
Signature	<code>async-io-state-abort-and-close async-io-state &amp;key close-callback keep-alive-p</code>
Arguments	<p><code>async-io-state</code> An <code>async-io-state</code>.</p> <p><code>keep-alive-p</code> A generalized boolean.</p> <p><code>close-callback</code> A function designator for a function of one argument, or <code>nil</code>.</p>
Values	None.
Description	<p>The function <code>async-io-state-abort-and-close</code> aborts any I/O on <code>async-io-state</code>, closes it and optionally calls the <code>close-callback</code>.</p> <p><code>async-io-state-abort-and-close</code> first aborts any I/O operation that is in progress, and then closes the state (using <code>close-async-io-state</code>).</p> <p>The value of <code>keep-alive-p</code> is passed to <code>close-async-io-state</code>.</p> <p>If <code>close-callback</code> is non-nil, it should be a function taking one argument. It is called with the state as its argument after the state is closed.</p> <p><code>async-io-state-abort-and-close</code> is asynchronous. The state is known to be closed only when the <code>close-callback</code> is called.</p> <p>See <code>close-async-io-state</code> about accessing the state after it is closed.</p>

See also      **async-io-state-abort**  
**close-async-io-state**  
“[The Async-I/O-State API](#)” on page 412

## async-io-state-address                          *Function*

Summary      Returns the local address and port number for an **async-io-state** that has a socket.

Package      **comm**

Signature     **async-io-state-address** **async-io-state** => **address**, **port**

Arguments    **async-io-state**    An **async-io-state**.

Values        **address**        An integer or an **ipv6-address** object.  
**port**        An integer.

Description    The function **async-io-state-address** returns the local address and port number for **async-io-state** if it has a socket (currently all states).  
**address** is the local host address of the socket in the state.  
**port** is the local port number of the socket in the state.

See also     **async-io-state-peer-address**  
**get-socket-address**  
“[The Async-I/O-State API](#)” on page 412

## async-io-state-attach-ssl                          *Function*

Summary      Attaches SSL to an **async-io-state** that contains a TCP socket.

Package      **comm**

Signature	<code>async-io-state-attach-ssl</code> <code>async-io-state callback &amp;key ssl-side</code> <code>ssl-ctx</code> <code>ctx-configure-callback</code> <code>ssl-configure-callback</code>
Arguments	<p><code>async-io-state</code> An <code>async-io-state</code>.</p> <p><code>callback</code> A function designator for a function with two arguments.</p> <p><code>ssl-side</code> One of the keywords <code>:client</code>, <code>:server</code> or <code>:both</code>.</p> <p><code>ssl-ctx</code> A symbol or a foreign pointer.</p> <p><code>ctx-configure-callback</code></p> <p>A function designator or <code>nil</code>. The default value is <code>nil</code>.</p> <p><code>ssl-configure-callback</code></p> <p>A function designator or <code>nil</code>. The default value is <code>nil</code>.</p> <p><code>handshake-timeout</code></p> <p>A <code>real</code> or <code>nil</code> (the default).</p>
Values	None
Description	<p>The function <code>async-io-state-attach-ssl</code> attaches SSL to <code>async-io-state</code>, which must contain a TCP socket, typically the result of <code>create-async-io-state</code> or a state created by <code>accept-tcp-connections-creating-async-io-states</code>. <code>async-io-state</code> must not have SSL attached to it already.</p> <p><code>ssl-side</code>, <code>ssl-ctx</code>, <code>ctx-configure-callback</code>, <code>ssl-configure-callback</code> and <code>handshake-timeout</code> are interpreted as described in “Keyword arguments for use with SSL” on page 421. <code>ssl-ctx</code> defaults to <code>t</code> and <code>ssl-side</code> defaults to <code>:server</code>.</p> <p>When SSL has been attached successfully or otherwise, <code>callback</code> is called with two arguments: <code>async-io-state</code> and an error-indicator. The error-indicator is <code>nil</code> when successful, other-</p>

wise it is a list of a format control-string and args, suitable for applying to `format`. When the error-indicator is non-nil, `async-io-state` is not attached to SSL.

`async-io-state-attach-ssl` must not be called when there is any other operation on `async-io-state` and new operations on `async-io-state` must not be started until `callback` has been called.

Notes	<code>create-async-io-state-and-connected-tcp-socket</code> and <code>accept-tcp-connections-creating-async-io-states</code> can attach SSL themselves, and in most cases that is the best way to do it. <code>async-io-state-attach-ssl</code> allows the attachment to be done later.
See also	<code>create-async-io-state-and-connected-tcp-socket</code> <code>accept-tcp-connections-creating-async-io-states</code> <code>async-io-state-detach-ssl</code> “Using Asynchronous I/O with SSL” on page 421

	<i>Function</i>
Summary	Returns the length of the buffered data in an <code>async-io-state</code> .
Package	<code>comm</code>
Signature	<code>async-io-state-buffered-data-length</code> <code>async-io-state</code> => <code>length</code>
Arguments	<code>async-io-state</code> An <code>async-io-state</code> .
Values	<code>length</code> A non-negative integer.
Description	The function <code>async-io-state-buffered-data-length</code> returns the length of the buffered data in <code>async-io-state</code> .

See also      **async-io-state-get-buffered-data**  
                “The Async-I/O-State API” on page 412

## async-io-state-ctx

*Function*

Summary      Accesses the **SSL\_CTX** attached to an **async-io-state**.

Package      **comm**

Signature     **async-io-state-ctx** **async-io-state** => **ssl-ctx-pointer**

Arguments    **async-io-state**    An **async-io-state**.

Values        **ssl-ctx-pointer**   A foreign pointer of type **ssl-ctx-pointer**,  
                 or **nil**.

Description     The function **async-io-state-ctx** accesses the **SSL\_CTX**  
                that is attached to the **async-io-state** **async-io-state**.  
  
                It returns **nil** if SSL is not attached.

See also      **async-io-state**  
                  **ssl-ctx-pointer**

## async-io-state-detach-ssl

*Function*

Summary      Detaches SSL to an **async-io-state** that contains a TCP  
                socket.

Package      **comm**

Signature    **async-io-state-detach-ssl** **async-io-state** **callback**

Arguments    **async-io-state**    An **async-io-state**.

	<i>callback</i>	A function designator for a function with one argument.
Values	None	
Description		The function <code>async-io-state-detach-ssl</code> detaches SSL from <code>async-io-state</code> . Subsequent communications through <code>async-io-state</code> will be without SSL.  When SSL has been detached, <i>callback</i> is called with <code>async-io-state</code> .  If <code>async-io-state</code> did not have SSL attached then <code>async-io-state-detach-ssl</code> has no effect.  <code>async-io-state-detach-ssl</code> must not be called when there is any other operation on <code>async-io-state</code> , and new operations on <code>async-io-state</code> must not be started until <i>callback</i> has been called.
Notes		There is no need to call <code>async-io-state-detach-ssl</code> before <code>close-async-io-state</code> because that also detaches SSL.
See also		<code>async-io-state-attach-ssl</code> <code>close-async-io-state</code> “Using Asynchronous I/O with SSL” on page 421

	<b>Function</b>
Summary	Returns the <code>wait-state-collection</code> of an <code>async-io-state</code> .
Package	<code>comm</code>
Signature	<code>async-io-state-collection async-io-state -&gt; collection</code>
Arguments	<code>async-io-state</code> An <code>async-io-state</code> .

Values	<i>collection</i>	A <b>wait-state-collection</b> .
Description	The function <b>async-io-state-collection</b> returns the <b>wait-state-collection</b> associated with <b>async-io-state</b> .	
See also	<b>async-io-state</b> <b>wait-state-collection</b> “The Async-I/O-State API” on page 412	

## **async-io-state-discard** *Function*

Summary	Discards some bytes from the internal buffer in an <b>async-io-state</b> .	
Package	<b>comm</b>	
Signature	<b>async-io-state-discard</b> <b>async-io-state</b> <b>discard</b> => <b>unread-buffer-length</b>	
Arguments	<b>async-io-state</b>	An <b>async-io-state</b> .
	<b>discard</b>	A positive integer.
Values	<b>unread-buffer-length</b> A non-negative integer.	
Description	<p>The function <b>async-io-state-discard</b> discards the first <i>discard</i> bytes from the internal buffer in <b>async-io-state</b>. The rest of the buffer is preserved for future reading.</p> <p><b>async-io-state-discard</b> must only be called inside the scope of the <i>callback</i> of <b>async-io-state-read-with-checking</b>. Once <b>async-io-state-discard</b> has been called, the <i>callback</i> must not access the buffer again.</p> <p>The return value <b>unread-buffer-length</b> is the remaining number of bytes in the buffer.</p>	

See also      **async-io-state-read-with-checking**  
                 “The Async-I/O-State API” on page 412

	<i>Function</i>				
Summary	Stops the current read operation in an <b>async-io-state</b> .				
Package	<b>comm</b>				
Signature	<b>async-io-state-finish</b> <i>async-io-state</i> &optional <i>discard</i> => <i>unread-buffer-length</i>				
Arguments	<table border="0"> <tr> <td><i>async-io-state</i></td><td>An <b>async-io-state</b>.</td></tr> <tr> <td><i>discard</i></td><td>A positive integer or <b>nil</b>.</td></tr> </table>	<i>async-io-state</i>	An <b>async-io-state</b> .	<i>discard</i>	A positive integer or <b>nil</b> .
<i>async-io-state</i>	An <b>async-io-state</b> .				
<i>discard</i>	A positive integer or <b>nil</b> .				
Values	<table border="0"> <tr> <td><i>unread-buffer-length</i></td><td></td></tr> <tr> <td></td><td>A non-negative integer.</td></tr> </table>	<i>unread-buffer-length</i>			A non-negative integer.
<i>unread-buffer-length</i>					
	A non-negative integer.				
Description	<p>The function <b>async-io-state-finish</b> stops the current read operation in <i>async-io-state</i>, so no further calls to the <b>async-io-state-read-with-checking</b> <i>callback</i> will occur. If <i>discard</i> is non-nil, then it discards the first <i>discard</i> bytes from the internal buffer in <i>async-io-state</i>. The rest of the buffer is preserved for future reading.</p> <p><b>async-io-state-finish</b> must only be called inside the scope of the <i>callback</i> of <b>async-io-state-read-with-checking</b>. Once <b>async-io-state-finish</b> has been called, the <i>callback</i> must not access the buffer again and a new read operation can be started.</p> <p>The return value <i>unread-buffer-length</i> is the remaining number of bytes in the buffer.</p>				
See also	<b>async-io-state-read-with-checking</b> “The Async-I/O-State API” on page 412				

	<i>Function</i>
Summary	Copies buffered data from an <b>async-io-state</b> and discards it from the state.
Package	<code>comm</code>
Signature	<code>async-io-state-get-buffered-data async-io-state buffer &amp;key start end =&gt; length</code>
Arguments	<p><b>async-io-state</b> An <b>async-io-state</b>.</p> <p><b>buffer</b> A <b>cl:base-string</b> or an 8-bit <b>cl:simple-array</b>.</p> <p><b>start</b> A lower bounding index designator for <b>buffer</b>.</p> <p><b>end</b> An upper bounding index designator for <b>buffer</b>.</p>
Values	<b>length</b> A non-negative integer.
Description	<p>The function <b>async-io-state-get-buffered-data</b> copies to the buffer <b>buffer</b> (between <b>start</b> and <b>end</b>) as much as possible of the buffered data in <b>async-io-state</b> and discards it from <b>async-io-state</b>.</p> <p>The default value of <b>start</b> is 0. The default value of <b>end</b> is the length of <b>buffer</b>.</p> <p>The return value <b>length</b> is the number of elements copied into <b>buffer</b>.</p> <p><b>async-io-state-get-buffered-data</b> cannot be called while an operation is active in <b>async-io-state</b>, that is between the call to <b>async-io-state-read-buffer</b> or <b>async-io-state-write-buffer</b>, and the call to the callback or <b>async-io-state-abort</b>, or between a call to <b>async-io-state-read-with-checking</b> and the call to <b>async-io-state-finish</b> or <b>async-io-state-abort</b>.</p>

Notes	Use <code>async-io-state-buffered-data-length</code> to find how much buffered data there is in <code>async-io-state</code> .
See also	<code>async-io-state-buffered-data-length</code> “The Async-I/O-State API” on page 412

## **async-io-state-handshake** *Function*

Summary	Perform a SSL handshake on an <code>async-io-state</code> .	
Package	<code>comm</code>	
Signature	<code>async-io-state-handshake</code> <code>async-io-state</code> <code>callback</code> & <code>optional timeout</code>	
Arguments	<code>async-io-state</code>	A <code>socket-stream</code> .
	<code>callback</code>	A function designator for a function with two arguments.
	<code>timeout</code>	<code>nil</code> or a real.
Values	None.	
Description	<p>The function <code>async-io-state-handshake</code> performs a handshake on <code>async-io-state</code>, which must be attached to SSL.</p> <p>When the handshake has finished successfully or failed, <code>callback</code> is called with two arguments: <code>async-io-state</code> and an error-indicator. The error-indicator is <code>nil</code> when successful, otherwise it is a list suitable for an error call as in <code>(apply 'error error-indicator)</code>. The <code>async-io-state-read-status</code> of <code>async-io-state</code> is also set appropriately.</p> <p>If the handshake does not finish in <code>timeout</code> seconds, <code>callback</code> is called with non-nil error-indicator: <code>("Handshake timed out")</code>, and the <code>async-io-state-read-status</code> is set to <code>:timeout</code>. If the other side closes the socket cleanly, <code>callback</code> is called error-indicator: <code>("SSL connection closed")</code>,</p>	

and the `async-io-state-read-status` is set to `:eof`. Other cases indicate an actual error in the handshake.

`async-io-state-handshake` must not be called when there is any other operation on `async-io-state` and new operations on `async-io-state` must not be started until `callback` has been called.

Notes	If SSL was attached with <code>ssl-side :both</code> , then you will need to specify which side to take in the handshake by calling <code>ssl-set-accept-state</code> or <code>ssl-set-connect-state</code> with the <code>ssl-pointer</code> return by <code>socket-stream-ssl</code> .
See also	<code>async-io-state</code> “Using SSL” on page 418

## **async-io-state-max-read** *Accessor*

Summary	Accesses the maximum bytes to read of an <code>async-io-state</code> .	
Package	<code>comm</code>	
Signature	<code>async-io-state-max-read</code> <code>async-io-state =&gt; max-read</code>  <code>setf</code> ( <code>async-io-state-max-read</code> <code>async-io-state</code> ) <code>max-read =&gt; max-read</code>	
Arguments	<code>async-io-state</code>	An <code>async-io-state</code> .
	<code>max-read</code>	An integer.
Values	<code>max-read</code>	An integer.
Description	The accessor <code>async-io-state-max-read</code> is used to read and write the maximum bytes to try to read of <code>async-io-state</code> . <code>max-read</code> is an integer specifying the maximum number of bytes to try to read between calls to the callback in <code>async-io-state-read-with-checking</code> .	

See also      **async-io-state**  
**async-io-state-read-with-checking**  
“[The Async-I/O-State API](#)” on page 412

## **async-io-state-name** *Accessor*

Summary      Accesses the name of an **async-io-state**.

Package      **comm**

Signature      **async-io-state-name** **async-io-state** => **name**  
**setf** (**async-io-state-name** **async-io-state**) **name** => **name**

Arguments      **async-io-state**    An **async-io-state**.  
**name**            A Lisp object.

Values      **name**            A Lisp object.

Description      The accessor **async-io-state-name** is used to access the *name* of **async-io-state**. This names the state for debugging purposes.

See also      **async-io-state**  
**create-async-io-state**  
“[The Async-I/O-State API](#)” on page 412

## **async-io-state-object** *Function*

Summary      Returns the object used to create an **async-io-state**.

Package      **comm**

Signature      **async-io-state-object** **async-io-state** => **object**

Arguments	<code>async-io-state</code>	An <code>async-io-state</code> .
Values	<code>object</code>	A <code>socket-stream</code> or an integer.
Description		The function <code>async-io-state-object</code> returns the <i>object</i> that was supplied in the call to <code>create-async-io-state</code> that created <code>async-io-state</code> .
See also		<code>async-io-state</code> <code>create-async-io-state</code> “The Async-I/O-State API” on page 412

## **async-io-state-old-length** *Function*

Summary	Returns the old length of an <code>async-io-state</code> .	
Package	<code>comm</code>	
Signature	<code>async-io-state-old-length</code> <code>async-io-state</code> => <code>old-length</code>	
Arguments	<code>async-io-state</code>	An <code>async-io-state</code> .
Values	<code>old-length</code>	An integer.
Description		The function <code>async-io-state-old-length</code> is used to get the old length of <code>async-io-state</code> . <i>old-length</i> is an integer specifying the length of the old part in the buffer, that is the part that was seen in the previous invocation of the callback in <code>async-io-state-read-with-checking</code> .
See also		<code>async-io-state</code> <code>async-io-state-read-with-checking</code> “The Async-I/O-State API” on page 412

		<i>Function</i>
<b>async-io-state-peer-address</b>		
Summary	Returns the local address and port number for an <b>async-io-state</b> state that has a connected socket.	
Package	<code>comm</code>	
Signature	<code>async-io-state-peer-address</code>	<code>async-io-state =&gt; address, port</code>
Arguments	<code>async-io-state</code>	An <b>async-io-state</b> .
Values	<code>address</code>	An integer, an <b>ipv6-address</b> or <b>nil</b> .
	<code>port</code>	An integer or <b>nil</b> .
Description	The function <b>async-io-state-peer-address</b> returns the remote address and port number for <i>async-io-state</i> if it has a socket which is connected.  <i>address</i> is the remote host address of the socket in the state. <i>port</i> is the remote port number of the socket in the state. For an unconnected socket both <i>address</i> and <i>port</i> are <b>nil</b> .	
See also	 <a href="#"><b>async-io-state-address</b></a> <a href="#"><b>get-socket-peer-address</b></a> <a href="#">“The Async-I/O-State API” on page 412</a>	

		<i>Function</i>
<b>async-io-state-read-buffer</b>		
Summary	Asynchronously fills a buffer with bytes read from an <b>async-io-state</b> .	
Package	<code>comm</code>	
Signature	<code>async-io-state-read-buffer</code>	<code>async-io-state buffer callback &amp;key start end timeout error-callback user-info</code>

Arguments	<i>async-io-state</i>	An <b>async-io-state</b> .
	<i>buffer</i>	A <b>cl:base-string</b> or an 8-bit <b>cl:simple-array</b> .
	<i>callback</i>	A function designator for a function of 3 arguments.
	<i>start</i>	A lower bounding index designator for <i>buffer</i> .
	<i>end</i>	An upper bounding index designator for <i>buffer</i> .
	<i>timeout</i>	<b>nil</b> or a positive real.
	<i>error-callback</i>	A function designator for a function of 3 arguments, or <b>nil</b> .
	<i>user-info</i>	A Lisp object.
Values	None.	
Description	<p>The function <b>async-io-state-read-buffer</b> asynchronously fills the buffer <i>buffer</i> between <i>start</i> and <i>end</i> with bytes read from <i>async-io-state</i>. When buffer is full (between <i>start</i> and <i>end</i>) or the <b>async-io-state-read-timeout</b> of <i>async-io-state</i> has passed, the <i>callback</i> is called like this:</p> <pre><b>callback</b> <i>async-io-state</i> <i>buffer</i> <i>number-of-bytes-read</i></pre> <p>If an error occurs during the I/O operation and <i>error-callback</i> is non-nil, then <i>error-callback</i> is called with these same arguments:</p> <pre><b>error-callback</b> <i>async-io-state</i> <i>buffer</i> <i>number-of-bytes-read</i></pre> <p>If <i>error-callback</i> is <b>nil</b>, then <i>callback</i> is called, so it should check for errors using <b>async-io-state-read-status</b>.</p> <p>The default value of <i>start</i> is 0. The default value of <i>end</i> is the length of <i>buffer</i>.</p>	

If the operation does not finish within the state's `async-io-state-read-timeout` period then state's `async-io-state-read-status` is set to `:timeout` and `callback` is called.

If `timeout` or `user-info` are supplied then they set `async-io-state-read-timeout` and `async-io-state-user-info` in `async-io-state` for this and subsequent operations.

If another read operation on the state is in progress, an error is signaled.

#### See also

`async-io-state-write-buffer`  
`async-io-state-read-with-checking`  
“The Async-I/O-State API” on page 412

## `async-io-state-read-status`

## `async-io-state-write-status`

## *Functions*

Summary	Returns the read or write status of an <code>async-io-state</code> .	
Package	<code>comm</code>	
Signature	<code>async-io-state-read-status</code> <code>async-io-state</code> => <code>read-status</code> <code>async-io-state-write-status</code> <code>async-io-state</code> => <code>write-status</code>	
Arguments	<code>async-io-state</code>	An <code>async-io-state</code> .
Values	<code>read-status</code>	<code>nil</code> , <code>:eof</code> , <code>:timeout</code> or an error value.
	<code>write-status</code>	<code>nil</code> , <code>:eof</code> , <code>:timeout</code> or an error value.
Description	The function <code>async-io-state-read-status</code> returns the read status of <code>async-io-state</code> . <code>read-status</code> is <code>nil</code> for a working socket, <code>:eof</code> for end of file, <code>:timeout</code> if a timeout has occurred or some other values meaning an error has occurred.	

The function `async-io-state-write-status` returns the write status of `async-io-state`. `write-status` is `nil` for a working socket, `:eof` for end of file, `:timeout` if a timeout has occurred or some other values meaning an error has occurred.

See also

`async-io-state`  
“The Async-I/O-State API” on page 412

## `async-io-state-read-timeout`

## `async-io-state-write-timeout`

## *Accessors*

Summary      Accesses the read and write timeouts of an `async-io-state`.

Package      `comm`

Signature      `async-io-state-read-timeout async-io-state => read-timeout`  
`setf (async-io-state-read-timeout async-io-state) read-timeout => read-timeout`  
  
`async-io-state-write-timeout async-io-state => write-timeout`  
`setf (async-io-state-write-timeout async-io-state) write-timeout => write-timeout`

Arguments      `async-io-state`      An `async-io-state`.

`read-timeout`      `nil` or a positive real.

`write-timeout`      `nil` or a positive real.

Values          `read-timeout`      `nil` or a positive real.

`write-timeout`      `nil` or a positive real.

Description      The accessor `async-io-state-read-timeout` is used to read and write the read timeout of `async-io-state`. `read-timeout` is `nil` if there is no timeout and otherwise is a timeout in seconds.

The accessor `async-io-state-write-timeout` is used to read and write the write timeout of `async-io-state`. `write-timeout` is `nil` if there is no timeout and otherwise is a timeout in seconds.

## See also

`async-io-state`  
`create-async-io-state`  
“The Async-I/O-State API” on page 412

	<i>Function</i>														
<b>async-io-state-read-with-checking</b>															
Summary	Repeatedly tries to read bytes from an <code>async-io-state</code> , and invokes a callback.														
Package	<code>comm</code>														
Signature	<code>async-io-state-read-with-checking async-io-state callback &amp;key timeout max-read error-callback user-info element-type</code>														
Arguments	<table> <tr> <td><code>async-io-state</code></td><td>An <code>async-io-state</code>.</td></tr> <tr> <td><code>callback</code></td><td>A function designator for a function of 3 arguments, or <code>nil</code>.</td></tr> <tr> <td><code>timeout</code></td><td><code>nil</code> or a positive real.</td></tr> <tr> <td><code>max-read</code></td><td>A positive integer.</td></tr> <tr> <td><code>error-callback</code></td><td>A function designator for a function of 3 arguments, or <code>nil</code>.</td></tr> <tr> <td><code>user-info</code></td><td>A Lisp object.</td></tr> <tr> <td><code>element-type</code></td><td>A type specifier.</td></tr> </table>	<code>async-io-state</code>	An <code>async-io-state</code> .	<code>callback</code>	A function designator for a function of 3 arguments, or <code>nil</code> .	<code>timeout</code>	<code>nil</code> or a positive real.	<code>max-read</code>	A positive integer.	<code>error-callback</code>	A function designator for a function of 3 arguments, or <code>nil</code> .	<code>user-info</code>	A Lisp object.	<code>element-type</code>	A type specifier.
<code>async-io-state</code>	An <code>async-io-state</code> .														
<code>callback</code>	A function designator for a function of 3 arguments, or <code>nil</code> .														
<code>timeout</code>	<code>nil</code> or a positive real.														
<code>max-read</code>	A positive integer.														
<code>error-callback</code>	A function designator for a function of 3 arguments, or <code>nil</code> .														
<code>user-info</code>	A Lisp object.														
<code>element-type</code>	A type specifier.														
Values	None.														
Description	The function <code>async-io-state-read-with-checking</code> repeatedly tries to read up to <code>async-io-state-max-read</code>														

more bytes from `async-io-state`, append them to the internal buffer and call `callback` like this:

```
callback async-io-state buffer end
```

`async-io-state` is the argument to `async-io-state-read-with-checking`, `buffer` is a `cl:simple-array` of element type `element-type` containing data from index 0 up to `end`, and `end` is a positive integer indicating the end of the filled part of `buffer`.

The buffer must not be modified or accessed outside the scope of the callback or after `async-io-state-discard` or `async-io-state-finish` have been called.

The element type of `buffer` is `element-type`, which can be `base-char`, `(unsigned-byte 8)` or `(signed-byte 8)`. The default value of `element-type` is `base-char`.

The callback is responsible for processing the data in the buffer and optionally indicating that the read operation is complete as follows:

- The function `async-io-state-old-length` can be used to find the length of the old part in the buffer, that is the part that contained data in the previous call to the callback. When `async-io-state-read-with-checking` is called, it resets the old length to 0, so `async-io-state-old-length` returns 0 in the first invocation of `callback`.
- You can use `async-io-state-discard` with `discard` between 0 and `end` to discard the first `discard` bytes of the buffer. This is typically done when the callback has processed some of the bytes and does not want to see them again. Until bytes are discarded explicitly, they are accumulated in the buffer for subsequent calls to the callback.
- When the callback decides that the operation is complete, it needs to call `async-io-state-finish`. This optionally discards bytes as described above, and keeps the remaining bytes for future read operations from `async-io-state`.

If the operation does not finish within the state's `async-io-state-read-timeout` period then the callback is called with the state's `async-io-state-read-status` set to `:timeout`.

If an error occurs during the I/O operation and `error-callback` is non-nil, then `error-callback` is called like this:

```
error-callback async-io-state buffer end
```

If `error-callback` is nil, then `callback` is called, so it should check for errors using `async-io-state-read-status`.

If `timeout`, `max-read` or `user-info` are supplied then they set `async-io-state-read-timeout`, `async-io-state-max-read` and `async-io-state-user-info` in `async-io-state` for this and subsequent operations.

If another read operation is in progress on the state, an error is signaled.

**Notes** Once the callback has called `async-io-state-finish` it can start further reading operations on `async-io-state`. The accessors `async-io-state-read-timeout`, `async-io-state-max-read` and `async-io-state-user-info` can be used to read and write the corresponding values in the callback.

**Examples** Reading http headers, which are separated from the http body by two consecutive newlines. We assume these functions:

1. `my-parse-http-headers` which takes a buffer, start and end and returns a parsed headers-object.
2. `my-read-http-body` takes an `async-io-state`, headers-object and a user-defined object and reads the body via the Async-IO-State API.
3. `my-record-socket-error` which takes a user defined object and the error flag and handles a socket error.
4. `find-nn-in-buffer` which takes buffer, start and end and returns the index of the first two consecutive newlines if any.

The callback is defined like this:

```
(defun http-header-reading-callback (state buffer end)
  (if-let (cannot-read
            (async-io-state-read-status state))
    (my-record-socket-error
      (async-io-state-user-info state)
      cannot-read)
    (let ((start (async-io-state-old-length state)))
      (let ((start-search-for-nn
              (if (zerop start) 0 (1- start))))
        (when-let (h-end (find-nn-in-buffer
                           buffer
                           start-search-for-nn
                           end))
          (let ((h-object (my-parse-http-headers
                           buffer 0 h-end)))
            (async-io-state-finish state (+ h-end 2))
            (my-read-http-body
              state
              h-object
              (async-io-state-user-info state))))))))
```

The callback is used like this:

```
(async-io-state-read-with-checking
  state
  'http-header-reading-callback)
```

See also      [async-io-state-read-buffer](#)  
                [async-io-state-write-buffer](#)  
                “The Async-I/O-State API” on page 412

## async-io-state-receive-message *Function*

Summary      Asynchronously receives a message from a socket.

Package      `comm`

Signature      `async-io-state-receive-message async-io-state buffer callback &key start end timeout error-callback needs-address user-info`

Arguments	<i>async-io-state</i>	An <code>async-io-state</code> .
	<i>buffer</i>	A <code>cl:base-string</code> or an 8-bit <code>cl:simple-array</code> .
	<i>callback</i>	A function designator.
	<i>start</i>	A lower bounding index designator for <i>buffer</i> .
	<i>end</i>	An upper bounding index designator for <i>buffer</i> .
	<i>timeout</i>	<code>nil</code> or a non-negative real.
	<i>error-callback</i>	A function designator.
	<i>needs-address</i>	A boolean.
	<i>user-info</i>	A Lisp object.
Values	None.	
Description	<p>The function <code>async-io-state-receive-message</code> starts a read operation of "receiving" on <i>async-io-state</i>, which means that when there is input on the socket it calls <code>recv</code> or <code>recvfrom</code> to read the data into <i>buffer</i> between <i>start</i> and <i>end</i>. The default value of <i>start</i> is 0. The default value of <i>end</i> is the length of <i>buffer</i>.</p> <p><i>callback</i> should be a function of 3 or 5 arguments. If the reading succeeds and <i>needs-address</i> is <code>nil</code>, then <i>callback</i> is called with this signature:</p> <pre><code>callback async-io-state buffer number-of-bytes-read</code></pre> <p>If the reading succeeds and <i>needs-address</i> is non-<code>nil</code>, then <i>callback</i> is called with this signature:</p> <pre><code>callback async-io-state buffer number-of-bytes-read ip-address port-number</code></pre> <p>where <i>ip-address</i> and <i>port-number</i> are the socket address of the sender, and can be used as the <i>hostspec</i> and <i>service</i> when</p>	

required. Typically these are used in `async-io-state-send-message-to-address` to send a message back to the sender.

The default value of `needs-address` is `nil`.

`error-callback`, `timeout`, `start`, `end` and `user-info` have the same meaning as in `async-io-state-read-buffer`.

- Notes
1. `async-io-state-receive-message` is typically used only with an `async-io-state` containing a UDP socket, created by `create-async-io-state-and-udp-socket`, `create-async-io-state-and-connected-udp-socket` or calling `create-async-io-state` with `udp` non-`nil`.
  2. The socket may or may not be connected.

Example      (`example-edit-file "async-io/udp"`)

See also      `create-async-io-state-and-udp-socket`  
`create-async-io-state-and-connected-udp-socket`  
`async-io-state-send-message`  
`async-io-state-send-message-to-address`  
“The Async-I/O-State API” on page 412

async-io-state-send-message		<i>Function</i>
Summary	Asynchronously sends a message on a connected socket.	
Package	<code>comm</code>	
Signature	<code>async-io-state-send-message</code> <code>async-io-state</code> <code>buffer</code> <code>callback</code> <code>&amp;key</code> <code>start</code> <code>end</code> <code>timeout</code> <code>error-callback</code> <code>user-info</code>	
Arguments	<code>async-io-state</code>	An <code>async-io-state</code> .
	<code>buffer</code>	A <code>cl:base-string</code> or an 8-bit <code>cl:simple-array</code> .

<i>callback</i>	A function designator for a function of 1 argument.
<i>start</i>	A lower bounding index designator for <i>buffer</i> .
<i>end</i>	An upper bounding index designator for <i>buffer</i> .
<i>timeout</i>	<code>nil</code> or a non-negative real.
<i>error-callback</i>	A function designator.
<i>user-info</i>	A Lisp object.
Values	None.
Description	<p>The function <code>async-io-state-send-message</code> asynchronously sends a message from <i>buffer</i> between <i>start</i> and <i>end</i>. The socket in <code>async-io-state</code> must be connected. When the send is successful, <i>callback</i> is called with <code>async-io-state</code> as its only argument.</p> <p>The default value of <i>start</i> is 0. The default value of <i>end</i> is the length of <i>buffer</i>.</p> <p><i>error-callback</i>, <i>timeout</i>, <i>start</i>, <i>end</i> and <i>user-info</i> have the same meaning as in <code>async-io-state-write-buffer</code>.</p>
Notes	<p><code>async-io-state-send-message</code> is typically used only with an <code>async-io-state</code> containing a UDP socket, created by <code>create-async-io-state-and-udp-socket</code>, <code>create-async-io-state-and-connected-udp-socket</code> or calling <code>create-async-io-state</code> with <i>udp</i> non-nil.</p> <p>The contents of <i>buffer</i> must not be changed until <i>callback</i> has been called.</p> <p>For unconnected UDP sockets, use <code>async-io-state-send-message-to-address</code>.</p>

See also `create-async-io-state-and-connected-udp-socket`  
`async-io-state-receive-message`  
`async-io-state-send-message-to-address`  
“The Async-I/O-State API” on page 412

## **async-io-state-send-message-to-address** *Function*

Summary	Asynchronously sends a message on an unconnected socket.
Package	<code>comm</code>
Signature	<code>async-io-state-send-message-to-address (async-io-state hostspec service buffer callback &amp;key start end timeout error-callback user-info)</code>
Arguments	<p><code>async-io-state</code> An <code>async-io-state</code>.</p> <p><code>hostspec, service</code> Specify the socket address to send to in the standard way.</p> <p><code>buffer</code> A <code>cl:base-string</code> or an 8-bit <code>cl:simple-array</code>.</p> <p><code>callback</code> A function designator for a function of 1 argument.</p> <p><code>start</code> A lower bounding index designator for <code>buffer</code>.</p> <p><code>end</code> An upper bounding index designator for <code>buffer</code>.</p> <p><code>timeout</code> <code>nil</code> or a non-negative real.</p> <p><code>error-callback</code> A function designator.</p> <p><code>user-info</code> A Lisp object.</p>
Values	None.

Description	<p>The function <code>async-io-state-send-message-to-address</code> asynchronously sends a message from <i>buffer</i> between <i>start</i> and <i>end</i> to the socket address which is specified by <i>hostspec</i> and <i>service</i>. For the interpretation of <i>hostspec</i> and <i>service</i> see “Specifying the target for connecting and binding a socket” on page 408.</p> <p>The default value of <i>start</i> is 0. The default value of <i>end</i> is the length of <i>buffer</i>.</p> <p>The socket in <code>async-io-state</code> must not be connected. When the sending is successful, <i>callback</i> is called with <code>async-io-state</code> as its only argument.</p> <p><i>error-callback</i>, <i>timeout</i>, <i>start</i>, <i>end</i> and <i>user-info</i> have the same meaning as in <code>async-io-state-write-buffer</code>.</p>
Notes	<ol style="list-style-type: none"> <li>1. <code>async-io-state-send-message-to-address</code> is typically used only with an <code>async-io-state</code> containing a UDP socket, created by <code>create-async-io-state-and-udp-socket</code>, <code>create-async-io-state-and-connected-udp-socket</code> or calling <code>create-async-io-state</code> with <i>udp</i> non-nil.</li> <li>2. The contents of <i>buffer</i> must not be changed until <i>callback</i> has been called.</li> <li>3. If <i>hostspec</i> is a host name (that is a string not specifying an IP address), then <code>async-io-state-send-message-to-address</code> uses the family of the socket to decide whether to look for IPv6 or IPv4 addresses. If <code>async-io-state</code> was created by <code>create-async-io-state</code>, the <i>ipv6</i> argument to <code>create-async-io-state</code> must match the family of the socket for <code>async-io-state-send-message-to-address</code> to work.</li> <li>4. For connected UDP sockets, use <code>async-io-state-send-message</code>.</li> </ol>
Example	<code>(example-edit-file "async-io/udp")</code>

See also      `create-async-io-state-and-connected-udp-socket`  
`async-io-state-receive-message`  
`async-io-state-send-message`  
“The Async-I/O-State API” on page 412

## async-io-state-ssl

*Function*

Summary      Accesses the `SSL` attached to an `async-io-state`.

Package      `comm`

Signature      `async-io-state-ssl async-io-state => ssl-pointer`

Arguments      `async-io-state`      An `async-io-state`.

Values      `ssl-pointer`      A foreign pointer of type `ssl-pointer`, or `nil`.

Description      The function `async-io-state-ssl` accesses the `SSL` that is attached to the `async-io-state` `async-io-state`.  
It returns `nil` if `SSL` is not attached.

See also      `async-io-state`  
`ssl-pointer`

## async-io-state-ssl-side

*Function*

Summary      Accesses the `ssl-side` of an `async-io-state`.

Package      `comm`

Signature      `async-io-state-ssl-side async-io-state => ssl-side`

Arguments      `async-io-state`      An `async-io-state`.

Values	<i>ssl-side</i>	<code>:client, :server, :both or nil</code>
Description	The function <code>async-io-state-ssl-side</code> accesses the ssl-side of the <code>async-io-state</code> <code>async-io-state</code> . It returns <code>nil</code> if SSL is not attached.	
Note	<code>async-io-state-ssl-side</code> is useful as a predicate for testing if an <code>async-io-state</code> has SSL attached.	
See also	<code>async-io-state</code>	

## **async-io-state-write-buffer** *Function*

Summary	Asynchronously writes a buffer to an <code>async-io-state</code> .	
Package	<code>comm</code>	
Signature	<code>async-io-state-write-buffer</code> <code>async-io-state</code> <code>buffer</code> <code>callback</code> <code>&amp;key start end timeout error-callback user-info</code>	
Arguments	<i>async-io-state</i>	An <code>async-io-state</code> .
	<i>buffer</i>	A <code>cl:base-string</code> or an 8-bit <code>cl:simple-array</code> .
	<i>callback</i>	A function designator for a function of 3 arguments.
	<i>start</i>	A lower bounding index designator for <code>buffer</code> .
	<i>end</i>	An upper bounding index designator for <code>buffer</code> .
	<i>timeout</i>	<code>nil</code> or a positive real.
	<i>error-callback</i>	A function designator for a function of 3 arguments, or <code>nil</code> .
	<i>user-info</i>	A Lisp object.

Values	None.
Description	<p>The function <code>async-io-state-write-buffer</code> asynchronously writes the part of buffer <i>buffer</i> between indexes <i>start</i> and <i>end</i> to <code>async-io-state</code>. When this writing has succeeded or the state's <code>async-io-state-write-timeout</code> has passed, <i>callback</i> is called like this:</p> <pre><code>callback async-io-state buffer number-of-bytes-written</code></pre> <p>The default value of <i>start</i> is 0. The default value of <i>end</i> is the length of <i>buffer</i>.</p> <p>If an error occurs during the I/O operation and <code>error-callback</code> is non-nil, then <code>error-callback</code> is called with these same arguments:</p> <pre><code>error-callback async-io-state buffer number-of-bytes-written</code></pre> <p>If <code>error-callback</code> is <code>nil</code>, then <i>callback</i> is called, so it should check for errors using <code>async-io-state-write-status</code>.</p> <p>If the operation does not finish within the state's <code>async-io-state-write-timeout</code> period then the state's <code>async-io-state-write-status</code> is set to <code>:timeout</code> and <i>callback</i> is called.</p> <p>If <code>timeout</code> or <code>user-info</code> are supplied then they set the state's <code>async-io-state-write-timeout</code> and <code>async-io-state-user-info</code> for this and subsequent operations.</p>
See also	<p><code>async-io-state-read-buffer</code>  <code>async-io-state-read-with-checking</code>  “The Async-I/O-State API” on page 412</p>

## async-io-state-user-info

*Accessor*

Summary	Accesses the user info of an <code>async-io-state</code> .
Package	<code>comm</code>

Signature	<code>async-io-state-user-info</code> <code>async-io-state =&gt; user-info</code> <code>setf (async-io-state-user-info</code> <code>async-io-state)</code> <code>user-info</code> <code>=&gt; user-info</code>	
Arguments	<code>async-io-state</code>	An <code>async-io-state</code> .
	<code>user-info</code>	A Lisp object.
Values	<code>user-info</code>	A Lisp object.
Description	The accessor <code>async-io-state-user-info</code> is used to read and write the <code>user-info</code> of <code>async-io-state</code> . LispWorks itself does not use this value for any purpose.	
See also	<code>async-io-state</code> <code>create-async-io-state</code> “The Async-I/O-State API” on page 412	

		<i>Function</i>
	<b>attach-ssl</b>	
Summary	Attaches SSL to a socket stream.	
Package	<code>comm</code>	
Signature	<code>attach-ssl</code> <code>socket-stream &amp;key</code> <code>ssl-ctx</code> <code>ssl-side</code> <code>ctx-configure-callback</code> <code>ssl-configure-callback</code> <code>handshake-timeout</code> <code>tlsext-host-name</code> <code>=&gt; ssl</code>	
Arguments	<code>socket-stream</code>	A <code>socket-stream</code> .
	<code>ssl-ctx</code>	A symbol or a foreign pointer.
	<code>ssl-side</code>	One of the keywords <code>:client</code> , <code>:server</code> or <code>:both</code> .

*ctx-configure-callback*

A function designator or `nil`. The default value is `nil`.

*ssl-configure-callback*

A function designator or `nil`. The default value is `nil`.

*handshake-timeout*

A `real` or `nil` (the default).

*tlsext-host-name* A string or `nil`.

Values      `ssl`      A foreign pointer of type `ssl-pointer`.

Description      The function `attach-ssl` attaches SSL to the socket-stream socket-stream.

The allowed values and meaning of the keyword arguments are as described for `socket-stream`.

Note that `attach-ssl` is used by

`(make-instance 'comm:socket-stream :ssl-ctx ...)`

and by

`(comm:open-tcp-stream ... :ssl-ctx ...)`

but you can also call it explicitly.

Before starting to create objects, `attach-ssl` ensures the SSL library (by calling `ensure-ssl`) and calls `do-rand-seed` to seed the Pseudo Random Number Generator (PRNG), so normally you do not need to worry about these.

`ssl-side`, `ssl-ctx`, `ctx-configure-callback`, `ssl-configure-callback` and `handshake-timeout` are interpreted as described in “Keyword arguments for use with SSL” on page 421. After this, `ssl_set_fd` is used to attach the `SSL` to the socket and this is recorded in the socket stream.

The default value of `ssl-ctx` is `t` and the default value of `ssl-side` is `:server`.

If `tlsext-host-name` is non-nil, then the SNI extension in the SSL connection is set to its value.

When a `socket-stream` is closed, `detach-ssl` is called with `:retry-count nil`, which, if the stream is attached to SSL, calls `ssl_shutdown` and then frees the object (or objects) that were automatically allocated.

If SSL is already attached to `socket-stream` then `attach-ssl` signals an error.

See also      `detach-ssl`

	<i>Function</i>
<b>call-wait-state-collection</b>	
Summary	Calls the functions associated with the active states in a <code>wait-state-collection</code> .
Package	<code>comm</code>
Signature	<code>call-wait-state-collection collection</code>
Arguments	<code>collection</code> A <code>wait-state-collection</code> .
Description	The function <code>call-wait-state-collection</code> calls the functions associated with the active states in <code>collection</code> , and perform any actions requested by messages that arrive from other processes.
Notes	Typically you would not call <code>call-wait-state-collection</code> yourself, but it will be called by <code>loop-processing-wait-state-collection</code> .
See also	<code>create-and-run-wait-state-collection</code> <code>loop-processing-wait-state-collection</code> “The Async-I/O-State API” on page 412

<b>close-accepting-handle</b>	<i>Function</i>
Summary	Closes an accepting handle.
Package	<code>comm</code>
Signature	<code>close-accepting-handle <i>accepting-handle</i> &amp;optional <i>callback</i></code>
Arguments	<p><i>accepting-handle</i> An <code>accepting-handle</code>.</p> <p><i>callback</i> A function designator or <code>nil</code>.</p>
Description	<p>The function <code>close-accepting-handle</code> closes the accepting handle <i>accepting-handle</i>. In particular, it closes the socket which frees up the port that the socket is bound to.</p> <p><i>accepting-handle</i> has to be an accepting handle, currently that means the result of <code>accept-tcp-connections-creating-async-io-states</code>.</p> <p>If <i>callback</i> is non-nil, it must be a function of one argument. <i>callback</i> is called after closing the handle, with the collection which was supplied to <code>accept-tcp-connections-creating-async-io-states</code> which created the handle.</p> <p><code>close-accepting-handle</code> is asynchronous. To do something which is guaranteed to happen after the socket is closed, use <i>callback</i>.</p>
Notes	<i>callback</i> is called on the collection process, so it should not do much work.
See also	<p><code>accepting-handle</code></p> <p><code>accept-tcp-connections-creating-async-io-states</code></p>

	<i>Function</i>				
Summary	Closes an <b>async-io-state</b> and removes it from any internal structures.				
Package	<code>comm</code>				
Signature	<code>close-async-io-state <i>async-io-state</i> &amp;key <i>keep-alive-p</i> =&gt; <i>buffered-data-length</i></code>				
Arguments	<table> <tr> <td><i>async-io-state</i></td><td>An <b>async-io-state</b>.</td></tr> <tr> <td><i>keep-alive-p</i></td><td>A generalized boolean.</td></tr> </table>	<i>async-io-state</i>	An <b>async-io-state</b> .	<i>keep-alive-p</i>	A generalized boolean.
<i>async-io-state</i>	An <b>async-io-state</b> .				
<i>keep-alive-p</i>	A generalized boolean.				
Values	<table> <tr> <td><i>buffered-data-length</i></td><td></td></tr> <tr> <td></td><td>A non-negative integer.</td></tr> </table>	<i>buffered-data-length</i>			A non-negative integer.
<i>buffered-data-length</i>					
	A non-negative integer.				
Description	<p>The function <b>close-async-io-state</b> closes <i>async-io-state</i> and removes it from any internal structures. Once <i>async-io-state</i> has been closed, you cannot perform I/O operations on it.</p> <p>By default, <b>close-async-io-state</b> also closes the <i>object</i> in <i>async-io-state</i> (that is, the argument to <b>create-async-io-state</b>). This closing can be prevented by supplying true for <i>keep-alive-p</i>, so you can perform further I/O operations on that <i>object</i>. In this case you will need to close <i>object</i> later.</p> <p><i>async-io-state</i> may contain some buffered data that it read from the object but did not use yet. The return value is the length of such data and you can use <b>async-io-state-get-buffered-data</b> to get it.</p>				
Notes	If <i>async-io-state</i> is attached to SSL, then it is detached. This occurs even if <i>keep-alive-p</i> is true.				
See also	“The Async-I/O-State API” on page 412				

	<i>Function</i>
Summary	Closes a <code>wait-state-collection</code> and all of its states.
Package	<code>comm</code>
Signature	<code>close-wait-state-collection collection</code>
Arguments	<i>collection</i> A <code>wait-state-collection</code> .
Description	The function <code>close-wait-state-collection</code> closes all of the states in <i>collection</i> . That means that the underlying communication object is closed and the <code>async-io-state</code> objects that are currently associated with <i>collection</i> cannot be used for further I/O and will not receive callbacks anymore.
Notes	<p><code>close-wait-state-collection</code> does not do anything that affects further processing in <i>collection</i>. In particular, you can add new states to the collection afterwards, and waiting and calling, either by <code>loop-processing-wait-state-collection</code> or <code>wait-for-wait-state-collection</code> and <code>call-wait-state-collection</code>, can continue. <code>loop-processing-wait-state-collection</code> does not stop if <code>close-wait-state-collection</code> is called inside it.</p> <p><code>close-wait-state-collection</code> is a "nasty" call, because it just kills any <code>async-io-state</code> associated with the collection. Normally should only be used only when you stop using the collection.</p> <p><code>close-wait-state-collection</code> cannot be called on a collection in parallel to itself or <code>loop-processing-wait-state-collection</code>, <code>wait-for-wait-state-collection</code> or <code>call-wait-state-collection</code>. It can be called inside the scope of <code>call-wait-state-collection</code>, and <code>loop-processing-wait-state-collection</code>.</p>

You can use `apply-in-wait-state-collection-process` to cause execution inside the scope of `call-wait-state-collection`.

See also      `create-and-run-wait-state-collection`  
                 “The Async-I/O-State API” on page 412

	<i>Function</i>
<b>create-and-run-wait-state-collection</b>	
Summary	Creates and runs a <code>wait-state-collection</code> .
Package	<code>comm</code>
Signature	<code>create-and-run-wait-state-collection name &amp;key handler with-backtrace =&gt; wait-state-collection</code>
Arguments	<p><code>name</code>      A Lisp object that names the collection. It is used only for printing.</p> <p><code>handler</code>      <code>nil</code>, <code>t</code>, the keyword <code>:abort</code> or a function.</p> <p><code>with-backtrace</code>      The keyword <code>:bug-form</code>, <code>t</code>, the keyword <code>:quick</code>, or <code>nil</code>.</p>
Values	<p><code>wait-state-collection</code></p> <p>A <code>wait-state-collection</code>.</p>
Description	<p>The function <code>create-and-run-wait-state-collection</code> creates and runs a <code>wait-state-collection</code>.</p> <p><code>create-and-run-wait-state-collection</code> creates a <code>wait-state-collection</code> and then starts a new process which calls <code>loop-processing-wait-state-collection</code> on the new <code>wait-state-collection</code> (and therefore activates it), and returns it as <code>wait-state-collection</code>. The new process has process name "Loop Collection <code>name</code>". When <code>loop-processing-wait-state-collection</code> exits, <code>wait-state-collection</code> is closed and the other process exits too.</p>

You can use `wait-state-collection-stop-loop` to make `loop-processing-wait-state-collection` exit, and hence close `wait-state-collection` and make the process go away. Calling `process-terminate` on the process itself can also be used, because it will use `wait-state-collection-stop-loop`.

`handler` specifies handling of errors that occur on the process in which the collection is run. The values have the following effects:

<code>nil</code>	No handling.
<code>:abort</code>	Abort (calls the function <code>cl:abort</code> ).
<code>t</code>	Print the condition to the standard output, and unless <code>with-backtrace</code> is <code>nil</code> produces a backtrace, and then aborts.
A function	Must be a function of three arguments when <code>with-backtrace</code> is non-nil, or two arguments when <code>with-backtrace</code> is <code>nil</code> . When a serious condition is signaled, the handler is called inside the context of the error (like a handler in <code>cl:handler-bind</code> ).

When `with-backtrace` is non-nil:

`handler object condition backtrace-string`

When `with-backtrace` is `nil`:

`handler object condition`

The `object` argument is the object that is responsible for the error. Currently this is always the `async-io-state` with which the callback that caused the error is associated. If there is an error outside a callback (which should not happen, unless there is a bug), then `object` is `nil`. `condition` is the condition that is signaled. `backtrace-string` is a string which is the result of producing a backtrace. If the handler returns, `(cl:abort)` is called.

*with-backtrace* controls whether a backtrace is produced when *handler* is `t` or a function. It is passed to `output-backtrace` as the first argument. See `output-backtrace` for details.

The default value of *handler* is `nil`. The default value of *with-backtrace* is `:bug-form`.

*wait-state-collection* can be used immediately by passing it to one of the `create-async-io-state*` functions.

#### Notes

1. The `wait-state-collection` *wait-state-collection* does nothing by itself. You need to create and use `async-io-state` objects to actually do something.
2. Aborting by the handler is done by calling `(cl:abort)`, which aborts to the closest enclosing abort restart. If your code establishes such a restart around the error, the aborting will abort to it. Otherwise it will abort back to the loop of waiting and calling.
3. Real applications will probably always pass the handler.
4. While the handler is run, no further processing is done in the collection. Therefore the handler should not do a significant amount of work.

#### See also

`wait-state-collection-stop-loop`  
`create-async-io-state-and-connected-tcp-socket`  
`create-async-io-state-and-connected-udp-socket`  
`create-async-io-state`  
`create-async-io-state-and-udp-socket`  
`accept-tcp-connections-creating-async-io-states`

## **create-async-io-state**

## *Function*

Summary      Creates an `async-io-state` for a socket.

Package      `comm`

Signature	<code>create-async-io-state collection object &amp;key read-timeout write-timeout user-info udp ipv6 name queue-output =&gt; async-io- state</code>	
Arguments	<i>collection</i>	A <code>wait-state-collection</code> .
	<i>object</i>	A <code>socket-stream</code> or an integer.
	<i>read-timeout</i>	<code>nil</code> or a positive real.
	<i>write-timeout</i>	<code>nil</code> or a positive real.
	<i>user-info</i>	A Lisp object.
	<i>udp</i>	<code>nil</code> , <code>t</code> , or the keyword <code>:connected</code> .
	<i>ipv6</i>	A boolean.
	<i>name</i>	A Lisp object.
	<i>queue-output</i>	A boolean.
Values	<code>async-io-state</code>	An <code>async-io-state</code> .
Description	<p>The function <code>create-async-io-state</code> creates an <code>async-io-state</code> for the object <i>object</i>. If <i>object</i> is an integer, then it is assumed to be a socket handle (a file descriptor on Unix-like systems). If <i>object</i> is a <code>socket-stream</code>, then the <code>async-io-state</code> contains its socket.</p> <p><i>read-timeout</i>, <i>write-timeout</i> and <i>user-info</i> are set in <code>async-io-state</code> using the corresponding accessors <code>async-io-state-read-timeout</code>, <code>async-io-state-write-timeout</code> and <code>async-io-state-user-info</code>.</p> <p>If <i>udp</i> is non-nil and <i>object</i> is a socket, then this tells <code>create-async-io-state</code> that the socket is a UDP socket (rather than TCP). If <i>udp</i> is <code>:connected</code>, this also tells <code>create-async-io-state</code> that the socket is a connected socket, which affects whether you can use <code>async-io-state-send-message</code> (connected) or <code>async-io-state-send-message-to-address</code> (unconnected). When <i>object</i> is a stream, it is always assumed</p>	

to be a TCP socket, regardless of the value of *udp*. The default value of *udp* is `nil`.

*ipv6* tells `create-async-io-state` whether the socket was made as an IPv6 socket (with `AF_INET6`) or IPv4 (with `AF_INET`). This makes a difference only for unconnected UDP sockets (it tells `async-io-state-send-message-to-address` when called with a host name whether to look for IPv6 or IPv4 addresses).

*queue-output* controls what happens if you try to perform a write operation on the state while another write operation is ongoing. When *queue-output* is `nil` this will cause an error. When *queue-output* is non-nil, the second write operation is queued and actually executed later. The default value of *queue-output* is `nil`.

After calling `create-async-io-state`, *object* should not be used directly for I/O in the same direction (read or write) until `close-async-io-state` has been called.

See also	<code>create-async-io-state-and-connected-tcp-socket</code> <code>accept-tcp-connections-creating-async-io-states</code> “The Async-I/O-State API” on page 412
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		<i>Function</i>
<b><code>create-async-io-state-and-connected-tcp-socket</code></b>		<i>Function</i>
Summary	Creates an <code>async-io-state</code> which attempts to make a TCP connection.	
Package	<code>comm</code>	
Signature		<code>create-async-io-state-and-connected-tcp-socket collection host service callback &amp;key read-timeout write-timeout user-info connect-timeout local-address local-port keepalive nodelay name queue-output =&gt; async-io-state ssl-ctx ctx-configure-callback ssl- configure-callback handshake-timeout</code>
Arguments	<code>collection</code>	A <code>wait-state-collection</code> .

<i>host</i>	An integer or a string or an <code>ipv6-address</code> object.
<i>service</i>	A string or a fixnum.
<i>callback</i>	A function designator for a function of two arguments.
<i>read-timeout</i>	<code>nil</code> or a positive real.
<i>write-timeout</i>	<code>nil</code> or a positive real.
<i>user-info</i>	A Lisp object.
<i>connect-timeout</i>	<code>nil</code> or a positive real.
<i>local-address</i>	<code>nil</code> , an integer, a string or an <code>ipv6-address</code> object.
<i>local-port</i>	<code>nil</code> , a string or a fixnum.
<i>keepalive</i>	A generalized boolean.
<i>nodelay</i>	A generalized boolean.
<i>queue-output</i>	A boolean.
<i>name</i>	A Lisp object.
<i>ssl-ctx</i>	A symbol or a foreign pointer.
<i>ctx-configure-callback</i>	A function designator or <code>nil</code> . The default value is <code>nil</code> .

<i>ssl-configure-callback</i>	A function designator or <code>nil</code> . The default value is <code>nil</code> .
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#### *handshake-timeout*

A `real` or `nil` (the default).

Values	<i>async-io-state</i>	An <code>async-io-state</code> .
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Description	
	The function <code>create-async-io-state-and-connected-tcp-socket</code> creates an <code>async-io-state</code> which attempts to make a TCP connection to <code>host</code> on port <code>service</code> within <code>connect-timeout</code> seconds. <code>host</code> and <code>service</code> are interpreted as described in “Specifying the target for connecting and binding a socket” on page 408.
	When the connection has been made, <code>callback</code> is called with arguments <code>async-io-state</code> and <code>nil</code> . Normally <code>callback</code> will start asynchronous I/O by calling <code>async-io-state-read-buffer</code> , <code>async-io-state-write-buffer</code> or <code>async-io-state-read-with-checking</code> .
	If no connection can be made, <code>callback</code> is called with <code>async-io-state</code> and a list of a format control-string and args, suitable for applying to <code>format</code> . In general, it doesn't make much sense for the callback to call <code>error</code> within <code>callback</code> , so it should report the problem in some way, typically by writing to some log. It may also need to inform the user interactively, but that needs to be done in another process, and is better done by using some kind of end-user dialog rather than invoking <code>error</code> .
	<code>local-address</code> and <code>local-port</code> are used to bind the local side of the socket to a particular address and/or port if non-nil.
	<code>keepalive</code> and <code>nodelay</code> set the SO_KEEPALIVE and TCP_NODELAY in the socket. The default value of <code>keepalive</code> is <code>nil</code> . The default value of <code>nodelay</code> is <code>t</code> .
	<code>queue-output</code> controls what happens if you try to perform a write operation on the state while another write operation is ongoing. When <code>nil</code> , this will cause an error. When non-nil, the second write operation is queued and actually executed later. The default value of <code>queue-output</code> is <code>nil</code> .
	<code>read-timeout</code> , <code>write-timeout</code> , <code>user-info</code> and <code>name</code> are set in <code>async-io-state</code> using the corresponding accessors <code>async-io-state-read-timeout</code> , <code>async-io-state-write-timeout</code> , <code>async-io-state-user-info</code> and <code>async-io-state-name</code> .

The default value of *name* is a string "Connected TCP".

*ssl-ctx*, *ctx-configure-callback*, *ssl-configure-callback* and *hand-shake-timeout* are interpreted as described in "Keyword arguments for use with SSL" on page 421. Unlike the other ways of creating a socket stream with SSL processing, `create-async-io-state-and-connected-tcp-socket` does not take the *ssl-side* argument and always uses the value `:client`.

Once the connection has been made,, you can get the socket by calling `async-io-state-object` on `async-io-state` (see `async-io-state`)

See also      `create-async-io-state`  
                 `accept-tcp-connections-creating-async-io-states`  
                  "The Async-I/O-State API" on page 412

## `create-async-io-state-and-connected-udp-socket`                  *Function*

Summary      Creates an `async-io-state` where the *object* is a connected UDP socket.

Package      `comm`

Signature     `create-async-io-state-and-connected-udp-socket collection hostspec service &key queue-output name errorp ipv6 read-timeout write-timeout user-info local-address local-port => async-io-state`

Arguments    *collection*      A `wait-state-collection` to associate with the result.

*hostspec, service*   Specify the socket address to connect to in the standard way.

*ipv6*               One of `nil`, `t` or the keyword `:any`.

*errorp*              A boolean.

*local-address, local-port*

		Specify the local socket address in the standard way.
	<i>queue-output</i>	A boolean.
	<i>read-timeout</i>	<code>nil</code> or a positive real.
	<i>write-timeout</i>	<code>nil</code> or a positive real.
	<i>user-info</i>	A Lisp object.
	<i>name</i>	A Lisp object.
Values	<code>async-io-state</code>	An <code>async-io-state</code> .
Description		<p>The function <code>create-async-io-state-and-connected-udp-socket</code> creates a new UDP socket, connects it to the socket address specified by <i>hostspec</i> and <i>service</i>, optionally binds it if <i>local-port</i> or <i>local-address</i> are non-<code>nil</code>, and then creates and returns an <code>async-io-state</code> object that can be used to perform I/O operations on the socket. The I/O operations are done using <code>async-io-state-receive-message</code> and <code>async-io-state-send-message</code>.</p> <p><i>hostspec</i> and <i>service</i> are interpreted as described in “Specifying the target for connecting and binding a socket” on page 408.</p> <p><i>local-address</i> and <i>local-port</i> are also interpreted as described in “Specifying the target for connecting and binding a socket” on page 408. Both values can be <code>nil</code>.</p> <p>Connecting the socket affects the destination of messages sent using the <code>async-io-state</code>, and also restricts the origin of received messages.</p> <p>When <i>ipv6</i> is <code>:any</code>, the system selects whether to use an IPv4 or IPv6 socket (normally it will be IPv4). When <i>ipv6</i> is <code>t</code> it forces using IPv6, and <code>nil</code> forces IPv4. The default value of <i>ipv6</i> is <code>:any</code>.</p> <p><i>queue-output</i> controls what happens if you try to perform a write operation on the state while another write operation is</p>

ongoing. When *queue-output* is `nil`, this will cause an error. When *queue-output* is non-`nil`, the second write operation is queued and actually executed later. The default value of *queue-output* is `t`.

*read-timeout*, *write-timeout*, *user-info* and *name* are set in `async-io-state` using the corresponding accessors `async-io-state-read-timeout`, `async-io-state-write-timeout`, `async-io-state-user-info` and `async-io-state-name`.

The default value of *name* is a string "Connected UDP".

When *errorp* is `nil`, `create-async-io-state-and-connected-udp-socket` returns `nil` for run time errors rather than signalling an error. The default value of *errorp* is `t`.

- Notes
1. If you need an unconnected socket, use `create-async-io-state-and-udp-socket`.
  2. The call to `create-async-io-state-and-connected-udp-socket` itself is synchronous.
  3. You cannot use `async-io-state-send-message-to-address` with the result of `create-async-io-state-and-connected-udp-socket` (because the socket address to send to is already specified by connecting.)

- See also
- `async-io-state-receive-message`  
`async-io-state-send-message`  
`create-async-io-state-and-udp-socket`  
“The Async-I/O-State API” on page 412

	<b>Function</b>
<b>create-async-io-state-and-udp-socket</b>	
Summary	Creates an <code>async-io-state</code> where <i>object</i> is an unconnected UDP socket.
Package	<code>comm</code>

Signature	<code>create-async-io-state-and-udp-socket collection &amp;key name errorp ipv6 queue-output read-timeout write-timeout user-info local- address local-port =&gt; result</code>	
Arguments	<code>collection</code>	A <code>wait-state-collection</code> to associate with the returned <code>async-io-state</code> .
	<code>ipv6</code>	One of <code>nil</code> , <code>t</code> , the keyword <code>:any</code> or the keyword <code>:both</code> .
	<code>errorp</code>	A boolean.
	<code>local-address</code> , <code>local-port</code>	Specify the local socket address in the standard way.
	<code>read-timeout</code>	<code>nil</code> or a positive real.
	<code>write-timeout</code>	<code>nil</code> or a positive real.
	<code>user-info</code>	A Lisp object.
	<code>name</code>	A Lisp object.
	<code>queue-output</code>	A boolean.
Values	<code>result</code>	An <code>async-io-state</code> or <code>nil</code> .
Description	<p>The function <code>create-async-io-state-and-udp-socket</code> creates an <code>async-io-state</code> where <i>object</i> is an unconnected UDP socket.</p> <p><code>create-async-io-state-with-udp-socket</code> creates a new UDP socket, optionally binds it if <i>local-port</i> or <i>local-address</i> is non-<code>nil</code>, and then creates and returns an <code>async-io-state</code> object that can be used to perform I/O operations on the socket. The I/O operations are performed using <code>async-io-state-receive-message</code> and <code>async-io-state-send-message-to-address</code>. <i>local-address</i> and <i>local-port</i> specify the local socket address as described in “Specifying the target for connecting and binding a socket” on page 408. Both values can be <code>nil</code>.</p>	

*queue-output* controls what happens if you try to perform a write operation on the state while another write operation is ongoing. When `nil`, this will cause an error. When non-`nil`, the second write operation is queued and actually executed later. The default value of *queue-output* is `t`.

When *ipv6* is `:any`, the system selects whether to use an IPv4 or IPv6 socket (normally it will be IPv4). When *ipv6* is `t` it forces using IPv6, and `nil` forces IPv4. The value `:both` means using IPv6, but also allow receiving messages in IPv4. The default value of *ipv6* is `:any`.

When *errorp* is `nil`, `create-async-io-state-and-udp-socket` returns `nil` for run time errors rather than signalling an error. The default value of *errorp* is `t`.

*read-timeout*, *write-timeout*, *user-info* and *name* are set the new `async-io-state` using the corresponding accessors `async-io-state-read-timeout`, `async-io-state-write-timeout`, `async-io-state-user-info` and `async-io-state-name`.

The default value of *name* is a string "UDP".

## Notes

1. If the socket is used to receive messages from unknown senders (that is as a server), then you need to bind the socket by supplying *local-port*. If the socket is only used to send messages then you do not need to bind it, because the recipient of the messages can find the socket's address if it needs to send a reply. You can supply *local-address* to restrict which connections are allowed.
2. You can find the source address of a message that is received using the result of `create-async-io-state-and-udp-socket` by supplying *needs-address t* to `async-io-state-receive-message`.
3. If you need to connect the socket, use `create-async-io-state-and-connected-udp-socket` instead.

4. The call to `create-async-io-state-and-udp-socket` itself is synchronous.
5. You cannot use `async-io-state-send-message` (without address) with the result of `create-async-io-state-and-udp-socket` (because the socket address to send to must be specified).

Example      `(example-edit-file "async-io/udp")`

See also     `async-io-state-receive-message`  
`async-io-state-send-message-to-address`  
`create-async-io-state-and-connected-udp-socket`  
“The Async-I/O-State API” on page 412

## connect-to-tcp-server *Function*

Summary     Attempts to connect to a socket on a server.

Package     `comm`

Signature    `connect-to-tcp-server hostspec service &key errorp timeout local-address local-port keepalive nodelay ipv6 => handle`

Arguments	<code>hostspec</code>	An integer or a string or an <code>ipv6-address</code> object.
	<code>service</code>	A string or a fixnum.
	<code>errorp</code>	A boolean.
	<code>timeout</code>	A positive number, or <code>nil</code> .
	<code>local-address</code>	<code>nil</code> , an integer, a string or an <code>ipv6-address</code> object.
	<code>local-port</code>	<code>nil</code> , a string or a fixnum.
	<code>keepalive</code>	A generalized boolean.
	<code>nodelay</code>	A generalized boolean.

	<i>ipv6</i>	<code>nil</code> , <code>t</code> or <code>:any</code> .
Values	<i>handle</i>	A handle suitable for a <code>socket-stream</code> or a subclass, or <code>nil</code> .
Description	<p>The function <code>connect-to-tcp-server</code> attempts to connect to a socket on a server and returns a handle for the connection if successful. This handle can then be used as the socket when making a <code>socket-stream</code>.</p> <p>The IP address to connect to is specified by <code>hostspec</code>, and the service to provide is specified by <code>service</code>. These two arguments are interpreted as described in “Specifying the target for connecting and binding a socket” on page 408.</p> <p>If <code>errorp</code> is <code>nil</code>, failure to connect (possibly after <code>timeout</code> seconds) returns <code>nil</code>, otherwise an error is signaled.</p> <p><code>timeout</code> specifies a connection timeout. <code>connect-to-tcp-server</code> waits for at most <code>timeout</code> seconds for the TCP connection to be made. If <code>timeout</code> is <code>nil</code> it waits until the connection attempt succeeds or fails. On failure, <code>connect-to-tcp-server</code> signals an error or returns <code>nil</code> according to the value of <code>errorp</code>. To provide a timeout for reads after the connection is made, see <code>read-timeout</code> in <code>socket-stream</code>. The default value of <code>timeout</code> is <code>nil</code>.</p> <p>If <code>local-address</code> is <code>nil</code> then the operating system chooses the local address of the socket. Otherwise the value is interpreted as for <code>hostspec</code> and specifies the local address of the socket. The default value of <code>local-address</code> is <code>nil</code>.</p> <p>If <code>local-port</code> is <code>nil</code> then the operating system chooses the local port of the socket. Otherwise the string or fixnum value is interpreted as for <code>service</code> and specifies the local port of the socket. The default value of <code>local-port</code> is <code>nil</code>.</p> <p>If <code>keepalive</code> is true, <code>SO_KEEPALIVE</code> is set on the socket. The default value of <code>keepalive</code> is <code>nil</code>.</p>	

If *nodelay* is true, `TCP_NODELAY` is set on the socket. The default value of *nodelay* is t.

*ipv6* specifies the address family to use when *hostspec* is a string. When *ipv6* is :any, `connect-to-tcp-server` uses either of IPv4 or IPv6. When *ipv6* is t, it uses only IPv6 addresses, and when *ipv6* is nil it tries only IPv4. The default value of *ipv6* is :any.

- |       |   |
|-------|---|
| Notes | <ol style="list-style-type: none"> <li>1. On Unix the name of the service can normally be found in <code>/etc/services</code>. If it is not there, the manual entry for services can be used to find it.</li> <li>2. In most situations, <code>open-tcp-stream</code>, which returns a stream rather than a handle, is the more convenient interface. <code>connect-to-tcp-server</code> is useful when want to associate further information with the stream. You can define a subclass of <code>socket-stream</code>, connect using <code>connect-to-tcp-server</code>, and call <code>make-instance</code> with your subclass, passing the <i>handle</i> as the socket.</li> </ol> |
|-------|---|

- |          |  |
|----------|--|
| See also | <a href="#">socket-stream</a><br><a href="#">open-tcp-stream</a> |
|----------|--|

## destroy-ssl

### Function

- |             |  |
|-------------|--|
| Summary     | Frees a <code>ssl</code> .   |
| Package     | <code>comm</code>  |
| Signature   | <code>destroy-ssl ssl-pointer</code>   |
| Arguments   | <code>ssl-pointer</code> A foreign pointer of type <code>ssl-pointer</code> .  |
| Description | The function <code>destroy-ssl</code> frees the <code>ssl</code> pointed to by <code>ssl-pointer</code> and also frees any LispWorks cached values associated with it. |

See also      **ssl-pointer**

**destroy-ssl-ctx**                          *Function*

Summary      Frees a **SSL\_CTX**.

Package      **comm**

Signature      **destroy-ssl-ctx** *ssl-ctx-pointer*

Arguments      *ssl-ctx-pointer*    A foreign pointer of type **ssl-ctx-pointer**.

Description      The function **destroy-ssl-ctx** frees the **SSL\_CTX** pointed to by *ssl-ctx-pointer* and also frees any LispWorks cached values associated with it.

See also      **ssl-ctx-pointer**

**detach-ssl**                          *Function*

Summary      Detaches the SSL from a socket stream.

Package      **comm**

Signature      **detach-ssl** *socket-stream* &**key** *retry-count* *retry-timeout*

Arguments      *socket-stream*    A **socket-stream**.

*retry-count*    A non-negative integer.

*retry-timeout*   A non-negative real.

Description      The function **detach-ssl** detaches the SSL from the socket-stream *socket-stream*. If *socket-stream* is not attached to an SSL, **detach-ssl** just returns immediately. Otherwise, it detaches

the SSL from *socket-stream*, tries to shut down the SSL cleanly, and then frees the objects that were allocated by `attach-ssl`.

*retry-count* specifies how many additional times to call `SSL_shutdown` after the second to attempt to get a successful shutdown. The default value of *retry-count* is 5.

*retry-timeout* specifies the time in seconds to wait between each of the calls to `SSL_shutdown`. If it fails to get a successful shutdown after these attempts, `detach-ssl` signals an error. The default value of *retry-timeout* is 0.1.

Note that the shutdown calls happen after the SSL has been detached from *socket-stream* as far as LispWorks is concerned, so if an error occurs at this point and is aborted, *socket-stream* can be used in `attach-ssl` again (assuming that the peer can cope with this situation).

If *retry-count* is `nil`, `detach-ssl` does not try to get a successful shutdown call. This value is used when the stream is closed, but should not be used normally.

See also      `attach-ssl`

## do-rand-seed

*Function*

Summary      Calls the SSL function `RAND_seed`.

Package      `comm`

Signature      `do-rand-seed`

Arguments      `do-rand-seed` takes no arguments.

Values      `do-rand-seed` returns no values.

Description      The function `do-rand-seed` calls the SSL function `RAND_seed` with some suitable value, which is dependent in a

non-trivial way on the current time, the history of the current process and the history of the machine it is running on.

If the machine that it runs on has the file `/dev/urandom`, `do-rand-seed` does nothing.

See also [attach-ssl](#)

## **ensure-ssl** *Function*

Summary Initializes SSL.

Package `comm`

Signature `ensure-ssl &key library-path already-done`

Arguments `library-path` A string or a list of strings.

`already-done` A generalized boolean.

Description The function `ensure-ssl` initializes SSL. If it was already called in the image, `ensure-ssl` does nothing. Otherwise it loads the library, calls `SSL_library_init`, calls `SSL_load_error_strings` and performs internal initializations.

If `already-done` is true, `ensure-ssl` does only the internal initializations. The default value of `already-done` is `nil`.

If `library-path` is passed, it needs to be either a string, specifying one library, or a list of strings specifying multiple libraries. The default value of `library-path` is platform-specific. The initial default value is described in “How LispWorks locates the OpenSSL libraries” on page 420. This default may be changed by calling `set-ssl-library-path`.

See also [openssl-version](#)  
[set-ssl-library-path](#)

		<i>Function</i>
	<b>get-default-local-ipv6-address</b>	
Summary		Gets the default IPv6 address of the local host.
Package		<code>comm</code>
Signature		<code>get-default-local-ipv6-address =&gt; result</code>
Arguments		None.
Values	<i>result</i>	An <code>ipv6-address</code> object or <code>nil</code> .
Description		The function <code>get-default-local-ipv6-address</code> tries to find the local default IPv6 address and if successful returns it.
See also		<code>ipv6-address</code> <code>get-ip-default-zone-id</code>
	<b>get-host-entry</b>	<i>Function</i>
Summary		Returns address (IPv6 and IPv4) or name information about a given host.
Package		<code>comm</code>
Signature		<code>get-host-entry host &amp;key fields ipv6 v4mapped addrconfig numerichost avoid-reverse-lookup =&gt; field-values</code>
Arguments	<i>host</i>	A number or a string.
	<i>fields</i>	A list of keywords.
	<i>ipv6</i>	<code>nil</code> , <code>t</code> or the keyword <code>:any</code> .
	<i>avoid-reverse-lookup</i>	A generalized boolean.
	<i>v4mapped</i>	A boolean.

	<i>addrconfig</i>	A boolean.
	<i>numerichost</i>	A boolean.
Values	<i>field-values</i>	Values, one for each field.
Description		<p>The function <code>get-host-entry</code> returns address or name information about the given host. By default, it tries to find addresses both of IPv6 and IPv4. It uses whatever host naming services are configured on the current machine. <code>nil</code> is returned if the host is unknown.</p> <p><i>host</i> can be one of the following:</p> <ul style="list-style-type: none"> <li>• a name string, for example "<code>www foobar com</code>"</li> <li>• a dotted inet address string, for example "<code>209.130.14.246</code>"</li> <li>• a integer representing the inet address, for example <code>#xD1820EF6</code></li> </ul> <p><i>fields</i> is a list of keywords describing what information to return for the host. If <code>get-host-entry</code> succeeds, it returns multiple values, one value for each field specified. The following fields are allowed:</p> <ul style="list-style-type: none"> <li><code>:address</code> The primary IP address.</li> <li><code>:ipv6-address</code> The primary IPv6 address.</li> <li><code>:ipv4-address</code> The primary IPv4 address.</li> <li><code>:addresses</code> A list of all the IP addresses.</li> <li><code>:ipv6-addresses</code> A list of all the IPv6 addresses, only.</li> <li><code>:ipv4-addresses</code> A list of all the IPv4 addresses, only.</li> <li><code>:name</code> The primary name as a string.</li> <li><code>:aliases</code> The alias names as a list of strings.</li> </ul>

IPv4 addresses are returned as integers and IPv6 addresses are returned as objects of type `ipv6-address`.

If `ipv6` is `nil` or `t` the search is restricted to one family only IPv4 or IPv6. The default value of `ipv6` is `:any`, meaning that addresses in both families are returned. If the argument `host` is a string, that has a similar effect to using the family-specific keywords, but it may be faster. For example, these two calls returns the same addresses (possibly in a different order):

```
(get-host-entry "hostname"
                :fields '(:ipv6-addresses))

(get-host-entry "hostname"
                :fields '(:addresses) :ipv6 t)
```

If `host` is an address of the other type, that is integer with `ipv6` `t` or `ipv6-address` with `ipv6 nil`, then `get-host-entry` first tries to do a reverse lookup to find the name of the host, and then looks for the values as if it was called with this name as the host.

When `avoid-reverse-lookup` is non-`nil`, `get-host-entry` avoids doing reverse lookup if `host` is a string which specifies a valid address (either IPv6 or IPv4). The default value of `avoid-reverse-lookup` is `nil`, so by default it does the lookup.

The arguments `v4mapped`, `addrconfig` and `numerichost` have an effect only when `host` is a string. They define the flags `AI_V4MAPPED`, `AI_ADDRCONFIG` and `AI_NUMERICHOST` when doing the `getaddrinfo` call.

When `v4mapped` is `t`, the IPv6 addresses contain an IPv4 address mapped to IPv6 (`::ffff:<IPv4>`). The default value of `v4mapped` is `nil`.

When `addrconfig` is `t`, addresses of a family are returned only if the local system is configured to handle them. The default value of `addrconfig` is `nil`.

When `numerichost` is `t`, `host` is assumed to be a numeric address, either IPv4 if dotted notation or IPv6. If it is not,

`get-host-entry` just returns `nil`. Using `numerichost` can speed up `get-host-entry`, because it prevents any DNS lookup. This has an effect only if `avoid-reverse-lookup` is non-`nil`. The default value of `numerichost` is `nil`.

- Notes
1. Although the results of `get-host-entry` are not cached by LispWorks, the Operating System might cache them.
  2. When `get-host-entry` is passed a string specifying an IPv6 address, the address can be followed by '%' character and a scope ID. If the scope ID is a decimal number or a valid interface name on the local system, the resulting address contains the scope ID as a number.

Examples

```
CL-USER 16 > (comm:get-host-entry "www.altavista.com"
                                     :fields '(:address))
3511264349

CL-USER 17 > (comm:get-host-entry 3511264349
                                     :fields '(:name))
"altavista.com"

CL-USER 18 > (comm:get-host-entry "altavista.com"
                                     :fields '(:name
                                               :address
                                               :aliases))
"altavista.com"
3511264349
("www.altavista.com" "www.altavista.com")
```

## get-ip-default-zone-id

## Function

- Summary Gets the default zone ID of the local host.
- Package `comm`
- Signature `get-ip-default-zone-id => result`
- Arguments None.

Values	<i>result</i>	An integer or a string, or <code>nil</code> .
Description	The function <code>get-ip-default-zone-id</code> tries to find the local default zone ID, and if successful returns it as an integer or a string.	
See also	<code>ipv6-address</code> <code>get-default-local-ipv6-address</code>	

## **get-service-entry** *Function*

Summary	Returns information about a service.	
Package	<code>comm</code>	
Signature	<code>get-service-entry service protocol &amp;key fields =&gt; value1, value2, ...</code>	
Arguments	<i>service</i>	An integer or a string.
	<i>protocol</i>	A string or <code>nil</code> .
	<i>fields</i>	A list of keywords specifying which information is required.
Values	<i>value1, value2, ...</i>	Multiple values corresponding to the keywords in <i>fields</i> , as described below.
Description	<p>The function <code>get-service-entry</code> looks up <i>service</i> in the system database. If <i>service</i> is an integer, it is the port number to look up. If <i>service</i> is a string, it is a name to look up (it may be one of the aliases).</p> <p>If <i>protocol</i> is a string, then <code>get-service-entry</code> looks for a system database entry with protocol <i>protocol</i>, otherwise it finds the first entry with any protocol.</p> <p><i>fields</i> specifies which information is returned. When <code>get-service-entry</code> finds an entry, it returns information about it</p>	

as multiple values corresponding to the keywords in *fields*. These keywords can be:

- `:name`      Return the name of the entry.
- `:port`      Return the port number of the entry.
- `:aliases`      Return a list of aliases of the service.
- `:protocol`      Return the protocol of the entry, as lower-case strings like "tcp" or "udp".

If *service* is an integer then the default value of *fields* is `(:name)`. Otherwise the default value of *fields* is `(:port)`.

- Notes
- 1. `get-service-entry` tells you what the host computer knows. The results can be quite different between computers.
  - 2. There can be multiple entries with the same name but different protocols. Many services have entries for both UDP and TCP, normally with the same port number. In many cases the protocol that is selected when you pass *protocol nil* is not the correct protocol to use.

- Examples
- ```
(get-service-entry "smtp" nil) => 25
(get-service-entry 25 nil :fields '(:name :aliases)) =>
"smtp", ("mail")
(get-service-entry "mail" nil) => 25
```

- See also
- "Specifying the target for connecting and binding a socket" on page 408

## get-socket-address

## *Function*

- Summary
- Returns the local address and port number of a given socket.
- Package
- `comm`

|             |                                                                                                            |                                                                            |
|-------------|------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|
| Signature   | <code>get-socket-address socket =&gt; address, port</code>                                                 |                                                                            |
| Arguments   | <code>socket</code>                                                                                        | A socket handle.                                                           |
| Values      | <code>address</code>                                                                                       | The local host address of the socket or <code>nil</code> if not connected. |
|             | <code>port</code>                                                                                          | The local port number of the socket or <code>nil</code> if not connected.  |
| Description | The function <code>get-socket-address</code> returns the local address of a connected socket.              |                                                                            |
| Notes       | Connected sockets have two addresses, local and remote.                                                    |                                                                            |
| See also    | <a href="#"><code>get-socket-peer-address</code></a><br><a href="#"><code>socket-stream-address</code></a> |                                                                            |

## get-socket-peer-address *Function*

|             |                                                                                                     |                                                                             |
|-------------|-----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| Summary     | Returns the remote address and port number of a given socket.                                       |                                                                             |
| Package     | <code>comm</code>                                                                                   |                                                                             |
| Signature   | <code>get-socket-peer-address socket =&gt; address, port</code>                                     |                                                                             |
| Arguments   | <code>socket</code>                                                                                 | A socket handle.                                                            |
| Values      | <code>address</code>                                                                                | The remote host address of the socket or <code>nil</code> if not connected. |
|             | <code>port</code>                                                                                   | The remote port number of the socket or <code>nil</code> if not connected.  |
| Description | The function <code>get-socket-peer-address</code> returns the remote address of a connected socket. |                                                                             |

Notes        Connected sockets have two addresses, local and remote.

See also     **get-socket-address**  
             **socket-stream-peer-address**

## get-verification-mode                                  *Function*

Summary      Returns the mode of the SSL.

Package      **comm**

Signature     **get-verification-mode ssl-or-ssl-ctx => result**

Arguments    **ssl-or-ssl-ctx**    A foreign pointer of type **ssl-pointer** or  
**ssl-ctx-pointer**.

Values        **result**        A list of symbols.

Description     The function **get-verification-mode** returns the mode of  
the **ssl-pointer** or **ssl-ctx-pointer** as a list of symbols.  
  
*result* is a list containing zero or more of the symbols **:verify-client-once**, **:verify-peer** and **:fail-if-no-peer-cert**, corresponding to the C constants  
**VERIFY\_CLIENT\_ONCE** **VERIFY\_PEER** and  
**FAIL\_IF\_NO\_PEER\_CERT** respectively.

See also      **set-verification-mode**

## ip-address-string                                  *Function*

Summary      Returns the IP address string for an IP address. This can be  
either a dotted address for an integer representing an IPv4  
address, or an IPv6 address string for **ipv6-address**.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>comm</code>                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Signature   | <code>ip-address-string ip-address =&gt; string-ip-address</code>                                                                                                                                                                                                                                                                                                                                                                                   |
| Arguments   | <code>ip-address</code> An integer or an <code>ipv6-address</code> .                                                                                                                                                                                                                                                                                                                                                                                |
| Values      | <code>string-ip-address</code> A string, either dotted string format for an integer or an IPv6 string for <code>ipv6-address</code> .                                                                                                                                                                                                                                                                                                               |
| Description | <p>The function <code>ip-address-string</code> converts its argument to a string in the standard dotted IP address notation <code>a.b.c.d</code>.</p> <p>The function <code>ip-address-string</code> converts its argument to a string in the standard IP address notation. For an IPv4 address (supplied as an integer) this is the <code>a.b.c.d</code> notation. For IPv6 it is the standard IPv6 address notation (not including scope ID).</p> |
| See also    | <code>string-ip-address</code>                                                                                                                                                                                                                                                                                                                                                                                                                      |

|             | Type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Represents IPv6 addresses.                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Package     | <code>comm</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Description | <p>Objects of type <code>ipv6-address</code> represent an IPv6 address. <code>ipv6-address</code> objects are normally created by <code>get-host-entry</code>. They can also be created by <code>parse-ipv6-address</code>.</p> <p><code>ipv6-address</code> can be used wherever an IP address is needed, most commonly <code>open-tcp-stream</code>.</p> <p><code>ipv6-address</code> may contain a scope ID, which is not really part of the address, but is needed for using local addresses.</p> |

The string representation of an `ipv6-address` can be retrieved by `ip-address-string`. The scope ID can be accessed by `ipv6-address-scope-id`.

See also `get-host-entry`  
`ipv6-address-p`  
`ip-address-string`  
`ipv6-address-scope-id`  
`parse-ipv6-address`

## **ipv6-address-p** *Function*

Summary The predicate for objects of type `ipv6-address`.

Package `comm`

Signature `ipv6-address-p object => result`

Arguments `object` A Lisp object.

Values `result` A boolean.

Description The function `ipv6-address-p` is the predicate for whether its argument `object` is of type `ipv6-address`.

See also `ipv6-address`

## **ipv6-address-scope-id** *Function*

Summary Returns the scope ID of an IPv6 address.

Package `comm`

Signature `ipv6-address-scope-id ipv6-address => scope-id`

|             |                                                                                                                                                                                                             |                                      |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| Arguments   | <i>ipv6-address</i>                                                                                                                                                                                         | An <code>ipv6-address</code> object. |
| Values      | <i>scope-id</i>                                                                                                                                                                                             | A number or a string.                |
| Description | The function <code>ipv6-address-scope-id</code> returns the scope ID of the IPv6 address <i>ipv6-address</i> .<br><br>Global addresses have scope ID 0.<br><br><i>scope-id</i> may be a string or a number. |                                      |
| See also    |                                                                                                                                                                                                             | <code>ipv6-address</code>            |

## **ipv6-address-string** *Function*

|             |                                                                                                          |                                      |
|-------------|----------------------------------------------------------------------------------------------------------|--------------------------------------|
| Summary     | Returns the standard string representation of an IPv6 address.                                           |                                      |
| Package     | <code>comm</code>                                                                                        |                                      |
| Signature   | <code>ipv6-address-string</code>                                                                         | <i>ipv6-address =&gt; string</i>     |
| Arguments   | <i>ipv6-address</i>                                                                                      | An <code>ipv6-address</code> object. |
| Values      | <i>string</i>                                                                                            | A string.                            |
| Description | The function <code>ipv6-address-string</code> returns the standard string representation of the address. |                                      |
| Notes       | The result <i>string</i> does not include the scope ID.                                                  |                                      |
| See also    | <code>ip-address-string</code>                                                                           |                                      |

## **make-ssl-ctx** *Function*

|         |                                      |
|---------|--------------------------------------|
| Summary | Makes a <code>SSL_CTX</code> object. |
|---------|--------------------------------------|

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>comm</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Signature   | <code>make-ssl-ctx &amp;key ssl-ctx ssl-side =&gt; ssl-ctx-ptr</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Arguments   | <p><code>ssl-ctx</code> A symbol or a foreign pointer.</p> <p><code>ssl-side</code> One of the keywords <code>:client</code>, <code>:server</code> or <code>:both</code>.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Values      | <code>ssl-ctx-ptr</code> A foreign pointer of type <code>ssl-ctx-pointer</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Description | <p>The function <code>make-ssl-ctx</code> first calls <code>ensure-ssl</code>, and returns a foreign pointer of type <code>ssl-ctx-pointer</code>.</p> <p>If the value of <code>ssl-ctx</code> is <code>t</code>, <code>:default</code>, <code>:v2</code>, <code>:v3</code>, <code>:v23</code> or <code>:tls-v1</code>, <code>make-ssl-ctx</code> creates a <code>SSL_CTX</code> object and returns a pointer to it.</p> <p>The value of <code>ssl-ctx</code> can also be a foreign pointer of type <code>ssl-ctx-pointer</code>, in which case it is simply returned. If <code>ssl-ctx</code> is a foreign pointer of type <code>ssl-pointer</code>, then <code>make-ssl-ctx</code> signals an error.</p> <p>The meaning of the keyword arguments <code>ssl-ctx</code> and <code>ssl-side</code> is as described for <code>socket-stream</code>. The default value of <code>ssl-ctx</code> is <code>t</code> and the default value of <code>ssl-side</code> is <code>:server</code>.</p> |
| See also    | <code>ensure-ssl</code><br><code>socket-stream</code><br><code>ssl-ctx-pointer</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

|           | <i>Function</i>                                                          |
|-----------|--------------------------------------------------------------------------|
| Summary   | Loops processing a <code>wait-state-collection</code> .                  |
| Package   | <code>comm</code>                                                        |
| Signature | <code>loop-processing-wait-state-collection wait-state-collection</code> |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arguments   | <code>wait-state-collection</code><br><br>A <code>wait-state-collection</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Description | The function <code>loop-processing-wait-state-collection</code> loops processing <code>wait-state-collection</code> .<br><br><code>loop-processing-wait-state-collection</code> loops waiting for any state to be ready (using <code>wait-for-wait-state-collection</code> ) and processes any state that is ready (using <code>call-wait-state-collection</code> ). It establishes restarts that allow aborting back into the loop, and a mechanism that allows <code>wait-state-collection-stop-loop</code> to stop the loop.<br><br>If <code>wait-state-collection-stop-loop</code> is called on the <code>wait-state-collection</code> , which can be from other threads, <code>wait-state-collection-stop-loop</code> stops looping and returns. |
| Notes       | In most cases using <code>create-and-run-wait-state-collection</code> is more convenient.<br><br>There can be only one <code>loop-processing-wait-state-collection</code> on each <code>wait-state-collection</code> at a time. Typically this will occur in a process that is made specifically to run <code>loop-processing-wait-state-collection</code> on the collection.                                                                                                                                                                                                                                                                                                                                                                         |
| See also    | <code>create-and-run-wait-state-collection</code><br><code>wait-for-wait-state-collection</code><br><code>wait-state-collection-stop-loop</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

|           | <b>make-wait-state-collection</b>                        | <i>Function</i> |
|-----------|----------------------------------------------------------|-----------------|
| Summary   | Returns a new empty <code>wait-state-collection</code> . |                 |
| Package   | <code>comm</code>                                        |                 |
| Signature | <code>make-wait-state-collection =&gt; collection</code> |                 |

|             |                                                                                                         |                                  |
|-------------|---------------------------------------------------------------------------------------------------------|----------------------------------|
| Values      | <i>collection</i>                                                                                       | A <b>wait-state-collection</b> . |
| Description | The function <code>make-wait-state-collection</code> returns a new empty <b>wait-state-collection</b> . |                                  |
| See also    | <code>create-and-run-wait-state-collection</code><br>“The Async-I/O-State API” on page 412              |                                  |

## open-tcp-stream *Function*

|           |                                                                                                                                                                                                                                                                                                           |                                                                         |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| Summary   | Attempts to connect to a socket on a server and returns a stream object for the connection.                                                                                                                                                                                                               |                                                                         |
| Package   | <code>comm</code>                                                                                                                                                                                                                                                                                         |                                                                         |
| Signature | <code>open-tcp-stream hostspec service &amp;key direction element-type<br/>     errorp read-timeout write-timeout timeout ssl-ctx ctx-configure-<br/>     callback ssl-configure-callback handshake-timeout tlsext-host-name<br/>     local-address ipv6 local-port nodelay keepalive =&gt; stream</code> |                                                                         |
| Arguments | <i>hostspec</i>                                                                                                                                                                                                                                                                                           | An integer or string or an <code>ipv6-address</code> object.            |
|           | <i>service</i>                                                                                                                                                                                                                                                                                            | A string or a fixnum.                                                   |
|           | <i>direction</i>                                                                                                                                                                                                                                                                                          | One of <code>:input</code> , <code>:output</code> or <code>:io</code> . |
|           | <i>element-type</i>                                                                                                                                                                                                                                                                                       | <code>base-char</code> or a subtype of <code>integer</code> .           |
|           | <i>errorp</i>                                                                                                                                                                                                                                                                                             | A boolean.                                                              |
|           | <i>read-timeout</i>                                                                                                                                                                                                                                                                                       | A positive number, or <code>nil</code> .                                |
|           | <i>write-timeout</i>                                                                                                                                                                                                                                                                                      | A positive number, or <code>nil</code> .                                |
|           | <i>timeout</i>                                                                                                                                                                                                                                                                                            | A positive number, or <code>nil</code> .                                |
|           | <i>ssl-ctx</i>                                                                                                                                                                                                                                                                                            | A symbol or a foreign pointer.                                          |

*ctx-configure-callback*

A function designator or `nil`. The default value is `nil`.

*ssl-configure-callback*

A function designator or `nil`. The default value is `nil`.

*handshake-timeout*

A `real` or `nil` (the default).

*tlsext-host-name* A string, `t` or `nil`.

*local-address* `nil`, an integer, a string or a `ipv6-address` object.

*ipv6* `nil`, `t` or `:any`.

*local-port* `nil`, a string or a fixnum.

*nodelay* A generalized boolean.

*keepalive* A generalized boolean.

Values      *stream*      A `socket-stream`.

Description      The function `open-tcp-stream` attempts to connect to a socket on a server and returns *stream* for the connection if successful.

The IP address to connect to is specified by *hostspec*, and the service to provide is specified by *service*. These two arguments are interpreted as described in “Specifying the target for connecting and binding a socket” on page 408.

The direction of the connection is given by *direction*. Its default value is `:io`. The element type of the connection is determined from *element-type*, and is `base-char` by default.

If *errorp* is `nil`, failure to connect (possibly after *timeout* seconds) returns `nil`, otherwise an error is signaled.

*timeout* specifies a connection timeout. `open-tcp-stream` waits for at most *timeout* seconds for the TCP connection to be made. If *timeout* is `nil` it waits until the connection attempt succeeds or fails. On failure, `open-tcp-stream` signals an error or returns `nil` according to the value of *errorp*. To provide a timeout for reads after the connection is made, see *read-timeout*. The default value of *timeout* is `nil`.

*read-timeout* specifies the read timeout of the stream. If it is `nil` (the default), the stream does not time out during reads, and these may hang. See `socket-stream` for more details. To provide a connection timeout, see *timeout*.

*write-timeout* is similar to *read-timeout*, but for writes. See `socket-stream` for more details.

`ssl-ctx`, `ctx-configure-callback`, `ssl-configure-callback` and `handshake-timeout` are interpreted as described in “Keyword arguments for use with SSL” on page 421. Unlike the other ways of creating a socket stream with SSL processing, `open-tcp-stream` does not take the `ssl-side` argument and always uses the value `:client`.

If `tlsext-host-name` is a string, then the SNI extension in the SSL connection to set to its value. If `tlsext-host-name` is `t` and `hostspec` is a string, then the SNI extension in the SSL connection to set to `hostspec`.

If `local-address` is `nil` then the operating system chooses the local address of the socket. Otherwise the value is interpreted as for `hostspec` and specifies the local address of the socket. The default value of `local-address` is `nil`.

If `local-port` is `nil` then the operating system chooses the local port of the socket. Otherwise the string or fixnum value is interpreted as for `service` and specifies the local port of the socket. The default value of `local-port` is `nil`.

`ipv6` specifies the address family to use when `hostspec` is a string. When `ipv6` is `:any`, `open-tcp-stream` uses either of IPv4 or IPv6. When `ipv6` is `t`, it uses only IPv6 addresses, and

when `ipv6` is `nil` it tries only IPv4. The default value of `ipv6` is `:any`.

If `keepalive` is true, `SO_KEEPALIVE` is set on the socket. The default value of `keepalive` is `nil`.

If `nodelay` is true, `TCP_NODELAY` is set on the socket. The default value of `nodelay` is `t`.

- |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes   | <ol style="list-style-type: none"><li>1. On Unix the name of the service can normally be found in <code>/etc/services</code>. If it is not there, the manual entry for services can be used to find it.</li><li>2. If <code>switch-open-tcp-stream-with-ssl-to-java</code> was called with its argument on non-nil or not supplied, when <code>SSL-CTX</code> is non-nil open-tcp-stream uses Java sockets instead of ordinary sockets. This is the default behavior on Android, because OpenSSL is not available on Android. The resulting streams have some limitations, most importantly <code>c1:listen</code> is not reliable on them. They also verify the host, which ordinary sockets do not currently do, in the same way that the default in <code>open-tcp-stream-using-java</code> does. See “Socket streams with Java sockets and SSL on Android” on page 432 for a full description, and <code>open-tcp-stream-using-java</code> for details about verification and which keywords are used.</li></ol> |
| Example | The following example opens an HTTP connection to a given host, and retrieves the root page:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

```

(with-open-stream (http (comm:open-tcp-stream
                           "www.lispworks.com" 80))
  (format http "GET / HTTP/1.0~C~C~C"
          (code-char 13) (code-char 10)
          (code-char 13) (code-char 10))
  (force-output http)
  (write-string "Waiting to reply...")
  (loop for ch = (read-char-no-hang http nil :eof)
        until ch
        do (write-char #\.)
        (sleep 0.25)
        finally (unless (eq ch :eof)
                  (unread-char ch http)))
  (terpri)
  (loop for line = (read-line http nil nil)
        while line
        do (write-line line)))

```

|          |                                                                                                                                                                                                                                                                                                                        |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| See also | <a href="#">connect-to-tcp-server</a><br><a href="#">start-up-server</a><br><a href="#">socket-stream</a><br><a href="#">socket-stream-shutdown</a><br><a href="#">switch-open-tcp-stream-with-ssl-to-java</a><br><a href="#">open-tcp-stream-using-java</a><br>“TCP and UDP socket communication and SSL” on page 407 |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## open-tcp-stream-using-java *Function*

|           |                                                                                                                                                                                                                                                                                                     |                                                              |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
| Summary   | Open a TCP stream using Java sockets for communication.                                                                                                                                                                                                                                             |                                                              |
| Package   | <code>comm</code>                                                                                                                                                                                                                                                                                   |                                                              |
| Signature | <code>open-tcp-stream-using-java <i>hostspec service</i> &amp;key <i>factory verify direction element-type errorp read-timeout write-timeout timeout ssl-ctx ctx-configure-callback ssl-configure-callback tlsext-host-name local-address ipv6 local-port nodelay keepalive -&gt; stream</i></code> |                                                              |
| Arguments | <i>hostspec</i>                                                                                                                                                                                                                                                                                     | An integer or string or an <code>ipv6-address</code> object. |
|           | <i>service</i>                                                                                                                                                                                                                                                                                      | A string or a fixnum.                                        |

|             |                                                                                                               |                                                                                                                                |
|-------------|---------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
|             | <i>factory</i>                                                                                                | A Java socket factory.                                                                                                         |
|             | <i>verify</i>                                                                                                 | <code>t</code> , <code>nil</code> , <code>:strict</code> , <code>:browser-compat</code> , a string or a <code>jobject</code> . |
|             | <i>direction</i>                                                                                              | One of <code>:input</code> , <code>:output</code> or <code>:io</code> .                                                        |
|             | <i>element-type</i>                                                                                           | <code>base-char</code> or a subtype of <code>integer</code> .                                                                  |
|             | <i>errorp</i>                                                                                                 | A boolean.                                                                                                                     |
|             | <i>read-timeout</i>                                                                                           | A positive number, or <code>nil</code> .                                                                                       |
|             | <i>write-timeout</i>                                                                                          | Ignored.                                                                                                                       |
|             | <i>timeout</i>                                                                                                | A positive number, or <code>nil</code> .                                                                                       |
|             | <i>ssl-ctx</i>                                                                                                | A generalized boolean.                                                                                                         |
|             | <i>ctx-configure-callback</i>                                                                                 |                                                                                                                                |
|             |                                                                                                               | Ignored.                                                                                                                       |
|             | <i>ssl-configure-callback</i>                                                                                 |                                                                                                                                |
|             |                                                                                                               | Ignored.                                                                                                                       |
|             | <i>tlsext-host-name</i>                                                                                       | Ignored.                                                                                                                       |
|             | <i>local-address</i>                                                                                          | <code>nil</code> , an integer, a string or a <code>ipv6-address</code> object.                                                 |
|             | <i>local-port</i>                                                                                             | <code>nil</code> , a string or a fixnum.                                                                                       |
|             | <i>ipv6</i>                                                                                                   | Ignored.                                                                                                                       |
|             | <i>nodelay</i>                                                                                                | A generalized boolean.                                                                                                         |
|             | <i>keepalive</i>                                                                                              | A generalized boolean.                                                                                                         |
| Values      | <i>stream</i>                                                                                                 | A <code>socket-stream</code> .                                                                                                 |
| Description | The function <code>open-tcp-stream-using-java</code> opens a TCP stream using Java sockets for communication. |                                                                                                                                |

**Note:** `open-tcp-stream-using-java` does not have any clear advantage over `open-tcp-stream`. Use it only when you really need it.

`open-tcp-stream-using-java` accepts the same arguments as `open-tcp-stream`, plus `factory` and `verify`, but ignores the values of `write-timeout`, `ipv6`, `ctx-configure-callback`, `ssl-configure-callback` and `tlsext-host-name`. It also treats `ssl-ctx` as a generalized boolean, where any non-nil value means using SSL Java object.

`open-tcp-stream-using-java` opens and returns a `socket-stream` like `open-tcp-stream`, but the socket object that it uses is a Java object. However, `c1:listen` is unreliable on such streams, and they cannot be used in `wait-for-input-streams`. See “Socket streams with Java sockets and SSL on Android” on page 432 for details.

The keyword argument `factory` can be used to specify the socket factory to use to create the Java socket. When passed, it must be a Java socket factory, that is a `jobject` which is an instance of class `javax.net.SocketFactory`. In this case the socket is generated from this factory, the factory determines whether it is a SSL socket or not, and the value of `ssl-ctx` is used only to decide whether to do a handshake. By default, the default factory (the result of `"getDefault"`) of `javax.net.SocketFactory` (when `ssl-ctx` is nil) or `javax.net.ssl.SSLSocketFactory` (when `ssl-ctx` is non-nil) is used.

The keyword argument `verify` is used only when `ssl-ctx` is non-nil. It controls verification of `hostspec` when SSL is used, which means checking that the certificate that was returned by the server is for this server. The default value `t` means using `SSLCertificateSocketFactory` on Android when `factory` is not supplied (see below), on other platforms it is the same as `:strict`. `:strict` mean uses the strict verifier (Java class `org.apache.http.conn.ssl.StrictHostnameVerifier`). `:browser-compat` means using "browser compatible"

verifier (Java class `org.apache.http.conn.ssl.BrowserCompatHostnameVerifier`). Verification with `:browser-compat` is a little more relaxed than with `:strict`.

On Android when `verify` is `t` and `factory` is `nil`, the code uses the socket factory `android.net.SSLCertificateSocketFactory` (instead of the default of `javax.net.ssl.SSLSocketFactory`), which is doing the verification itself. When `factory` is non-`nil`, Android does the same as in the previous paragraph (`verify` using the strict verifier). The `SSLCertificateSocketFactory` has the advantage that it uses SNI (Server Name Indication), which makes verification work better.

When `verify` is a string, it has to be the hostname to use for verification, instead of the `hostspec` argument. The verification is done using the strict verifier.

When `verify` is a `jobject`, it must be a verifier (of class `javax.net.ssl.HostnameVerifier`), and it is used as-is.

The verifier classes above are part of `httpclient` from `apache.org`, and therefore to use them (which is the default when using SSL), you need to have `httpclient`. On Android it is always available, so it is not an issue, on another architectures it needs to be added to the class path.

When `verify` is `nil`, the `hostspec` is not verified, which is not recommended. However, there are valid sites which will fail verification, because they return a certificate for the wrong site (that happens due to use of virtual hosts). At the time of writing, "`gmail.com`" is one of them, and returns a certificate for "`mail.google.com`". However, if the client uses SNI, which is used by Java socket in Java 1.7 or higher, this server does return the correct certificate, and in general all servers should work when using SNI. On Android the default setting uses the `SSLCertificateSocketFactory` (discussed above), which is using SNI. Thus there is a problem only when using Java 1.6 or earlier, and for Android only when you use your

own factory. For these cases, you can either use `verify nil`, or pass the name in the certificate as the `verify` argument:

```
(comm:open-tcp-stream-using-java "gmail.com" 443 :ssl-  
ctx t :verify "mail.google.com")
```

Note however that this will fail if SNI is used.

Notes

1. The Java virtual machine (JVM) must be running for `open-tcp-stream-using-java` to work. On Android the JVM always runs, on other architectures it needs to have been started by `init-java-interface`. When using `ssl-ctx`, `httpclient` must be available too, and again it is always available on Android.
2. On Android, or if you call `switch-open-tcp-stream-with-ssl-to-java`, `open-tcp-stream` uses Java objects for SSL streams. The result of `open-tcp-stream` and `open-tcp-stream-using-java` with `ssl-ctx` non-nil is identical in this case.
3. Using Java sockets was added mainly for SSL streams on Android. It may be useful in other circumstances.
4. You can also make a `socket-stream` with a Java socket by passing the Java socket that your code has created to `(make-instance 'socket-stream ...)`. Note that closing such a stream will close the socket, and if you want to avoid that you need to use `replace-socket-stream-socket`.

See also

“Socket streams with Java sockets and SSL on Android” on

page 432

`open-tcp-stream`

**openssl-version**

*Function*

Summary

Returns the version of the loaded OpenSSL library.

|             |                                                                                                                                                                        |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>comm</code>                                                                                                                                                      |
| Signature   | <code>openssl-version &amp;optional what =&gt; result</code>                                                                                                           |
| Arguments   | <code>what</code> One of the keywords <code>:version</code> , <code>:directory</code> , <code>:platform</code> , <code>:cflags</code> and <code>:built-on</code> .     |
| Values      | <code>result</code> A string.                                                                                                                                          |
| Description | The function <code>openssl-version</code> returns a string specifying the version of the loaded OpenSSL library.<br>The argument <code>what</code> takes these values: |
|             | <code>:version</code> <code>result</code> is the version string, which looks like:<br>"OpenSSL 0.9.7i 14 Oct 2005" or<br>"OpenSSL 0.9.8a 11 Oct 2005"                  |
|             | <code>:built-on</code> Returns a string specifying when it was built.                                                                                                  |
|             | <code>:directory</code> Returns where OpenSSL thinks it is installed.                                                                                                  |
|             | <code>:platform</code> Returns OpenSSL's idea of which platforms it is.                                                                                                |
|             | <code>:cflags</code> The compilation command.                                                                                                                          |
|             | The default value of <code>what</code> is <code>:version</code> .                                                                                                      |

See also      `ensure-ssl`

| <b>parse-ipv6-address</b> | <i>Function</i>                     |
|---------------------------|-------------------------------------|
| Summary                   | Parses a string as an IPv6 address. |
| Package                   | <code>comm</code>                   |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                           |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| Signature   | <code>parse-ipv6-address string &amp;key start end trim-whitespace =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                           |
| Arguments   | <i>string</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | A string.                                                 |
|             | <i>start, end</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Bounding index designators of string.                     |
|             | <i>trim-whitespace</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | A boolean.                                                |
| Values      | <i>result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | An <code>ipv6-address</code> object or <code>nil</code> . |
| Description | <p>The function <code>parse-ipv6-address</code> parses its argument string as an IPv6 address if possible, otherwise it returns <code>nil</code>. <i>start</i> and <i>end</i> specify the subsequence of <i>string</i> to parse. The default value of <i>start</i> is 0. The default value of <i>end</i> is <code>nil</code>, meaning the length of <i>string</i>.</p> <p><i>trim-whitespace</i> is a boolean specifying that leading and trailing whitespace characters may be ignored. Note that the address itself must not contain any whitespace. The default value of <i>trim-whitespace</i> is <code>t</code>.</p> <p>The address has to be in either standard IPv6 address notation, or dotted-quad notation. It can have the standard simplifications.</p> <p>In addition, the address may be followed by a '%' character and a scope ID. If the scope ID is a string of decimal characters, it is read as a decimal number, otherwise it is taken as-is. The address may also be followed by a '/' and a prefix length in decimal format. The result <code>ipv6-address</code> object remembers the prefix length and prints it when the object is printed, but it does not affect the address otherwise.</p> <p>If the syntax of the string <i>string</i> is correct, <code>parse-ipv6-address</code> constructs the <code>ipv6-address</code> object and returns it. It does not perform any address resolution.</p> |                                                           |
| See also    | <a href="#"><code>get-host-entry</code></a><br><a href="#"><code>string-ip-address</code></a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                           |

| <b>pem-read</b>      | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                      |           |                 |                        |                    |                                 |                 |                                              |               |                        |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-----------|-----------------|------------------------|--------------------|---------------------------------|-----------------|----------------------------------------------|---------------|------------------------|
| Summary              | An interface to the SSL <code>PEM_read_bio_*</code> functions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                      |           |                 |                        |                    |                                 |                 |                                              |               |                        |
| Package              | <code>comm</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                      |           |                 |                        |                    |                                 |                 |                                              |               |                        |
| Signature            | <code>pem-read <i>thing-to-read</i> <i>filename</i> &amp;key <i>pass-phrase</i> <i>callback</i> <i>errorp</i> =&gt; <i>result</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                      |           |                 |                        |                    |                                 |                 |                                              |               |                        |
| Arguments            | <table> <tr> <td><i>thing-to-read</i></td> <td>A string.</td> </tr> <tr> <td><i>filename</i></td> <td>A pathname designator.</td> </tr> <tr> <td><i>pass-phrase</i></td> <td>A string, or <code>nil</code>.</td> </tr> <tr> <td><i>callback</i></td> <td>A function designator, or <code>nil</code>.</td> </tr> <tr> <td><i>errorp</i></td> <td>A generalized boolean.</td> </tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <i>thing-to-read</i> | A string. | <i>filename</i> | A pathname designator. | <i>pass-phrase</i> | A string, or <code>nil</code> . | <i>callback</i> | A function designator, or <code>nil</code> . | <i>errorp</i> | A generalized boolean. |
| <i>thing-to-read</i> | A string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                      |           |                 |                        |                    |                                 |                 |                                              |               |                        |
| <i>filename</i>      | A pathname designator.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                      |           |                 |                        |                    |                                 |                 |                                              |               |                        |
| <i>pass-phrase</i>   | A string, or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                      |           |                 |                        |                    |                                 |                 |                                              |               |                        |
| <i>callback</i>      | A function designator, or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                      |           |                 |                        |                    |                                 |                 |                                              |               |                        |
| <i>errorp</i>        | A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                      |           |                 |                        |                    |                                 |                 |                                              |               |                        |
| Values               | <i>result</i> A foreign pointer or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                      |           |                 |                        |                    |                                 |                 |                                              |               |                        |
| Description          | <p>The function <code>pem-read</code> is an interface to the <code>PEM_read_bio_*</code> set of functions. See the manual entry for <code>pem</code> for specifications of these functions.</p> <p><i>thing-to-read</i> defines which function is required. <code>pem-read</code> concatenates <i>thing-to-read</i> with the string " <code>PEM_read_bio_</code>" to form the name of the <code>pem</code> function to call.</p> <p><i>filename</i> specifies the file to load.</p> <p>If <i>pass-phrase</i> is non-nil, it must be a string, which is passed to the <code>pem</code> function. The default value of <i>pass-phrase</i> is <code>nil</code>.</p> <p>If <i>callback</i> is non-nil, it must be a function with signature:</p> <pre><code>callback <i>maximum-length</i> <i>rwflag</i> =&gt; <i>pass-phrase</i></code></pre> <p>where <i>maximum-length</i> is an integer, <i>rwflag</i> is a boolean and <i>pass-phrase</i> is the pass-phrase to use. The default value of <i>callback</i> is <code>nil</code>, but you cannot pass non-nil values for both <i>pass-phrase</i> and <i>callback</i>.</p> |                      |           |                 |                        |                    |                                 |                 |                                              |               |                        |

If it succeeds, `pem-read` returns a foreign pointer to the structure that was returned by the `pem` function. If `pem-read` fails, if `errorp` is non-nil it signals an error, otherwise it returns `nil`. The default value of `errorp` is `nil`.

## **read-dhparams** *Function*

**Summary**     Reads or uses cached SSL DH parameters.

**Package**     `comm`

**Signature**     `read-dhparams filename &key pass-phrase callback errorp force => dh-ptr`

**Arguments**     `filename`         A pathname designator.

`pass-phrase`     A string, or `nil`.

`callback`      A function designator, or `nil`.

`errorp`        A generalized boolean.

`force`         A generalized boolean.

**Values**        `dh-ptr`      A foreign pointer or `nil`.

**Description**     The function `read-dhparams` reads or uses cached DH parameters.

`filename` specifies the file to check.

Unless `force` is true, `read-dhparams` checks whether the file `filename` has already been loaded, and if it has been loaded, uses the cached value.

If `force` is true, or if there is no cached value for `filename`, `read-dhparams` loads the file by calling `pem-read` with `thing-to-read` argument "DHparams", `pass-phrase`, `callback` and `errorp`. `read-dhparams` caches and returns a foreign pointer to the

resulting DH structure (that is, a pointer corresponding to the C type `DH*`).

If `read-dhparams` fails to load the file `filename`, if `errorp` is true it signals an error, otherwise it returns `nil`. The default value of `errorp` is `t`.

See also [pem-read](#)

## **replace-socket-stream-socket** *Function*

**Summary**      Replaces the socket in a `socket-stream`, returning the existing socket object without closing it.

**Package**      `comm`

**Signature**      `replace-socket-stream-socket socket-stream socket => socket-or-nil`

**Arguments**      `socket-stream`    A `socket-stream`.

`socket`            A socket object or `nil`.

**Values**            `socket-or-nil`    A socket object or `nil`.

**Description**      The function `replace-socket-stream-socket` replaces the socket in the `socket-stream` `socket-stream`, returning the existing socket object without closing it.

A socket object is normally a socket in the native operating system sense (an integer representing an `fd` socket on Unix, and an integer representing `SOCKET` on Microsoft Windows), but when using the Java interface it can also be a Java socket (`jobject` of class `java.net.Socket`).

`replace-socket-stream-socket` sets the socket in `socket-stream` to the argument `socket`, and then returns the old socket object without closing it.

|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | <ol style="list-style-type: none"> <li>1. Getting the old socket using the <code>socket-stream</code> accessor <code>socket-stream-socket</code> and then using <code>(setf socket-stream-socket)</code> to set the new one is different, because the <code>cl:setf</code> will close the old socket.</li> <li>2. Passing <code>nil</code> as the socket allows you to close the stream while retaining the socket.</li> <li>3. The new socket does not need to be the same kind of socket as the old one.</li> </ol> |
| See also | <code>socket-stream</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

## server-terminate *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                        |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|
| Summary     | Terminates a server.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                        |
| Package     | <code>comm</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                        |
| Signature   | <code>server-terminate &amp;optional process =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                        |
| Arguments   | <code>process</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | A <code>mp:process</code> object or <code>nil</code> . |
| Values      | <code>result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A boolean.                                             |
| Description | <p>The function <code>server-terminate</code> terminates a server process. If <code>process</code> is a process object it must be the result of a call to <code>start-up-server</code>. <code>server-terminate</code> terminates it, and frees all the associated resources.</p> <p>If <code>process</code> is <code>nil</code> or is not supplied, the call to <code>server-terminate</code> must be inside the scope of the process that was created by <code>start-up-server</code>, which can be either <i>function</i> or <i>announce</i> that you passed to <code>start-up-server</code>. <code>server-terminate</code> returns <code>t</code> in this case, and the actual termination happens after your function (that is, <i>function</i> or <i>announce</i>) returns.</p> |                                                        |

**server-terminate** returns **t** if the server was still active when it was called, otherwise it returns **nil**. It can be called repeatedly on the same server, and can be used as a predicate to check whether the server really went away.

|          |                                                                                                                                                                      |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | In LispWorks 6.0 and earlier versions, <b>process-kill</b> is the way to terminate servers. This is deprecated, because it may leave some value in an invalid state. |
| See also | <b>start-up-server</b>                                                                                                                                               |

## set-verification-mode *Function*

|             |                                                                                                                                                                                                                                                                                                            |                                                                                                       |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| Summary     | Sets the verification mode for CTX.                                                                                                                                                                                                                                                                        |                                                                                                       |
| Package     | <b>comm</b>                                                                                                                                                                                                                                                                                                |                                                                                                       |
| Signature   | <b>set-verification-mode ssl-ctx ssl-side mode &amp;optional callback</b>                                                                                                                                                                                                                                  |                                                                                                       |
| Arguments   | <b>ssl-ctx</b>                                                                                                                                                                                                                                                                                             | A foreign pointer of type <b>ssl-pointer</b> or <b>ssl-ctx-pointer</b> .                              |
|             | <b>ssl-side</b>                                                                                                                                                                                                                                                                                            | <b>:server</b> or <b>:client</b> .                                                                    |
|             | <b>mode</b>                                                                                                                                                                                                                                                                                                | An integer, one of the symbols <b>:never</b> , <b>:always</b> , <b>:once</b> , or a list of keywords. |
|             | <b>callback</b>                                                                                                                                                                                                                                                                                            | A foreign function.                                                                                   |
| Values      | <b>result</b>                                                                                                                                                                                                                                                                                              | A list of symbols.                                                                                    |
| Description | The function <b>set-verification-mode</b> sets the verification mode for CTX according to arguments <b>ssl-side</b> and <b>mode</b> .<br>When <b>ssl-side</b> is <b>:server</b> , <b>mode</b> can be:<br>An integer <b>mode</b> is passed directly to <b>SSL_set_verify</b> or <b>SSL_CTX_set_verify</b> . |                                                                                                       |

|                                                              |                                                                                                                                                                                                                                                                                                                                                                    |
|--------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>:never</b>                                                | The server will not send a client certificate request to the client, so the client will not send a certificate.                                                                                                                                                                                                                                                    |
| <b>:always</b>                                               | The server sends a client certificate request to the client. The certificate returned (if any) is checked. If the verification process fails, the TLS/SSL handshake is immediately terminated with an alert message containing the reason for the verification failure.                                                                                            |
| <b>:once</b>                                                 | Same as <b>:always</b> except that the client certificate is checked only on the initial TLS/SSL handshake, and not again in case of renegotiation.                                                                                                                                                                                                                |
| A list                                                       | The list contains (some of) the keywords <b>:verify-client-once</b> , <b>:verify-peer</b> and <b>:fail-if-no-peer-cert</b> . These keywords map to the corresponding C constants <b>VERIFY_CLIENT_ONCE</b> , <b>VERIFY_PEER</b> and <b>FAIL_IF_NO_PEER_CERT</b> respectively. See the manual entry for <b>SSL_CTX_set_verify</b> for the meaning of the constants. |
| When <i>ssl-side</i> is <b>:client</b> , <i>mode</i> can be: |                                                                                                                                                                                                                                                                                                                                                                    |
| An integer                                                   | <i>mode</i> is passed directly as for <i>ssl-side :server</i> .                                                                                                                                                                                                                                                                                                    |
| <b>:never</b>                                                | If not using an anonymous cipher, the server will send a certificate which will be checked by the client. The handshake will be continued regardless of the verification result.                                                                                                                                                                                   |
| <b>:always</b>                                               | The server certificate is verified. If the verification process fails, the TLS/SSL handshake is immediately terminated with an alert message containing the reason for the verifi-                                                                                                                                                                                 |

cation failure. If no server certificate is sent because an anonymous cipher is used, verification is ignored.

A list      The list contains keywords as described above for *ssl-side :server*.

If non-nil *callback* should be a symbol, function, string or foreign pointer designating a foreign function that is called to perform verification. The default value of *callback* is **nil**.

See also      **get-verification-mode**

## **set-ssl-ctx-dh** *Function*

Summary      Sets the DH parameters for a **SSL\_CTX**.

Package      **comm**

Signature      **set-ssl-ctx-dh ssl-ctx &key dh filename func filename-list pass-phrase callback => result**

Arguments      **ssl-ctx**      A foreign pointer.  
**filename**      A pathname designator or **nil**.  
**func**      A function designator or **nil**.  
**filename-list**      An association list.  
**pass-phrase**      A string, or **nil**.  
**callback**      A function designator, or **nil**.

Values      **result**      A boolean.

Description      The function **set-ssl-ctx-dh** sets the DH parameters for a **SSL\_CTX**.

*ssl-ctx* can be either a foreign pointer of type **ssl-ctx-pointer** or a foreign pointer of type **ssl-pointer**.

The value is to use is specified by one of the parameters *dh*, *filename*, *func* or *filename-list*.

If *dh* is non-nil, it must be a foreign pointer to a DH (corresponding to the C type `DH*`), and this DH is used as-is. The default value of *dh* is `nil`.

Otherwise, if *filename* is non-nil, it must be a pathname designator for a file containing DH parameters, which is loaded (by `read-dhparams`) and then used. In this case, *pass-phrase* and *callback* can be used, and are passed to `pem-read`.

Otherwise, if *func* is non-nil, it must be a function with signature:

`func is-export keylength => dh-ptr`

where *is-export* is a boolean, *keylength* is an integer, and *dh-ptr* is a pointer to an appropriate DH structure. `set-ssl-ctx-dh` installs *func* as the DH callback.

Otherwise (that is, if each of *dh*, *filename* and *func* are `nil`) then *filename-list* must be a non-nil association list of keylengths and filenames, sorted by the keylengths in ascending order (that is, larger keylengths are towards the end of the list). `set-ssl-ctx-dh` installs a DH callback which when called finds the first keylength which is equal or bigger than the required keylength, loads the associated file (by calling `read-dhparams`), and returns it. It also loads the first file of the list immediately.

*result* is `t` on success, `nil` otherwise.

See also

`pem-read`  
`read-dhparams`  
`ssl-ctx-pointer`  
`ssl-pointer`

|                            |                                              | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------------|----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>set-ssl-ctx-options</b> |                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Summary                    | Sets the options in a <code>SSL_CTX</code> . |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Package                    | <code>comm</code>                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Signature                  |                                              | <code>set-ssl-ctx-options SSL_CTX &amp;key microsoft_sess_id_bug netscape_challenge_bug netscape_reuse_cipher_change_bug sslref2_reuse_cert_type_bug microsoft_big_sslv3_buffer msie_sslv2_rsa_padding ssleay_080_client_dh_bug tls_d5_bug tls_block_padding_bug dont_insert_empty_fragments_all no_session_resumption_on_renegotiation single_dh_use ephemeral_rsa cipher_server_preference tls_rollback_bug no_sslv2 no_sslv3 no_tls1 pkcs1_check_1 pkcs1_check_2 netscape_ca_dn_bug netscape_demo_cipher_change_bug</code>                                                                                                   |
| Arguments                  | <code>ssl-ctx</code>                         | A foreign pointer.<br><br>Each of the keyword arguments is a generalized boolean defaulting to <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Description                |                                              | The function <code>set-ssl-ctx-options</code> sets the options in a <code>SSL_CTX</code> .<br><br><code>ssl-ctx</code> can be either a foreign pointer of type <code>SSL_CTX-pointer</code> or a foreign pointer of type <code>SSL-pointer</code> .<br><br>The option that is set is the <code>logior</code> of all the options that are passed to <code>set-ssl-ctx-options</code> via the keyword arguments. The value used for each non-nil keyword <code>keyword</code> is the value of <code>SSL_OP_keyword</code> . The meaning of the options is specified in the OpenSSL manual page for <code>SSL_set_options</code> . |
| See also                   |                                              | <code>ssl-ctx-pointer</code><br><code>ssl-pointer</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

|                                      |                                                | <i>Function</i> |
|--------------------------------------|------------------------------------------------|-----------------|
| <b>set-ssl-ctx-password-callback</b> |                                                |                 |
| Summary                              | Sets the password for a <code>SSL_CTX</code> . |                 |

|                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |                    |                 |                                              |                 |                                 |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------------------|-----------------|----------------------------------------------|-----------------|---------------------------------|
| Package         | <code>comm</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                |                    |                 |                                              |                 |                                 |
| Signature       | <code>set-ssl-ctx-password-callback ssl-ctx &amp;key callback password</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                |                    |                 |                                              |                 |                                 |
| Arguments       | <table> <tr> <td><i>ssl-ctx</i></td><td>A foreign pointer.</td></tr> <tr> <td><i>callback</i></td><td>A function designator, or <code>nil</code>.</td></tr> <tr> <td><i>password</i></td><td>A string, or <code>nil</code>.</td></tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <i>ssl-ctx</i> | A foreign pointer. | <i>callback</i> | A function designator, or <code>nil</code> . | <i>password</i> | A string, or <code>nil</code> . |
| <i>ssl-ctx</i>  | A foreign pointer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                |                    |                 |                                              |                 |                                 |
| <i>callback</i> | A function designator, or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                |                    |                 |                                              |                 |                                 |
| <i>password</i> | A string, or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |                    |                 |                                              |                 |                                 |
| Description     | <p>The function <code>set-ssl-ctx-password-callback</code> sets the password for a <code>SSL_CTX</code>, either to a callback or a password. <code>ssl-ctx</code> should be a foreign pointer of type <code>ssl-ctx-pointer</code>. If <code>callback</code> is non-<code>nil</code>, it must be a function with signature:</p> $\text{callback } \text{maximum-length } \text{rwflag} \Rightarrow \text{result}$ <p>where <code>maximum-length</code> is an integer, <code>rwflag</code> is a boolean and <code>result</code> is a string. The default value of <code>callback</code> is <code>nil</code>. If <code>password</code> is non-<code>nil</code> and <code>callback</code> is <code>nil</code>, a callback is installed that simply returns <code>password</code>. The default value of <code>password</code> is <code>nil</code>. If both <code>callback</code> and <code>password</code> are <code>nil</code>, <code>set-ssl-ctx-password-callback</code> signals an error.</p> |                |                    |                 |                                              |                 |                                 |
| See also        | <code>ssl-ctx-pointer</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                |                    |                 |                                              |                 |                                 |

|           | <i>Function</i>                                    |
|-----------|----------------------------------------------------|
| Summary   | Sets the SSL library path.                         |
| Package   | <code>comm</code>                                  |
| Signature | <code>set-ssl-library-path library-path</code>     |
| Arguments | <i>library-path</i> A string or a list of strings. |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The function <code>set-ssl-library-path</code> sets the SSL library path.</p> <p><i>library-path</i> should be a string or a list of strings. Each string specifies a library to load. The libraries are loaded in the order they are in the list.</p> <p>Note that in contrast to <code>ensure-ssl</code>, the effect of <code>set-ssl-library-path</code> persists after saving and restarting the image.</p> |
| See also    | <p><code>ensure-ssl</code><br/> “How LispWorks locates the OpenSSL libraries” on page 420</p>                                                                                                                                                                                                                                                                                                                      |

## socket-error *Class*

|              |                                        |                                |
|--------------|----------------------------------------|--------------------------------|
| Summary      | The condition class for socket errors. |                                |
| Package      | <code>comm</code>                      |                                |
| Superclasses | <code>simple-error</code>              |                                |
| Subclasses   | <code>ssl-condition</code>             |                                |
| Initargs     | <code>:stream</code>                   | A <code>socket-stream</code> . |
| Description  | The condition class for socket errors. |                                |

## socket-stream *Class*

|              |                              |                  |
|--------------|------------------------------|------------------|
| Summary      | The socket stream class.     |                  |
| Package      | <code>comm</code>            |                  |
| Superclasses | <code>buffered-stream</code> |                  |
| Initargs     | <code>:socket</code>         | A socket handle. |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <b>:direction</b> One of <code>:input</code> , <code>:output</code> , or <code>:io</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|             | <b>:element-type</b> One of <code>base-char</code> , <code>(signed-byte 8)</code> and<br><code>(unsigned-byte 8)</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|             | <b>:read-timeout</b> A positive number or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|             | <b>:write-timeout</b> A positive number or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|             | <b>:ssl-ctx</b> A keyword, <code>t</code> or <code>nil</code> , or a foreign pointer of<br>type <code>ssl-ctx-pointer</code> or <code>ssl-pointer</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|             | <b>:ssl-side</b> One of the keywords <code>:client</code> , <code>:server</code> or<br><code>:both</code> . The default value is <code>:server</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|             | <b>:ctx-configure-callback</b><br>A function designator or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|             | <b>:ssl-configure-callback</b><br>A function designator or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|             | <b>:handshake-timeout</b><br>A <code>real</code> or <code>nil</code> (the default).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|             | <b>:tlsext-host-name</b><br>A string or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Accessors   | <code>socket-stream-socket</code><br><code>stream:stream-read-timeout</code><br><code>stream:stream-write-timeout</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Description | <p>The class <code>socket-stream</code> implements a buffered stream connected to a socket. The socket handle, specified by <code>:socket</code>, and the direction, specified by <code>:direction</code>, must be passed for a meaningful stream to be constructed. Common Lisp input functions such as <code>read-char</code> will see <code>end-of-file</code> if the other end of the socket is closed.</p> <p>The <code>:element-type</code> initarg determines the expected element type of the stream traffic. However, stream input and output functions for character and binary data generally work in the</p> |

obvious way on a `socket-stream` with any of the allowed values of `element-type`. For example, `read-sequence` can be called with a string buffer and a binary `socket-stream`: the character data is constructed from the input as if by `code-char`. Similarly `write-sequence` can be called with a string buffer and a binary `socket-stream`: the output is converted from the character data as if by `char-code`. Also, 8-bit binary data can be read and written to a `base-char socket-stream`.

All standard stream I/O functions except for `write-byte` and `read-byte` have this flexibility.

The `:read-timeout` initarg specifies the read timeout in seconds, or is `nil`, meaning there are no timeouts during reads (this is the default).

The `read-timeout` property is intended for use when a socket connection might hang during a call to any Common Lisp input function. The `read-timeout` can be set by `make-instance` or by `open-tcp-stream`. It can also be modified by `(setf stream:stream-read-timeout)`. When `read-timeout` is `nil`, there is no timeout during reads and the call may hang. When `read-timeout` is not `nil`, and there is no input from the socket for more than `read-timeout` seconds, any reading function returns `end-of-file`. The `read-timeout` does not limit the time inside `read`, but the time between successful extractions of data from the socket. Therefore, if the reading needs several rounds it may take longer than `read-timeout`.

Using `(setf stream:stream-read-timeout)` on the stream while it is inside a read function has undefined effects. However, the `setf` function can be used between calls to read functions. The `read-timeout` property of a stream can be read by  
`(stream:stream-read-timeout stream)`

The `:write-timeout` initarg specifies the write timeout in seconds, or is `nil`, meaning that there are no timeouts during writes (this is the default).

The `write-timeout` property is similar to `read-timeout`, but for write operations. If flushing the stream buffer takes too long then `error` is called.

The initargs `:ssl-ctx`, `:ssl-side`, `:ctx-configure-callback`, `:ssl-configure-callback` and `:handshake-timeout` can be supplied to create and configure socket streams with SSL processing. See “Keyword arguments for use with SSL” on page 421 for more details.

If `:tlsext-host-name` initarg is a string then the SNI extension in the SSL connection to set to its value.

If there is a non-local exit while initializing the `socket-stream` (the most common reason being a SSL handshake failure when using SSL), then the stream will be closed. This will cause the socket to be closed as well.

## Notes

1. The function `wait-for-input-streams` and `wait-for-input-streams-returning-first` are a convenient interface for waiting for input from socket streams. The standard I/O functions (`c1:read`, `c1:read-char` and so on) can also wait properly. You can also use `process-wait` and similar functions with `c1:listen` in the `wait-function`, but you will need to use `with-noticed-socket-stream`.
2. The socket object in a `socket-stream` is normally a socket object in the operating system sense. On Unix and Microsoft Windows it is an integer corresponding to a socket as returned from the C functions `socket` and `accept`. It can also be a Java socket object, see “Socket streams with Java sockets and SSL on Android” on page 432 for details.
3. `(setf socket-stream-socket)` can be used to set the socket object in the stream, and can also set it to `nil`. When there is already a socket in the stream, `(setf socket-stream-socket)` closes it before setting the slot to

the new socket. The function `replace-socket-stream-socket` can be used to set the socket without closing the old one.

**Example**

The following makes a bidirectional stream connected to a socket specified by `handle`.

```
(make-instance 'comm:socket-stream
               :socket handle
               :direction :io
               :element-type 'base-char)
```

This example creates a socket stream with a read-timeout:

```
(make-instance 'comm:socket-stream
               :handle handle
               :direction :input
               :read-timeout 42)
```

The following form illustrates character I/O in a binary `socket-stream`:

```
(with-open-stream (x
                  (comm:open-tcp-stream
                   "localhost" 80
                   :element-type '(unsigned-byte 8)))
  (write-sequence (format nil "GET / HTTP/1.0~%~%") x)
  (force-output x)
  (let ((res (make-array 20 :element-type 'base-char)))
    (values (read-sequence res x) res)))
```

The following form illustrates binary I/O in a `base-char socket-stream`:

```

(with-open-stream (x
  (comm:open-tcp-stream
    "localhost" 80
    :element-type 'base-char))
  (write-sequence
    (map 'simple-array (unsigned-byte 8) 1)
    'char-code
    (format nil "GET / HTTP/1.0~%~%"))
  x)
  (force-output x)
  (let ((res (make-array 20
    :element-type
    '(unsigned-byte 8))))
    (values (read-sequence res x)
      (map 'string 'code-char res))))
```

See also [connect-to-tcp-server](#)  
[open-tcp-stream](#)  
[start-up-server](#)  
[stream-read-timeout](#)  
[wait-for-input-streams](#)  
[replace-socket-stream-socket](#)  
“TCP and UDP socket communication and SSL” on page 407

|           |                                                                     | <i>Function</i>                                                                   |
|-----------|---------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| Summary   | Returns the local address and port number of a given socket stream. |                                                                                   |
| Package   | <code>comm</code>                                                   |                                                                                   |
| Signature | <code>socket-stream-address stream =&gt; address, port</code>       |                                                                                   |
| Arguments | <code>stream</code>                                                 | A socket stream.                                                                  |
| Values    | <code>address</code>                                                | The local host address of the socket stream or <code>nil</code> if not connected. |
|           | <code>port</code>                                                   | The local port number of the socket stream or <code>nil</code> if not connected.  |

|             |                                                                                            |
|-------------|--------------------------------------------------------------------------------------------|
| Description | The function <b>socket-stream-address</b> returns the local address of a connected socket. |
| Notes       | Connected socket streams have two addresses, local and remote,                             |
| See also    | <b>socket-stream-peer-address</b><br><b>get-socket-address</b>                             |

## **socket-stream-ctx** *Function*

|             |                                                                                                                                                                                                  |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Accesses the <b>ssl_ctx</b> attached to a socket stream.                                                                                                                                         |
| Package     | <b>comm</b>                                                                                                                                                                                      |
| Signature   | <b>socket-stream-ctx</b> <i>socket-stream</i> => <b>ssl-ctx-pointer</b>                                                                                                                          |
| Arguments   | <i>socket-stream</i> A <b>socket-stream</b> .                                                                                                                                                    |
| Values      | <i>ssl-ctx-pointer</i> A foreign pointer of type <b>ssl-ctx-pointer</b> , or <b>nil</b> .                                                                                                        |
| Description | <p>The function <b>socket-stream-ctx</b> accesses the <b>ssl_ctx</b> that is attached to the <b>socket-stream</b> <i>socket-stream</i>.</p> <p>It returns <b>nil</b> if SSL is not attached.</p> |
| See also    | <b>socket-stream</b><br><b>ssl-ctx-pointer</b>                                                                                                                                                   |

## **socket-stream-handshake** *Function*

|         |                                      |
|---------|--------------------------------------|
| Summary | Perform a SSL handshake on a stream. |
| Package | <b>comm</b>                          |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| Signature   | <code>socket-stream-handshake stream &amp;optional timeout =&gt; success</code>                                                                                                                                                                                                                                                                                                                                                                     |                                |
| Arguments   | <code>stream</code>                                                                                                                                                                                                                                                                                                                                                                                                                                 | A <code>socket-stream</code> . |
|             | <code>timeout</code>                                                                                                                                                                                                                                                                                                                                                                                                                                | <code>nil</code> or a real.    |
| Values      | <code>success</code>                                                                                                                                                                                                                                                                                                                                                                                                                                | A boolean.                     |
| Description | <p>The function <code>socket-stream-handshake</code> performs a handshake on <code>stream</code>, which must be attached to SSL.</p> <p><code>socket-stream-handshake</code> returns false if the handshake does not finish in <code>timeout</code> seconds or if the SSL connection was cleanly closed by the other side. Other failures cause an error to be signaled.</p> <p><code>socket-stream-handshake</code> returns true on success.</p>   |                                |
| Notes       | <p>The other <code>socket-stream</code> interface functions signal errors if the handshake fail for any reason, including timeout or clean close.</p> <p>If SSL was attached with <code>ssl-side :both</code>, then you will need to specify which side to take in the handshake by calling <code>ssl-set-accept-state</code> or <code>ssl-set-connect-state</code> with the <code>ssl-pointer</code> return by <code>socket-stream-ssl</code>.</p> |                                |
| See also    | <a href="#"><code>socket-stream</code></a><br><a href="#">“Using SSL” on page 418</a>                                                                                                                                                                                                                                                                                                                                                               |                                |

|                                   | <b>Function</b>                                                      |
|-----------------------------------|----------------------------------------------------------------------|
| <b>socket-stream-peer-address</b> |                                                                      |
| Summary                           | Returns the remote address and port number of a given socket stream. |
| Package                           | <code>comm</code>                                                    |
| Signature                         | <code>socket-stream-peer-address stream =&gt; address, port</code>   |

|             |                                                                                                                                           |                                                                              |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| Arguments   | <i>stream</i>                                                                                                                             | A <b>socket-stream</b> .                                                     |
| Values      | <i>address</i>                                                                                                                            | The remote host address of the socket stream or <b>nil</b> if not connected. |
|             | <i>port</i>                                                                                                                               | The remote port number of the socket stream or <b>nil</b> if not connected.  |
| Description | Connected socket streams have two addresses, local and remote. The function <b>socket-stream-peer-address</b> returns the remote address. |                                                                              |
| See also    | <b>socket-stream-address</b><br><b>get-socket-peer-address</b>                                                                            |                                                                              |

## **socket-stream-shutdown** *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                       |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| Summary     | Performs a shutdown on one or both sides of a TCP socket connection.                                                                                                                                                                                                                                                                                                                                                                                                 |                                                       |
| Package     | <b>comm</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                       |
| Signature   | <b>socket-stream-shutdown</b> <i>stream direction &amp;key abort</i>                                                                                                                                                                                                                                                                                                                                                                                                 |                                                       |
| Arguments   | <i>stream</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                        | A <b>socket-stream</b> .                              |
|             | <i>direction</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                     | One of <b>:input</b> , <b>:output</b> or <b>:io</b> . |
|             | <i>abort</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                         | A generalized boolean.                                |
| Description | <p>The function <b>socket-stream-shutdown</b> performs a shutdown on one or both sides of a TCP socket connection of <i>stream</i>, which can indicate to the peer that no more data will be sent or received.</p> <p>When <i>direction</i> is <b>:input</b>, receive operations are shut down.<br/>       When <i>direction</i> is <b>:output</b>, send operations are shut down.<br/>       When <i>direction</i> is <b>:io</b>, all operations are shut down.</p> |                                                       |

If *abort* is true and *direction* is `:output` or `:io`, then any input or output in the socket stream buffers is discarded. Otherwise output is flushed and input is left in the buffer.

It is an error to read from *stream* (after no data is left in the buffer) after shutdown for `:input` or `:io` or to write to *stream* after shutdown for `:output` or `:io`.

|          |                                                                                                                                                                         |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | <code>socket-stream-shutdown</code> does not close the socket stream, so it is still necessary to call <code>close</code> to free resources associated with the stream. |
| See also | <code>socket-stream</code>                                                                                                                                              |

## socket-stream-ssl

*Function*

|             |                                                                                                                                                                                                                      |  |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Summary     | Accesses the <code>SSL</code> attached to a socket stream.                                                                                                                                                           |  |
| Package     | <code>comm</code>                                                                                                                                                                                                    |  |
| Signature   | <code>socket-stream-ssl socket-stream =&gt; ssl-pointer</code>                                                                                                                                                       |  |
| Arguments   | <code>socket-stream</code> A <code>socket-stream</code> .                                                                                                                                                            |  |
| Values      | <code>ssl-pointer</code> A foreign pointer of type <code>ssl-pointer</code> , or <code>nil</code> .                                                                                                                  |  |
| Description | <p>The function <code>socket-stream-ssl</code> accesses the <code>SSL</code> that is attached to the <code>socket-stream</code> <i>socket-stream</i>.</p> <p>It returns <code>nil</code> if SSL is not attached.</p> |  |
| See also    | <code>socket-stream</code><br><code>ssl-pointer</code>                                                                                                                                                               |  |

| <b>socket-stream-ssl-side</b> | <i>Function</i>                                                                                                                                                                              |
|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary                       | Accesses the ssl-side of a socket stream.                                                                                                                                                    |
| Package                       | <code>comm</code>                                                                                                                                                                            |
| Signature                     | <code>socket-stream-ssl-side socket-stream =&gt; ssl-side</code>                                                                                                                             |
| Arguments                     | <code>socket-stream</code> A <code>socket-stream</code> .                                                                                                                                    |
| Values                        | <code>ssl-side</code> : <code>client</code> , : <code>server</code> , : <code>both</code> or <code>nil</code> .                                                                              |
| Description                   | The function <code>socket-stream-ssl-side</code> accesses the ssl-side of the <code>socket-stream</code> <code>socket-stream</code> .<br>It returns <code>nil</code> if SSL is not attached. |
| Note                          | <code>socket-stream-ssl-side</code> is useful as a predicate for testing if an <code>socket-stream</code> has SSL attached.                                                                  |
| See also                      | <code>socket-stream</code>                                                                                                                                                                   |

| <b>ssl-cipher-pointer</b> | <i>FLI type descriptor</i>                                                                        |
|---------------------------|---------------------------------------------------------------------------------------------------|
| Summary                   | An FLI type for use with SSL.                                                                     |
| Package                   | <code>comm</code>                                                                                 |
| Signature                 | <code>ssl-cipher-pointer</code>                                                                   |
| Description               | The FLI type <code>ssl-cipher-pointer</code> corresponds to the C type <code>SSL_CIPHER*</code> . |

| <b>ssl-cipher-pointer-stack</b> | <i>FLI type descriptor</i>    |
|---------------------------------|-------------------------------|
| Summary                         | An FLI type for use with SSL. |

|             |                                                                                                                  |
|-------------|------------------------------------------------------------------------------------------------------------------|
| Package     | <code>comm</code>                                                                                                |
| Signature   | <code>ssl-cipher-pointer-stack</code>                                                                            |
| Description | The FLI type <code>ssl-cipher-pointer-stack</code> corresponds to the C type <code>STACK_OF(SSL_CIPHER)</code> . |

## **ssl-closed** *Class*

|              |                                                                                                                                         |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| Summary      | The class for SSL errors corresponding to <code>SSL_ERROR_ZERO_RETURN</code> .                                                          |
| Package      | <code>comm</code>                                                                                                                       |
| Superclasses | <code>ssl-condition</code>                                                                                                              |
| Description  | The condition class <code>ssl-closed</code> corresponds to <code>SSL_ERROR_ZERO_RETURN</code> . It means the underlying socket is dead. |

## **ssl-condition** *Class*

|              |                                                                                                               |
|--------------|---------------------------------------------------------------------------------------------------------------|
| Summary      | The condition class for SSL errors.                                                                           |
| Package      | <code>comm</code>                                                                                             |
| Superclasses | <code>socket-error</code>                                                                                     |
| Subclasses   | <code>ssl-closed</code><br><code>ssl-error</code><br><code>ssl-failure</code><br><code>ssl-x509-lookup</code> |
| Description  | The condition class for errors inside SSL.                                                                    |

| <b>ssl-ctx-pointer</b> | <i>FLI type descriptor</i>                                                                                                                                                                            |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary                | An FLI type for use with SSL.                                                                                                                                                                         |
| Package                | <code>comm</code>                                                                                                                                                                                     |
| Signature              | <code>ssl-ctx-pointer</code>                                                                                                                                                                          |
| Description            | The FLI type <code>ssl-ctx-pointer</code> corresponds to the C type <code>SSL_CTX*</code> .                                                                                                           |
| <b>ssl-error</b>       | <i>Class</i>                                                                                                                                                                                          |
| Summary                | The class for SSL errors corresponding to <code>SSL_ERROR_SYSCALL</code> .                                                                                                                            |
| Package                | <code>comm</code>                                                                                                                                                                                     |
| Superclasses           | <code>ssl-condition</code>                                                                                                                                                                            |
| Description            | The condition class <code>ssl-error</code> corresponds to <code>SSL_ERROR_SYSCALL</code> . It means that something got broken.                                                                        |
| <b>ssl-failure</b>     | <i>Class</i>                                                                                                                                                                                          |
| Summary                | The class for SSL errors corresponding to <code>SSL_ERROR_SSL</code> .                                                                                                                                |
| Package                | <code>comm</code>                                                                                                                                                                                     |
| Superclasses           | <code>ssl-condition</code>                                                                                                                                                                            |
| Description            | The condition class <code>ssl-failure</code> corresponds to <code>SSL_ERROR_SSL</code> . This means a failure in processing the input, typically due to a mismatch between the client and the server. |

You get this error when trying to use a SSL connection to a non-secure peer.

## **ssl-new** *Function*

|             |                                                                                                                                                                                       |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Creates a <code>SSL</code> .                                                                                                                                                          |
| Package     | <code>comm</code>                                                                                                                                                                     |
| Signature   | <code>ssl-new ssl-ctx-pointer =&gt; ssl-pointer</code>                                                                                                                                |
| Arguments   | <code>ssl-ctx-pointer</code> A foreign pointer of type <code>ssl-ctx-pointer</code> .                                                                                                 |
| Values      | <code>ssl-pointer</code> A foreign pointer of type <code>ssl-pointer</code> .                                                                                                         |
| Description | <p>The function <code>ssl-new</code> creates a <code>SSL</code> by a direct call to the C function <code>SSL_new</code>.</p> <p>It returns a pointer to the new <code>SSL</code>.</p> |
| See also    | <code>ssl-ctx-pointer</code><br><code>ssl-pointer</code>                                                                                                                              |

## **ssl-pointer** *FLI type descriptor*

|             |                                                                                     |
|-------------|-------------------------------------------------------------------------------------|
| Summary     | An FLI type for use with SSL.                                                       |
| Package     | <code>comm</code>                                                                   |
| Signature   | <code>ssl-pointer</code>                                                            |
| Description | The FLI type <code>ssl-pointer</code> corresponds to the C type <code>SSL*</code> . |

## ssl-x509-lookup

*Class*

|              |                                                                                                                                                                         |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary      | The class for SSL errors corresponding to <code>SSL_ERROR_WANT_X509_LOOKUP</code> .                                                                                     |
| Package      | <code>comm</code>                                                                                                                                                       |
| Superclasses | <code>ssl-condition</code>                                                                                                                                              |
| Description  | The condition class <code>ssl-x509-lookup</code> corresponds to <code>SSL_ERROR_WANT_X509_LOOKUP</code> . It happens when a certificate is rejected by a user callback. |

## start-up-server

*Function*

|           |                                                                                                                                                                             |                                                                                 |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| Summary   | Starts a TCP server.                                                                                                                                                        |                                                                                 |
| Package   | <code>comm</code>                                                                                                                                                           |                                                                                 |
| Signature | <code>start-up-server &amp;key function announce service address local-address local-port nodelay keepalive process-name wait error =&gt; process, startup-condition</code> |                                                                                 |
| Arguments | <code>function</code>                                                                                                                                                       | A function name.                                                                |
|           | <code>announce</code>                                                                                                                                                       | An output stream, <code>t</code> , <code>nil</code> or a function.              |
|           | <code>service</code>                                                                                                                                                        | An integer, a string or <code>nil</code> .                                      |
|           | <code>backlog</code>                                                                                                                                                        | <code>nil</code> or a positive integer.                                         |
|           | <code>address</code>                                                                                                                                                        | A synonym for <code>local-address</code> .                                      |
|           | <code>local-address</code>                                                                                                                                                  | An integer, an <code>ipv6-address</code> object, a string or <code>nil</code> . |
|           | <code>local-port</code>                                                                                                                                                     | A synonym for <code>service</code> .                                            |
|           | <code>nodelay</code>                                                                                                                                                        | A generalized boolean.                                                          |
|           | <code>keepalive</code>                                                                                                                                                      | A generalized boolean.                                                          |

|             |                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <i>process-name</i>      | A symbol or expression.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|             | <i>wait</i>              | A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|             | <i>ipv6</i>              | The keyword :any, the keyword :both, nil or t.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|             | <i>error</i>             | A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Values      | <i>process</i>           | A process, or nil.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|             | <i>startup-condition</i> | A condition object, or nil.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Description |                          | <p>The function <code>start-up-server</code> starts a TCP server. Use <code>open-tcp-stream</code> to send messages from another client to the server.</p> <p>The <i>function</i> argument provides the name of the function that processes connections. When a connection is made <i>function</i> is called with the connected socket handle, at which point you can make a stream using <code>make-instance</code> and communicate with the client. The server does not accept more connections until <i>function</i> returns, so normally it should create another light-weight process to handle the connection. However, the operating system typically provides a small queue of partially accepted connections, which prevents connection failure for new clients until the server is ready to accept more connections. If <i>function</i> is not specified the built-in Lisp listener server is used. See the examples section below.</p> <p>If <i>announce</i> is a stream or t (denoting <code>*standard-output*</code>), a message appears on the stream when the server is started.</p> <p>If <i>announce</i> is a function it is called when the server is started. <i>announce</i> should take two arguments: <i>socket</i> and <i>condition</i>. <i>socket</i> is the socket used by the server: <i>announce</i> can therefore be used to record this socket. <i>condition</i> describes the error if there is one. <i>announce</i> can be called with <i>socket</i> nil and a condition only if <i>error</i> is nil. If the process is killed, <i>announce</i> is called with <i>socket</i> nil and <i>condition</i> nil.</p> <p>The default for <i>announce</i> is nil, meaning there is no message.</p> |

*service* is interpreted as described in “Specifying the target for connecting and binding a socket” on page 408. The default value of *service* is a string “`lispworks`”.

*backlog* specifies the maximum number of pending connections for the socket in the operating system (see your operating system’s documentation for the function `listen`). The default value of *backlog* is 5.

If *local-address* is `nil` then the server will receive connections to all IP addresses on the computer. If *local-address* is non-`nil` then the server only receives connections for the IP address that *local-address* specifies. The default value of *local-address* is `nil`.

*address* also determines which family is used when making the socket. `AF_INET6` is used in these cases:

- The address is an `ipv6-address`.
- The address is a string specifying an IPv6 address.
- The address is a string that resolves to an IPv6 address.

Otherwise `AF_INET` is used. When *address* is not supplied, `AF_INET` is used. To open a server with `AF_INET6` listening to any address, either use the keyword argument `ipv6` or pass the zero IPv6 address “`::`”.

If *keepalive* is true, `SO_KEEPALIVE` is set on the socket. The default value of *keepalive* is `nil`.

If *nodelay* is true, `TCP_NODELAY` is set on the socket. The default value of *nodelay* is `t`.

The *process-name* specifies the process name. The default is constructed from the service name in the following fashion:

```
(format nil "~S server" service)
```

The *wait* argument controls whether `start-up-server` waits for the server to start or returns immediately. When *wait* is non-`nil` and an error was signaled, *process* is `nil` and the error is returned in *startup-condition*. Otherwise just one

value, the server process, is returned. The default for `wait` is `nil`.

`ipv6` affects the resolution of `address` if it is a string or `nil`. When `ipv6` is `nil`, it forces IPv4 addresses, and if `ipv6` is `t` it forces IPv6 addresses. When `ipv6` is `:any` the system tries either IPv4 or IPv6 and uses the first socket that it succeeds to bind. When `ipv6` is `:both` the system uses IPv6 (like the value `t`) but allows connection requests in IPv4. Note that with `t` only IPv6 connections are allowed. The default value of `ipv6` is `:any`.

The `error` argument controls what happens if an error is signaled in the server thread. If `error` is `nil` then the thread is terminated. If `error` is non-nil then the debugger is entered. The default value for `error` is (`not wait`).

#### Notes

1. Some versions of Microsoft Windows fail to detect the case where more than one server binds a given port, so an error will not be raised in this situation.
2. When the server is not needed any more, terminate it by calling `server-terminate` with the `process` returned by `start-up-server` as its argument, or call `server-terminate` from the `function` supplied to `start-up-server`.
3. When using using `ipv6 t`, it is possible to listen separately for IPv4 connections on the same service (by another service or using the Asynchronous I/O API). When using `:both`, it is not possible to listen separately to IPv4 on the same service.
4. The server has a mechanism that checks for repeated unexplained failures associated with accepting sockets, and if that happens too often it closes the accepting socket and opens it again. When that happens, `announce` is called again with the same arguments. If `service` was `nil`, the port that the underlying system assigned to the first socket is used for opening the socket again. One situation

that invokes that mechanism is putting an iOS device to sleep, which causes the accepting socket to become broken in a non-obvious way.

**Compatibility note** In LispWorks 6.1 and previous versions, the argument *ipv6 t* means either accepting IPv4 or not, depending on the default of the operating system. In LispWorks 7.0 and later *ipv6 t* means never allow IPv4 connections.

**Examples** The following example uses the built-in Lisp listener server:

```
(comm:start-up-server :service 10243)
```

It makes a Lisp listener server on port 10243 (check with local network managers that this port number is safe to use). When a client connects to this, Lisp calls `read`. The client should send a string using Common Lisp syntax followed by a newline. This string is used to name a new light-weight process that runs a Lisp listener. When this has been created, the server waits for more connections.

The next example illustrates the use of the *function* argument. For each line of input read by the server it writes the line back with a message. The stream generates `EOF` if the other end closes the connection.

```
(defvar *talk-port* 10244) ; a free TCP port number

(defun make-stream-and-talk (handle)
  (let ((stream (make-instance 'comm:socket-stream
                               :socket handle
                               :direction :io
                               :element-type
                               'base-char)))
    (mp:process-run-function (format nil "talk ~D"
                                      handle)
                             '()
                             'talk-on-stream stream)))
```

```

(defun talk-on-stream (stream)
  (unwind-protect
    (loop for line = (read-line stream nil nil)
          while line
          do
            (format stream "You sent: '~A'~%" line)
            (force-output stream))
    (close stream)))

(comm:start-up-server :function 'make-stream-and-talk
                      :service *talk-port*)

```

This is a client which uses the talk server:

```

(defun talking-to-myself ()
  (with-open-stream
    (talk (comm:open-tcp-stream "localhost"
                                *talk-port*))
    (dolist (monolog
              '("Hello self."
                "Why don't you say something original?"
                "Talk to you later then. Bye."))
      (write-line monolog talk)
      (force-output talk)
      (format t "I said: \"~A\"~%"
              monolog)
      (format t "Self replied: \"~A\"~%"
              (read-line talk nil nil)))))

(talking-to-myself)
=>
I said: "Hello self."
Self replied: "You sent: 'Hello self.'"
I said: "Why don't you say something original?"
Self replied: "You sent: 'Why don't you say something
original?'"
I said: "Talk to you later then. Bye."
Self replied: "You sent: 'Talk to you later then.
Bye.'"

```

This example illustrates a server which picks a free port and records the socket. The last form queries the socket for the port used.

```
(defvar *my-socket* nil)

(defun my-announce-function (socket condition)
  (if socket
      (setf *my-socket* socket)
      (my-log-error condition)))

(comm:start-up-server :service nil
                      :error nil
                      :announce 'my-announce-function)

(multiple-value-bind (address port)
    (comm:get-socket-address *my-socket*)
  port)
```

See also      [open-tcp-stream](#)  
[server-terminate](#)  
[socket-stream](#)

## **start-up-server-and-mp** *Function*

Package      `comm`

Signature      `start-up-server-and-mp &key function announce service local-address address process-name`

|           |                            |                                                                    |
|-----------|----------------------------|--------------------------------------------------------------------|
| Arguments | <code>function</code>      | A function name.                                                   |
|           | <code>announce</code>      | An output stream, <code>t</code> , <code>nil</code> or a function. |
|           | <code>service</code>       | An integer, a string or <code>nil</code> .                         |
|           | <code>local-address</code> | An integer, a string or <code>nil</code> .                         |
|           | <code>address</code>       | A synonym for <code>local-address</code> .                         |
|           | <code>process-name</code>  | A symbol or expression.                                            |

Description      The function `start-up-server-and-mp` starts multiprocess-ing if it has not already been started and then calls `start-up-server` with the supplied `function`, `announce`, `service`, `local-address` and `process-name` arguments.

Notes            **start-up-server-and-mp** is not implemented on Microsoft Windows.

See also        **start-up-server**

## **string-ip-address** *Function*

Summary        Returns either an integer representing an IPv4 address or an **ipv6-address** object from the given IP address string.

Package        **comm**

Signature      **string-ip-address** *ip-address-string* => *ip-address*

Arguments      *ip-address-string* A string denoting an IP address in either dotted format for IPv4 or standard IPv6 format.

Values          *ip-address*        Either an integer representing an IPv4 address, or an **ipv6-address** object.

Description      The function **string-ip-address** takes a string in the standard dotted IP address notation **a.b.c.d** and returns the corresponding integer IP address.

The function **string-ip-address** takes a string and tries to parse as an IP address. If *ip-address-string* is in a proper dotted IP address format, it returns an integer representing an IPv4 address. Otherwise it tries to read it as an IPv6 address using **parse-ipv6-address** (with *trim-whitespace-p nil*), which returns an **ipv6-address** object if it is successful or **nil** if it fails.

See also        **ip-address-string**  
                  **parse-ipv6-address**

|             | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Make <code>open-tcp-stream</code> use Java sockets for SSL streams.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Package     | <code>comm</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Signature   | <code>switch-open-tcp-stream-with-ssl-to-java &amp;optional on</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Arguments   | <code>on</code> A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Description | <p>The function <code>switch-open-tcp-stream-with-ssl-to-java</code> makes <code>open-tcp-stream</code> use Java sockets for SSL streams.</p> <p>The default state corresponds to <code>on</code> being <code>nil</code>, except on Android when <code>switch-open-tcp-stream-with-ssl-to-java</code> is called before delivering to Android (if the module "comm" was loaded) to switch the state to <code>t</code>. The default value of <code>on</code> is <code>t</code>.</p> <p>Once the state switches to <code>t</code>, when <code>open-tcp-stream</code> is called with <code>ssl-ctx</code> non-<code>nil</code>, it uses a Java socket instead of ordinary socket to implement the stream. The resulting stream has some limitations, in particular <code>c1:listen</code> does not work reliably on it. See "Socket streams with Java sockets and SSL on Android" on page 432 for details.</p> |
| Notes       | <ol style="list-style-type: none"> <li>1. The Java virtual machine (JVM) must be running for <code>open-tcp-stream</code> to work after it is switched to use Java sockets. On Android the JVM always runs, on other architectures it needs to have been started by <code>init-java-interface</code>.</li> <li>2. <code>open-tcp-stream-using-java</code> can be used to make plain (non-SSL) socket streams with Java sockets, if that seems to be useful.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| See also    | <code>open-tcp-stream</code><br><code>open-tcp-stream-using-java</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

“Socket streams with Java sockets and SSL on Android” on page 432

## wait-for-wait-state-collection *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Waits for a state in a collection to become active.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Package     | <code>comm</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Signature   | <code>wait-for-wait-state-collection <i>collection</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Arguments   | <code><i>collection</i></code> A <code>wait-state-collection</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Description | The function <code>wait-for-wait-state-collection</code> waits for one of the states in <code>collection</code> to become active, or until some message arrives from another process. Such messages may be a result of creating a new <code>async-io-state</code> associated with the collection, or a result of a call to <code>apply-in-wait-state-collection-process.wait-for-wait-state-collection</code> . <code>wait-for-wait-state-collection</code> returns once any of the states in <code>collection</code> is ready or there is a message.                                                                                                                                             |
| Notes       | <p>Typically you would not call <code>wait-for-wait-state-collection</code> yourself, but it will be called by <code>loop-processing-wait-state-collection</code>. However, sometimes you may want to create the looping code yourself. In the latter case, once <code>wait-for-wait-state-collection</code> returns, you will need to call <code>call-wait-state-collection</code> to handle the active states or messages in <code>collection</code>.</p> <p>You can use <code>apply-in-wait-state-collection-process</code> with a function that does nothing (e.g. <code>false</code>) to wake up a waiting call to <code>wait-for-wait-state-collection</code> on a specific collection.</p> |

See also      `create-and-run-wait-state-collection`  
`loop-processing-wait-state-collection`  
“The Async-I/O-State API” on page 412

## **wait-state-collection** *Class*

Summary      An object that controls asynchronous I/O via an event loop.

Package      `comm`

Superclasses      None

Subclasses      None

Description      Objects of class `wait-state-collection` control asynchronous I/O via an event loop.

See also      “The Async-I/O-State API” on page 412

## **wait-state-collection-stop-loop** *Function*

Summary      Stops a loop which is processing a `wait-state-collection`.

Package      `comm`

Signature      `wait-state-collection-stop-loop wait-state-collection`

Arguments      `wait-state-collection`  
                  A `wait-state-collection`.

Description      The function `wait-state-collection-stop-loop` stops a loop which is processing `wait-state-collection`.

If there is currently a call to `loop-processing-wait-state-collection` with the `wait-state-collection`, `wait-state-collection-stop-loop` makes it stop and return.

Notes      `wait-state-collection-stop-loop` can be called from any process.

See also    `loop-processing-wait-state-collection`

## with-noticed-socket-stream *Macro*

Package     `comm`

Signature    `with-noticed-socket-stream (stream) &body body`

Arguments    `stream`      A stream created using `open-tcp-stream`.

`body`        Code to be executed while the stream is “noticed”.

Description    The macro `with-noticed-socket-stream` evaluates the `body` forms with the stream `stream` “noticed” for input. `stream` becomes unnoticed afterwards.

The macro is designed to be used with streams created by `open-tcp-stream`.

Notes        1. You do not normally need to use this macro, because all of the standard functions that read from socket streams (`read-char` and so on) will do this automatically when necessary. However, if you call `process-wait` yourself with a `wait-function` that detects new input from a socket stream, then this macro is necessary to cause LispWorks to evaluate the `wait-function` when there is input on the underlying socket. Without that, there might be a delay before the thread responds to the input.

2. `with-noticed-socket-stream` is not implemented on the Windows platform.

See also

`open-tcp-stream`

# 33

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# The COMMON-LISP Package

This chapter describes the LispWorks extensions to symbols in the **COMMON-LISP** package, which is used by default. This chapter notes only those differences between LispWorks and the ANSI Common Lisp standard.

You should refer to this standard for full documentation about standard Common Lisp symbols. An HTML version, the Common Lisp HyperSpec, is available in the LispWorks IDE via the menu command **Help > Manuals > ANSI Common Lisp Standard**.

|           |                      | <i>Function</i>                                                                                       |
|-----------|----------------------|-------------------------------------------------------------------------------------------------------|
| apropos   |                      |                                                                                                       |
| Summary   |                      | Searches for interned symbols.                                                                        |
| Package   |                      | <code>common-lisp</code>                                                                              |
| Signature |                      | <code>apropos <i>string</i> &amp;optional <i>package external-only</i> =&gt; &lt;no values&gt;</code> |
| Arguments | <i>string</i>        | A string designator.                                                                                  |
|           | <i>package</i>       | A package designator or <code>nil</code> .                                                            |
|           | <i>external-only</i> | A generalized boolean.                                                                                |

|             |                                                                                                                                                                                                                                                                                                                               |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | The function <code>apropos</code> behaves as specified in ANSI Common Lisp. There is an additional optional argument <code>external-only</code> , which if true restricts the search to symbols which are external in the searched package or packages. The default value of <code>external-only</code> is <code>nil</code> . |
| See also    | <code>apropos-list</code><br><code>*describe-print-length*</code><br><code>*describe-print-level*</code><br><code>regexp-find-symbols</code>                                                                                                                                                                                  |

|                            | <i>Function</i>                                                                                                                                                                                                                                                                                                                    |                     |                      |                      |                                            |                            |                        |
|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------|----------------------|--------------------------------------------|----------------------------|------------------------|
| Summary                    | Searches for interned symbols.                                                                                                                                                                                                                                                                                                     |                     |                      |                      |                                            |                            |                        |
| Package                    | <code>common-lisp</code>                                                                                                                                                                                                                                                                                                           |                     |                      |                      |                                            |                            |                        |
| Signature                  | <code>apropos-list string &amp;optional package external-only =&gt; symbols</code>                                                                                                                                                                                                                                                 |                     |                      |                      |                                            |                            |                        |
| Arguments                  | <table> <tr> <td><code>string</code></td><td>A string designator.</td></tr> <tr> <td><code>package</code></td><td>A package designator or <code>nil</code>.</td></tr> <tr> <td><code>external-only</code></td><td>A generalized boolean.</td></tr> </table>                                                                        | <code>string</code> | A string designator. | <code>package</code> | A package designator or <code>nil</code> . | <code>external-only</code> | A generalized boolean. |
| <code>string</code>        | A string designator.                                                                                                                                                                                                                                                                                                               |                     |                      |                      |                                            |                            |                        |
| <code>package</code>       | A package designator or <code>nil</code> .                                                                                                                                                                                                                                                                                         |                     |                      |                      |                                            |                            |                        |
| <code>external-only</code> | A generalized boolean.                                                                                                                                                                                                                                                                                                             |                     |                      |                      |                                            |                            |                        |
| Values                     | <code>symbols</code> A list of symbols.boolean                                                                                                                                                                                                                                                                                     |                     |                      |                      |                                            |                            |                        |
| Description                | The function <code>apropos-list</code> behaves as specified in ANSI Common Lisp. There is an additional optional argument <code>external-only</code> , which if true restricts the search to symbols which are external in the searched package or packages. The default value of <code>external-only</code> is <code>nil</code> . |                     |                      |                      |                                            |                            |                        |
| See also                   | <code>apropos</code>                                                                                                                                                                                                                                                                                                               |                     |                      |                      |                                            |                            |                        |

**base-string****simple-base-string***Types*

|             |                                                                                                                                  |
|-------------|----------------------------------------------------------------------------------------------------------------------------------|
| Summary     | The base string types.                                                                                                           |
| Package     | <code>common-lisp</code>                                                                                                         |
| Signature   | <code>base-string length</code><br><code>simple-base-string length</code>                                                        |
| Arguments   | <code>length</code> The length of the string (or <code>*</code> , meaning any).                                                  |
| Description | <code>base-string</code> and <code>simple-base-string</code> are the types of base strings and simple base strings respectively. |
| See also    | <code>bmp-string</code><br><code>text-string</code><br>“Character and String types” on page 436                                  |

**close***Generic Function*

|                   |                                                                                                                                  |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------|
| Summary           | The function <code>close</code> is implemented as a generic function.                                                            |
| Package           | <code>common-lisp</code>                                                                                                         |
| Signature         | <code>close stream &amp;key abort =&gt; result</code>                                                                            |
| Method signatures | <code>close :around (stream buffered-stream) &amp;key abort</code><br><code>close (stream buffered-stream) &amp;key abort</code> |
| Arguments         | <code>stream</code> A stream.<br><code>abort</code> A generalized boolean.                                                       |
| Values            | <code>result</code> A boolean.                                                                                                   |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The standard function <code>close</code> is implemented as a generic function. All external resources used by the stream should be freed and true returned when that has been done. The result value for <code>close</code> is as per the Common Lisp ANSI specification.</p> <p>When <code>stream</code> is an instance of a subclass of <code>buffered-stream</code>, if <code>abort</code> is true then any remaining data in the buffer can be discarded. There are two built-in methods on <code>buffered-stream</code>. The primary method specialized on <code>buffered-stream</code> returns <code>t</code>. The other, an around method specialized on <code>buffered-stream</code>, checks whether the stream is closed, and if it is does nothing, including not calling the next method, which means not doing any of the primary, before and after methods. If the stream is opened, it flushes the stream buffer if <code>abort</code> is <code>nil</code>, calls the next method and marks the stream as closed if that method returns true. Thus the only requirement for a primary method specialized on a subclass of <code>buffered-stream</code> is that it must close any underlying data source and return true.</p> |
| Notes       | <ol style="list-style-type: none"> <li>1. You should not define an around method on a subclass of <code>buffered-stream</code>, as that will happen around the around method on <code>buffered-stream</code>. Use before and after methods instead.</li> <li>2. The <code>close</code> method on the <code>fundamental-stream</code> class sets a flag for <code>open-stream-p</code></li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| See also    | <code>buffered-stream</code><br><code>fundamental-stream</code><br><code>open-stream-p</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

|               | <i>Function</i>                                                                                        |
|---------------|--------------------------------------------------------------------------------------------------------|
| <b>coerce</b> | Function                                                                                               |
| Summary       | Extends the standard <code>coerce</code> function, allowing it to take any Common Lisp type specifier. |

|             |                                                                                                                                                                                                                                                                                                              |                                            |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|
| Package     | <code>common-lisp</code>                                                                                                                                                                                                                                                                                     |                                            |
| Signature   | <code>coerce object result-type =&gt; result</code>                                                                                                                                                                                                                                                          |                                            |
| Arguments   | <code>object</code>                                                                                                                                                                                                                                                                                          | A Lisp object.                             |
|             | <code>result-type</code>                                                                                                                                                                                                                                                                                     | A type specifier.                          |
| Values      | <code>result</code>                                                                                                                                                                                                                                                                                          | An object of type <code>result-type</code> |
| Description | <p>The function <code>coerce</code> performs those conversions required by the ANSI Common Lisp standard, but a larger set of type specifiers is allowed for coercion.</p> <p>A <code>type-error</code> is signaled if <code>result</code> cannot be returned as the <code>result-type</code> specifies.</p> |                                            |
| See also    | <code>concatenate</code>                                                                                                                                                                                                                                                                                     |                                            |

|                         |                                                                                                                                                                                                                                                                                                                                                                                               |                   |                                                |                         |                                    |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|------------------------------------------------|-------------------------|------------------------------------|
| <b>compile</b>          | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                               |                   |                                                |                         |                                    |
| Summary                 | Compiles a lambda expression into a compiled function.                                                                                                                                                                                                                                                                                                                                        |                   |                                                |                         |                                    |
| Package                 | <code>common-lisp</code>                                                                                                                                                                                                                                                                                                                                                                      |                   |                                                |                         |                                    |
| Signature               | <code>compile name &amp;optional definition =&gt; function, warnings-p, failure-p</code>                                                                                                                                                                                                                                                                                                      |                   |                                                |                         |                                    |
| Arguments               | <table> <tr> <td><code>name</code></td><td>A function name or <code>nil</code> or a list.</td></tr> <tr> <td><code>definition</code></td><td>A lambda expression or a function.</td></tr> </table>                                                                                                                                                                                            | <code>name</code> | A function name or <code>nil</code> or a list. | <code>definition</code> | A lambda expression or a function. |
| <code>name</code>       | A function name or <code>nil</code> or a list.                                                                                                                                                                                                                                                                                                                                                |                   |                                                |                         |                                    |
| <code>definition</code> | A lambda expression or a function.                                                                                                                                                                                                                                                                                                                                                            |                   |                                                |                         |                                    |
| Description             | <p><code>compile</code> calls the compiler to translate a lambda expression into a code vector containing an equivalent sequence of host specific machine code. A compiled function typically runs between 10 and 100 times faster. It is generally worth compiling the most frequently called Lisp functions in a large application during the development phase. The compiler detects a</p> |                   |                                                |                         |                                    |

large number of programming errors, and the resulting code runs sufficiently faster to justify the compilation time, even during development.

Warning messages are printed to `*error-output*`. Other messages are printed to `*standard-output*`.

`definition` and the return values are as specified for Common Lisp. Note that `name` may be a list not of the form `(setf symbol)`, which is an extension to Common Lisp.

`compile` also supports a LispWorks-specific extension allowing `compile` to compile an arbitrary form. When `definition` is not supplied and `name` is a list not of the form `(setf symbol)`, `compile` compiles it as if by `compile-file` but without any file related processing and does it in-memory, so it has also the same effect as loading. This has a similar effect to compiling a definition in the LispWorks Editor tool, except that there is no source recording. Multiple forms can be compiled in one call by wrapping them with `progn`. When `compile` is used this way it always returns `nil`.

**Notes** A compiled function object may be returned. Such compiled function objects are not printable (but see `disassemble`) other than as `#<Function FOO hex-address>`.

**Compatibility notes** In LispWorks 5.1 and previous versions, warning messages are printed to `*standard-output*`.

**Examples**

```
(defun fn (...) ...) ; interpreted definition for fn

(compile 'fn) ; replace with compiled
; definition

(compile nil '(lambda (x) (* x x)))
; returns compiled squaring function

(compile 'cube '(lambda (x) (* x x x)))
; defun and compile in one
```

|          |                                                                                                  |
|----------|--------------------------------------------------------------------------------------------------|
| Notes    | See <code>declare</code> for a list of the declarations that alter the behavior of the compiler. |
| See also | <code>compile-file</code><br><code>disassemble</code><br><code>declare</code>                    |

## **compile-file** *Function*

**Summary** Compiles a Lisp source file into a form that both loads and runs faster.

**Package** `common-lisp`

**Signature** `compile-file input-file &key output-file verbose print external-format load => output-truename, warnings-p, failure-p`

|                  |                        |                                                             |
|------------------|------------------------|-------------------------------------------------------------|
| <b>Arguments</b> | <i>input-file</i>      | A pathname designator.                                      |
|                  | <i>output-file</i>     | A pathname designator, or <code>:temp</code> .              |
|                  | <i>verbose</i>         | A generalized boolean.                                      |
|                  | <i>print</i>           | A generalized boolean.                                      |
|                  | <i>external-format</i> | An external format specification.                           |
|                  | <i>load</i>            | A generalized boolean or the keyword <code>:delete</code> . |

**Values** *output-truename* A pathname or `nil`.

*warnings-p* A generalized boolean.

*failure-p* A generalized boolean.

**Description** The function `compile-file` calls the compiler to translate a Lisp source file into a form that both loads and runs faster. A compiled function typically runs more than ten times faster than when interpreted (assuming that it is not spending most

of its work calling already compiled functions). A source file with a `.lisp` or `.lsp` extension compiles to produce a file with a `.fasl` extension (the actual extension depends on the host machine CPU and the LispWorks implementation). Subsequent use of `load` loads the compiled version (which is in LispWorks's FASL or Fast Load format) in preference to the source.

In compiling a file the compiler has to both compile each function and top level form in the file, and to produce the appropriate FASL directives so that loading has the desired effect. In particular objects need to have space allocated for them, and top level forms are called as they are loaded.

*output-file* specifies the location of the output file, relative to the current directory (not the path of the file). If it specifies a directory, then the output file is placed there instead of the same directory as the source. If it contains a file name but not a file type, then the platform specific file type is added and the result specifies the full path of the output file. If *output-file* has a type, it specifies the full path of the output file. Note that in this case when you want to load the file you will need to add the type to `*binary-file-types*`. See the example below.

The special value *output-file* :`temp` offers a convenient way to specify that the output file is a temporary file in a location that is likely to be writable.

*verbose* controls the printing of messages describing the file being compiled, the current optimization settings, and other information. If *verbose* is `nil`, there are no messages. If *verbose* is `0`, only the "Compiling file..." message is printed. For all other true values of *verbose*, messages are also printed about:

- compiler optimization settings before the file is processed, and
- multiple matches when *input-file* does not specify the pathname type, and

- any clean down (garbage collection) that occurs during the compilation.

The default value is the value of `*compile-verbose*`, which defaults to `t`.

`print` controls the printing of information about the compilation. It can have the following values. If `print` is `nil`, no information is printed. If `print` is a non-positive number, then only warnings are printed. If `print` is a positive number no greater than 1, or if `print` is any non-number object, then the information printed consists of all warning messages and one line of information per function that is compiled. If `print` is a number greater than 1, then full information is printed. The default value of `print` is the value of `*compile-print*`, which has the default value 1.

Warning messages are printed to `*error-output*`. Other messages are printed to `*standard-output*`.

`external-format` is interpreted as for `open`. The default value is `:default`.

If `load` is true, then the file is loaded after compilation. If `load` is the special value `:delete` then the compiled file is deleted after loading it. The source file is not affected. This is especially useful when using `output-file :temp`, to avoid leaving compiled files.

`output-truename` is the `truename` of the output file, or `nil` if that cannot be created.

`warnings-p` is `nil` if no conditions of type `error` or `warning` were detected during compilation. Otherwise `warnings-p` is a list containing the conditions.

`failure-p` is `nil` if no conditions of type `error` or `warning` (other than `style-warning`) were detected by the compiler, and `t` otherwise.

|                     |                                                                                                          |
|---------------------|----------------------------------------------------------------------------------------------------------|
| Compatibility notes | In LispWorks 5.1 and previous versions, warning messages are printed to <code>*standard-output*</code> . |
|---------------------|----------------------------------------------------------------------------------------------------------|

|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Examples | <pre>(compile-file "devel/fred.lisp") ; compile fred.lisp to fred.fasl (compile-file "devel/fred") ; does the same thing  (compile-file "test" :load t) ; compile test.lisp, then load if successful  (compile-file "program" :output-file "program.abc") ; compile "program.lisp" to "program.abc"  (push "abc" sys:*binary-file-types*) ; tells LispWorks that files with extension ; ".abc" are binaries</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Notes    | <p>See <code>declare</code> for a list of the declarations that alter the behavior of the compiler.</p> <p>The act of compiling a file should have no side effects, other than the creation of symbols and packages as the input file is read by the reader.</p> <p>By default a form is skipped if an error occurs during compilation. If you need to debug an error during compilation by <code>compile-file</code>, set <code>*compiler-break-on-error*</code>.</p> <p>During compilation of a file <code>foo.lisp</code> (on an Intel Macintosh, for example) a temporary output file named <code>t_foo.xfasl</code> is used, so that an unsuccessful compile does not overwrite an existing <code>foo.xfasl</code>.</p> <p>LispWorks uses the following naming conventions for fasl files, and it is recommended that you should use them too, to ensure correct operation of <code>load</code> and so on.</p> |

Table 33.1 Naming conventions for FASL files

| Machine/Implementation       | Fasl Extension |
|------------------------------|----------------|
| x86 Windows/32-bit LispWorks | .ofasl         |
| x64 Windows/64-bit LispWorks | .64ofasl       |

Table 33.1 Naming conventions for FASL files

| Machine/Implementation              | Fasl Extension |
|-------------------------------------|----------------|
| x86 Linux/32-bit LispWorks          | .ufasl         |
| amd64 Linux/64-bit LispWorks        | .64ufasl       |
| ARM Linux/32-bit LispWorks          | .rfasl         |
| ARM Linux/64-bit LispWorks          | .64rfasl       |
| x86 FreeBSD/32-bit LispWorks        | .ffasl         |
| amd64 FreeBSD/64-bit LispWorks      | .64ffasl       |
| AIX PowerPC/32-bit LispWorks        | .ifasl         |
| AIX PowerPC/64-bit LispWorks        | .64ifasl       |
| SPARC/32-bit LispWorks              | .wfasl         |
| SPARC/64-bit LispWorks              | .64wfasl       |
| x86 Solaris/32-bit LispWorks        | .sfasl         |
| amd64 Solaris/64-bit LispWorks      | .64sfasl       |
| Intel Macintosh/32-bit LispWorks    | .xfasl         |
| Intel Macintosh/64-bit LispWorks    | .64xfasl       |
| LispWorks for iOS Runtime simulator | .xcfasl        |
| LispWorks for iOS Runtime           | .rfasl         |
| LispWorks for Android Runtime       | .rfasl         |

You can find the fasl file extension appropriate for your machine by looking at the variable `*binary-file-type*`. The variable `*binary-file-types*` contains a list of all the file extensions currently recognized by `load`, `require` and `load-data-file` (in addition to `*binary-file-type*`).

Compatibility notes

1. In LispWorks for Windows 4.4 and previous versions, the fasl file extension is `.fsl`. This changed in LispWorks 5.0.

2. In LispWorks for Linux 4.4 and previous versions, the fasl file extension is `.ufs1`. This changed in LispWorks 5.0.

## See also

`compile`  
`compile-file-if-needed`  
`*compiler-break-on-error*`  
`disassemble`

**concatenate** *Function*

|             |                                                                                                                                                                                                                                                   |  |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Summary     | Extends the standard <code>concatenate</code> function allowing it to take any Common Lisp type.                                                                                                                                                  |  |
| Package     | <code>common-lisp</code>                                                                                                                                                                                                                          |  |
| Signature   | <code>concatenate result-type &amp;rest sequences =&gt; result-sequence</code>                                                                                                                                                                    |  |
| Arguments   | <code>result-type</code> A type specifier.<br><code>sequences</code> A sequence.                                                                                                                                                                  |  |
| Values      | <code>result-sequence</code> A sequence.                                                                                                                                                                                                          |  |
| Description | The function <code>concatenate</code> has been extended to take any Common Lisp type. The <code>result-sequence</code> will be of type <code>result-type</code> unless this is not possible, in which case a <code>type-error</code> is signaled. |  |
| See also    | <code>coerce</code>                                                                                                                                                                                                                               |  |

**declaim** *Macro*

|         |                                       |
|---------|---------------------------------------|
| Summary | Established a specified declarations. |
| Package | <code>common-lisp</code>              |

|             |                                                                                                                                                                                                                                                                                                                         |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signature   | <code>declare &amp;rest declarations</code>                                                                                                                                                                                                                                                                             |
| Arguments   | <i>declarations</i> Declaration forms.                                                                                                                                                                                                                                                                                  |
| Description | The macro <code>declare</code> behaves as specified in the ANSI Common Lisp Standard with one exception: for a top-level call to <code>declare</code> , optimize declarations are omitted from the compiled binary file. This is useful because you are unlikely to want to change these settings outside of that file. |
| See also    | <code>compile-file</code><br><code>declare</code><br><code>proclaim</code>                                                                                                                                                                                                                                              |

| <b>declare</b> |                                                                                                                                                                                                                                                                                                                                                                                                                           | <i>Special Form</i>                     |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
| Summary        | Declares a variable as special, provides advice to the Common Lisp system, or helps the programmer to optimize code.                                                                                                                                                                                                                                                                                                      |                                         |
| Package        | <code>common-lisp</code>                                                                                                                                                                                                                                                                                                                                                                                                  |                                         |
| Signature      | <code>declare declaration*</code>                                                                                                                                                                                                                                                                                                                                                                                         |                                         |
| Arguments      | <i>declaration</i>                                                                                                                                                                                                                                                                                                                                                                                                        | A declaration specifier, not evaluated. |
| Values         | <p>The special form <code>declare</code> behaves computationally as if it is not present (other than to affect the semantics), and is only allowed in certain contexts, such as after the variable list in a <code>let</code>, <code>do</code>, <code>defun</code> and so on.</p> <p>(Consult the syntax definition of each special form to see if it takes <code>declare</code> forms and/or documentation strings.)</p> |                                         |
| Description    | There are three distinct uses of <code>declare</code> : one is to declare Lisp variables as “special” (this affects the semantics of the appropriate bindings of the variables), the second is to pro-                                                                                                                                                                                                                    |                                         |

vide advice to help the Common Lisp system (in reality the compiler) run your Lisp code faster or with more sophisticated debugging options, and the third (using the `:explain` declaration) is to help you optimize your code.

If you use `declare` to specify types (and so eliminate type-checking for the specified symbols) and then supply the wrong type, you may obtain a “Segmentation Violation”. You can check this by interpreting the code (rather than compiling it).

The `declare` special form can be used as documented in the Common Lisp HyperSpec as well as with the following extensions:

- `hcl:special-global` declares that the symbol is never bound.

In SMP LispWorks the compiler signals error if it detects that a symbol declared as `hcl:special-global` is bound, and at run time it also signals an error.

In non-SMP LispWorks the compiler gives an error, but there is no run time check. The run time behavior is the same as `c1:special`, with all accesses to the symbol in low safety.

`hcl:special-global` is very useful, and because of the checks it is reasonably safe. It is useful not only for speed, but also to guard against unintentionally binding variables that should not be bound.

See also `defglobal-parameter`.

- `hcl:special-dynamic` declares that the symbol is never accessed outside the dynamic scope of the binding.

In high safety code accessing the symbol outside the scope of binding signals an error. In low safety code it may result in unpredictable behavior.

In non-SMP LispWorks the only effect of this declaration is to make all access to the variable low safety.

`hcl:special-dynamic` is useful, but because it can lead to unpredictable behavior you need to ensure that you test your program in high safety when you use it.

- `hcl:special-fast-access` declares that a symbol should be "fast access".

The semantics of the declaration is the same as `c1:special`, except that access to the variable is low safety. In addition, the compiler compiles access to the symbol in a way that speeds up the access, but also introduces a tiny reduction in the speed of the whole system. The balance between these effects is not obvious.

It is not obvious where `hcl:special-fast-access` is useful. If you can ensure that the symbol is always bound or never bound then `hcl:special-dynamic` or `hcl:special-global` are certainly better.

- `hcl:lambda-list` specifies the value to be returned when a programmer asks for the arglist of a function.
- `values` specifies the value to be returned when you ask for a description of the results of a function.
- `hcl:invisible-frame` specifies that calls to this function should not appear in a debugger backtrace.
- `hcl:alias` specifies that calls to this function should be displayed as calls to an alternative function in a debugger backtrace.
- `hcl:lambda-name` declares the name of the surrounding lambda.
- `:explain` controls messages printed by the compiler while it is processing forms.

You can also use `define-declaration` to add your own declarations, which do not affect compilation but are useful for code walkers.

Description of **hcl:lambda-name** This section documents the **hcl:lambda-name** declaration, which declares the name of the surrounding lambda. This declaration is useful only for a lambda that becomes a standalone function, that is lambda forms that are passed to **function**.

The dspec of the function that is returned by **function** is specified by the second element in the declaration. In the special case when the second element is a two-element list starting with the symbol **subfunction**, the dspec is that list with the dspec of the parent function added as a third element. For example, if you have:

```
(defun my-parent (x)
  #'(lambda (y)
      (declare (lambda-name (subfunction sub-name)))
      (* x y)))
```

then the dspec of the subfunction that **my-parent** returns would be (**subfunction sub-name my-parent**).

**hcl:lambda-name** is useful for debugging purposes and does not affect the behavior of the program. There are two different situations when **hcl:lambda-name** is useful:

- In a defining form that has a similar effect to the effect of **defun**, (that is creating a "top-level" function at load-time). In this case, you should also use **def** to be able to locate the source. For example, look at the output of  
`(pprint (macroexpand-1 '(defun func-name ()))).`
- In a "run time" subfunction (that is a subfunction created by a code at run time by executing **(function (lambda ...))**). In this case, you should be using the **(subfunction sub-name)** form above, so the recorded name contains the dspec of the parent function, otherwise the debugger will not be able to find the source from the subfunction.

`hcl:lambda-name` will also modify the function name of `flet` and `labels`, but these already have a name, so this is not often useful.

Naming functions and subfunctions is useful because it makes it easier to understand the flow of control when you see them in a backtrace. For subfunctions, it makes it easier to trace and advise them (see `trace` and `defadvice`).

Description of :`explain` The remainder of this description documents the syntax and use of `:explain` declarations.

***declaration*** ::= (:`explain` *option\**)

***option*** ::= *optionkey* | (*optionkey optionvalue*)

***optionkey*** ::= :`none` | :`variables` | :`types` | :`floats` | :`non-floats` | :`all-calls` | :`all-calls-with-arg-types` | :`calls` | :`boxing` | :`print-original-form` | :`print-expanded-form` | :`print-length` | :`print-level`

The `:explain` declaration controls messages printed by the compiler while it is processing forms. The declaration can be used with `proclaim` or `declaim` as a top level form to give it global or file scope. It can also be used at the start of a `#'lambda` form or function body to give it the scope of that function. The declaration has unspecified effect when used in other contexts, for example in the body of a `let` form.

An `:explain` declaration consists of a set of options of the form (*optionkey optionvalue*) which associates *optionvalue* with *optionkey* or *optionkey* which associates `t` with *optionkey*. By default, all of the *optionkeys* have an associated value `nil`. All *optionkeys* not specified by a declaration remain unchanged (except for the special action of the `:none` *optionkey* described below).

The *optionkey* should be one of the following:

**`:none`** Set value associated with all *optionkeys* to `nil`. This turns off all explanations.

|                                  |                                                                                                                                                                                             |
|----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>:variables</b>                | If <i>optionvalue</i> is non-nil, list all the variables of each function, specifying whether they are floating point or not.                                                               |
| <b>:types</b>                    | If <i>optionvalue</i> is non-nil, print information about compiler transformations that depend on declared or deduced type information.                                                     |
| <b>:floats</b>                   | If <i>optionvalue</i> is non-nil, print information about calls to functions that may allocate floats.                                                                                      |
| <b>:non-floats</b>               | If <i>optionvalue</i> is non-nil, print information about calls to functions that may allocate non-float numbers, for example bignums.                                                      |
| <b>:all-calls</b>                | If <i>optionvalue</i> is non-nil, print information about calls to normal functions.                                                                                                        |
| <b>:all-calls-with-arg-types</b> | If <i>optionvalue</i> is non-nil, print the argument types for calls to normal functions. Must be combined with <b>:all-calls</b> .                                                         |
| <b>:calls</b>                    | A synonym for <b>:all-calls</b> .                                                                                                                                                           |
| <b>:boxing</b>                   | If <i>optionvalue</i> is non-nil, print information about calls to functions that may allocate numbers, for example floats or bignums.                                                      |
| <b>:print-original-form</b>      | If <i>optionvalue</i> is non-nil, modifies the <b>:all-calls</b> , <b>:floats</b> and <b>:non-floats</b> explanations to include the original source code form that contains the call.      |
| <b>:print-expanded-form</b>      | If <i>optionvalue</i> is non-nil, modifies the <b>:all-calls</b> , <b>:floats</b> and <b>:non-floats</b> explanations to include the macroexpanded source code form that contains the call. |

- :print-length** Use the *optionvalue* as the value of  
     \***print-length\*** for :all-calls, :floats  
     and :non-floats explanations.
- :print-level** Use the *optionvalue* as the value of  
     \***print-level\*** for :all-calls, :floats  
     and :non-floats explanations.

|         |                                                                                                                                                                                                                                                                                                                                                                               |
|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Example | <pre>(defun foo (arg)   (declare     (:explain :variables)     (optimize (float 0)))   (let* ((double-arg (coerce arg 'double-float))          (next (+ double-arg 1d0))          (other (* double-arg 1/2)))     (values next other)))   ;;- Variables with non-floating point types:   ;;- ARG OTHER   ;;- Variables with floating point types:   ;;- DOUBLE-ARG NEXT</pre> |
|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|          |                                                                                                                                                                                                                        |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| See also | <a href="#">“Compiler control” on page 104</a><br><a href="#">compile</a><br><a href="#">compile-file</a><br><a href="#">proclaim</a><br><a href="#">define-declaration</a><br><a href="#">declaration-information</a> |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                 | <i>Macro</i>                                                                                                                                                                  |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>defclass</b> |                                                                                                                                                                               |
| Summary         | Remains as defined in ANSI Common Lisp, but extra control over parsing of class options and slot options, optimization of slot access, and checking of initargs, is provided. |
| Package         | <code>common-lisp</code>                                                                                                                                                      |
| Description     | The macro <b>defclass</b> is as defined in the ANSI standard with the following extensions.                                                                                   |

For extra class options, you may need to define the way these are parsed at `defclass` macroexpansion time. See `process-a-class-option` for details.

For non-standard slot options, you may need to define the way these are parsed at `defclass` macroexpansion time. See `process-a-slot-option` for details.

By default, standard slot accessors are optimized such that they do not call `slot-value-using-class`. This optimization can be switched off using the `:optimize-slot-access nil` class option.

To add valid initialization arguments for the class, use the class option `:extra-initargs`. The argument passed via this option is evaluated, and should return a list of extra initialization arguments for the class. `make-instance` and other CLOS initializations (see `set-clos-initarg-checking`) will treat these as valid when checking their arguments.

Compatibility notes

1. When a class is redefined, its extra initargs are always reset.
2. In early versions of LispWorks 4.3, extra initargs were not reset when a class was redefined without specifying extra initargs.

Example

This session illustrates the effects of the `:optimize-slot-access` class option. When true, slot access is more efficient but note that `slot-value-using-class` is not called.

```

CL-USER 26 > (compile '(defclass foo ()
  ((a :type fixnum
    :initarg :a
    :reader foo-a))))
NIL

CL-USER 27 > (compile '(defclass bar ()
  ((a :type fixnum
    :initarg :a
    :reader bar-a))
  (:optimize-slot-access nil)))
NIL

CL-USER 28 > (setf *foo*
  (make-instance 'foo :a 42)
  *bar* (make-instance 'bar :a 99))
#<BAR 21D33D4C>

CL-USER 29 > (progn
  (time (dotimes (i 1000000)
    (foo-a *foo*)))
  (time (dotimes (i 1000000)
    (bar-a *bar*))))
Timing the evaluation of (DOTIMES (I 1000000) (FOO-A
*FOO*))

user time      =      0.328
system time   =      0.015
Elapsed time =  0:00:00
Allocation   = 2280 bytes standard / 11002882 bytes
conses
0 Page faults
Timing the evaluation of (DOTIMES (I 1000000) (BAR-A
*BAR*))

user time      =      0.406
system time   =      0.015
Elapsed time =  0:00:00
Allocation   = 4304 bytes standard / 11004521 bytes
conses
0 Page faults
NIL

CL-USER 30 > (trace
  (clos:slot-value-using-class
  :when
  (and (member (first *traced-arglist*)

```

```
(list (find-class 'foo)
      (find-class 'bar)))
      (eq (third *traced-arglist*) 'a))))
(CLOS:SLOT-VALUE-USING-CLASS)

CL-USER 31 > (foo-a *foo*)
42

CL-USER 32 > (bar-a *bar*)
0 CLOS:SLOT-VALUE-USING-CLASS > ...
  >> CLASS          : #<STANDARD-CLASS BAR 214897F4>
  >> CLOS::OBJECT    : #<BAR 2148820C>
  >> CLOS::SLOT-NAME : A
0 CLOS:SLOT-VALUE-USING-CLASS < ...
  << VALUE-0 : 99
99
```

This session illustrates the `:extra-initargs` class option:

```

CL-USER 46 > (defclass a () ())
              (:extra-initargs '(:a-initarg)))
#<STANDARD-CLASS A 21C2E4FC>

CL-USER 47 > (defclass b (a) ())
              (:extra-initargs '(:b-initarg)))
#<STANDARD-CLASS B 2068573C>

CL-USER 48 > (defclass c (a) ())
#<STANDARD-CLASS C 22829D44>

CL-USER 49 > (make-instance 'b :a-initarg "A" :b-
initarg "B")
#<B 2068BCE4>

CL-USER 50 > (make-instance 'c :a-initarg "A" :b-
initarg "B")

Error: MAKE-INSTANCE is called with unknown keyword :B-
INITARG among the arguments (C :A-INITARG "A" :B-
INITARG "B") which is not one of (:A-INITARG).
 1 (continue) Ignore the keyword :B-INITARG
 2 (abort) Return to level 0.
 3 Return to top loop level 0.

Type :b for backtrace, :c <option number> to proceed,
or :? for other options

CL-USER 51 : 1 >

```

See also      [process-a-class-option](#)  
[process-a-slot-option](#)

## defpackage *Macro*

|           |                                                                                                        |
|-----------|--------------------------------------------------------------------------------------------------------|
| Summary   | Remains as defined in Common Lisp, but see <code>*handle-existing-defpackage*</code> for an extension. |
| Package   | <code>common-lisp</code>                                                                               |
| Signature | <code>defpackage defined-package-name [[option]] =&gt; package</code>                                  |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                      |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| Arguments   | <i>defined-package-name</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | A string designator. |
|             | <i>option</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Keyword options.     |
|             | <i>add-use-defaults</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | A keyword            |
| Values      | <i>package</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | A package.           |
| Description | <p>The macro <code>defpackage</code> is as defined in the ANSI standard, with the inclusion of the <code>:add-use-defaults</code> keyword. However, the standard explicitly declines to define what <code>defpackage</code> does if a package named <i>defined-package-name</i> already exists and is in a state that differs from that described by the <code>defpackage</code> form.</p> <p>Therefore an extension has been written that allows you to select between alternative behaviors. See <code>*handle-existing-defpackage*</code> for full details.</p> <p>One non-standard <i>option</i> is supported. <code>:add-use-defaults</code>, with a true argument, causes the package <i>defined-package-name</i> to inherit from the following packages (as well as any explicitly specified by the <code>:use</code> option):</p> <ul style="list-style-type: none"> <li>• <code>common-lisp</code></li> <li>• <code>lispworks</code></li> <li>• <code>harlequin-common-lisp</code></li> </ul> |                      |
| Example     | <pre>(defpackage "MY-PACKAGE" (:use "CAPI")             (:add-use-defaults t))  (package-use-list "MY-PACKAGE") =&gt; (#&lt;PACKAGE COMMON-LISP&gt; #&lt;PACKAGE LISPWORKS&gt; #&lt;PACKAGE HARLEQUIN-COMMON-LISP&gt; #&lt;PACKAGE CAPI&gt;)</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                      |
| See also    | <code>*handle-existing-defpackage*</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                      |

|             |                                                                                                                                                                                                                                                                                                                                                             | <i>Function</i> |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Summary     | Remains as defined in ANSI Common Lisp. Additionally, you can control the depth at which slots inside arrays, structures and conses are described.                                                                                                                                                                                                          |                 |
| Package     | <code>common-lisp</code>                                                                                                                                                                                                                                                                                                                                    |                 |
| Signature   | <code>describe <i>object</i> &amp;optional <i>stream</i> =&gt; &lt;no-values&gt;</code>                                                                                                                                                                                                                                                                     |                 |
| Arguments   | <p><i>object</i>            An object.</p> <p><i>stream</i>          An output stream designator.</p>                                                                                                                                                                                                                                                       |                 |
| Description | <p>The function <code>describe</code> displays information about the object object to the stream indicated by stream, as specified in ANSI Common Lisp.</p> <p>Arrays, structures and conses are described recursively up to the depth given in the value of the variable <code>*describe-level*</code>. Beyond that depth, objects are simply printed.</p> |                 |
| See also    | <code>*describe-length*</code><br><code>*describe-level*</code><br><code>*describe-print-length*</code><br><code>*describe-print-level*</code>                                                                                                                                                                                                              |                 |

|           |                                                                                                                                                                                                  | <i>Function</i> |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Summary   | Determines which files on the system have names matching a given pathname.                                                                                                                       |                 |
| Package   | <code>common-lisp</code>                                                                                                                                                                         |                 |
| Signature | <code>directory <i>pathname</i> &amp;key <i>test</i> <i>directories</i> <i>flat-file-namestring</i> <i>link-transparency</i> <i>non-existent-link-destinations</i> =&gt; <i>pathnames</i></code> |                 |
| Arguments | <i>pathname</i> A pathname, string, or file-stream.                                                                                                                                              |                 |

|                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>test</i>                           | Filtering test (only pathnames matching the test are collected).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <i>directories</i>                    | A boolean controlling whether non-matching directories are included in the result.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <i>flat-file-namestring</i>           | A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <i>link-transparency</i>              | If <code>nil</code> , then symbolic links are not followed. This means that returned names are not necessarily truenames, but has the useful feature that the <code>pathname-directory</code> of each pathname returned is the directory supplied as argument.<br><br>The default value of <i>link-transparency</i> is given by the special variable, <code>*directory-link-transparency*</code> , which has initial value <code>t</code> on non-Windows platforms. By setting this variable to <code>nil</code> , you can get the old behavior of <code>directory</code> . On Windows, where the file system does not normally support symbolic links, this variable is initially <code>nil</code> . |
| <i>non-existent-link-destinations</i> | If this is non-nil, then the pathname pointed to by a symbolic link appears in the output whether or not this file actually exists. If <code>:link-transparency</code> is non-nil and <code>:non-existent-link-destinations</code> is <code>nil</code> (this is the default on non-Windows platforms), then symbolic links to nonexistent files do not appear.<br><br>The default value is <code>nil</code> .                                                                                                                                                                                                                                                                                         |
| Values                                | <i>pathnames</i><br>A list of physical pathnames.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p><code>directory</code> collects all the pathnames matching the given pathname.</p> <p><code>directory</code> returns truenames, conforming to the ANSI specification for Common Lisp. Some programs may depend on the old behavior, however (and <code>directory</code> is slower if it has to find the truename for every file in the directory), and so two keyword arguments are available so that the old behavior can still be used: <i>link-transparency</i> and <i>non-existent-link-destinations</i>.</p> <p>Because truenames are now returned, the entries <code>.</code> and <code>..</code> no longer show up in the output of <code>directory</code>. This means, for instance, that</p> <pre>(directory #P"/usr/users/")</pre> <p>does not include <code>#P"/usr"</code>, which is the truename of <code>#P"/usr/users/.."</code></p> <p>The specification is unclear as to the appropriate behavior of <code>directory</code> in the presence of links to non-existent files or directories. For example, if the directory contains <code>foo</code>, which is a symbolic link to <code>bar</code>, and there is no file named <code>bar</code>, should <code>bar</code> show up in the directory listing? A keyword argument has been added which lets you control this behavior.</p> <p><code>directory</code> returns a single pathname if called with a non-wild (fully-specified) <i>pathname</i>. LispWorks <i>truenames</i> are fully-specified, so this affects recursive calls to <code>directory</code>.</p> <p><code>directories</code>, if non-nil, causes paths of directories that are sub-directories of the directory of the argument <i>pathname</i> to be included in the result, even if they do not match <i>pathname</i> in the name, type or version components. The default value of <code>directories</code> is <code>nil</code>.</p> <p>When <code>flat-file-namestring</code> is non-nil, <code>directory</code> matches the <code>file-namestring</code> of <i>pathname</i> as a flat string, rather than a</p> |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

pathname name and pathname type. The default value of *flat-file-namestring* is `nil`.

## Notes

1. The Search files tool in the LispWorks IDE uses this option when the **Match flat file-namestring** option is selected. See the *LispWorks IDE User Guide* for more information about the Search Files tool.
2. File names containing the character \* cannot be handled by LispWorks. This is because LispWorks uses \* as a wildcard, so there can be confusion if a file name containing \* is created, for example in the *pathnames* returned by `directory`.
3. The function `fast-directory-files` can be used for faster operations when operating on directories with large number of files.

## Compatibility notes

The `:check-for-subs` argument, implemented in LispWorks 4.0.1 and previous versions, has been removed. This argument controlled whether directories in the result have null name components. This option is no longer valid since ANSI Common Lisp specifies that `directory` returns true-names.

## Example

```
CL-USER 1 > (pprint (directory "."))
(#P"C:/Program Files/LispWorks/readme-6-1.txt"
 #P"C:/Program Files/LispWorks/lispworks-6-1-0-x86-
win32.exe"
 #P"C:/Program Files/LispWorks/license-6-1.txt"
 #P"C:/Program Files/LispWorks/lib/")
```

This session illustrates the effect of the *directories* argument:

```

CL-USER 5 > (pprint (directory "/tmp/t*"))

(#P"/tmp/test.lisp" #P"/tmp/test2/" #P"/tmp/test1/")

CL-USER 6 > (pprint (directory "/tmp/t*" :directories
t))

(#P"/tmp/patches/"
 #P"/tmp/test.lisp"
 #P"/tmp/test2/"
 #P"/tmp/opengl/"
 #P"/tmp/test1/"
 #P"/tmp/mnt/")

```

This example illustrates directory returning a single pathname in its result when given a full-specified pathname:

```

CL-USER 1 > (directory
               (make-pathname :host "H"
                             :device :unspecific
                             :directory (list :absolute
   "tmp")
                             :name :unspecific
                             :type :unspecific
                             :version :unspecific))
               (#P"H:/tmp/")

```

The next two examples illustrate the effect of *flat-file-namestring*. Suppose the directory *dir* contains files *interp.exe* and *file.lisp*.

This call matches *interp.exe*, where the name *interp* ends with *p*, but does not match *file.lisp*, where the name *file* ends with *e*:

```
(directory "dir/*p")
```

The next call matches *file.lisp*, where the namestring *file.lisp* ends with *p*, but does not match *interp.exe*, where the namestring *interp.exe* ends with *e*:

```
(directory "dir/*p" :flat-file-namestring t)
```

See also      **fast-directory-files**  
**truename**

| <b>disassemble</b> | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary            | Prints the machine code of a compiled function.                                                                                                                                                                                                                                                                                                                                                                                                           |
| Package            | <code>common-lisp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Signature          | <code>disassemble name-or-function =&gt; nil</code>                                                                                                                                                                                                                                                                                                                                                                                                       |
| Arguments          | <code>name-or-function</code> Either a function object, a lambda expression or a symbol with a function definition.                                                                                                                                                                                                                                                                                                                                       |
| Description        | <p>This function prints the machine code of a compiled function, to <code>*standard-output*</code>.</p> <p>If the function denoted by <code>name-or-function</code> is not compiled then it is first compiled using the function <code>compile</code>. This happens if <code>name-or-function</code> is a lambda expression or a symbol naming an interpreted function.</p> <p>An error is signaled if <code>name-or-function</code> is not suitable.</p> |
| Examples           | <pre>(disassemble #'(lambda (x) (progn x))) (disassemble 'cons) (disassemble #'map)</pre>                                                                                                                                                                                                                                                                                                                                                                 |
| Notes              | The output from <code>disassemble</code> lacks useful information such as local and lexical variable names. The representation of integers or characters or Lisp objects in general is not easily readable without detailed knowledge of the internals of the Lisp system and the host machine instruction set.                                                                                                                                           |
| See also           | <code>compile</code><br><code>compile-file</code>                                                                                                                                                                                                                                                                                                                                                                                                         |

| <b>documentation</b> | <i>Generic Function</i>                        |
|----------------------|------------------------------------------------|
| Summary              | Returns the documentation string if available. |

|                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package             | <code>common-lisp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Signature           | <code>documentation x doc-type =&gt; documentation</code><br><code>(setf documentation) new-value x doc-type =&gt; new-value</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Description         | <p>The generic function <code>documentation</code> operates as specified in the ANSI Common Lisp standard. Additional methods with signatures:</p> <pre>documentation (dspec t) (doc-type (eql 'dspec:dspec)) (setf documentation) new-value (dspec t) (doc-type (eql 'dspec:dspec))</pre> <p>are provided.</p> <p>This method allows finding or setting the documentation string when you know the <code>dspec</code>. See Chapter 7, “Dspecs: Tools for Handling Definitions” for information about <code>dspecs</code>.</p> <p><code>dspec</code> must be a <code>dspec</code>, but it can be non-canonical. This method canonicalizes <code>dspec</code> and then calls <code>documentation</code> with the name as the first argument and the appropriate <code>dspec</code> class name as the second, thereby calling a standard <code>documentation</code> method.</p> <p>If you define your own type of definitions (<code>def-saved-value</code> for example) with <code>define-dspec-class</code> you can add methods on <code>documentation</code> for your <code>dspec</code> class:</p> <pre>(documentation (dspec t) (doc-type (eql 'def-saved-value)))</pre> <p>This allows commands in the LispWorks IDE such as <b>Expression &gt; Documentation</b> to display the documentation.</p> |
| <b>double-float</b> | <i>Type</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Summary             | A subtype of <code>float</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

|                     |                                                                                                                                                                                                                                                                                                  |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package             | <code>common-lisp</code>                                                                                                                                                                                                                                                                         |
| Signature           | <code>double-float</code>                                                                                                                                                                                                                                                                        |
| Description         | <code>double-float</code> is disjoint from <code>short-float</code> and <code>single-float</code> in all LispWorks implementations in version 5.0 and later.                                                                                                                                     |
| Compatibility notes | In LispWorks 4.4 and previous on Windows and Linux platforms, all floats are of type <code>double-float</code> . However, there are distinct specialized array types ( <code>(array single-float)</code> , with single precision, and <code>(array double-float)</code> , with double precision. |
| See also            | <code>long-float</code><br><code>parse-float</code><br><code>short-float</code><br><code>single-float</code>                                                                                                                                                                                     |

| <b>*features*</b> |                                                                                                                                             | <i>Variable</i>                                   |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|
| Summary           | The features list.                                                                                                                          |                                                   |
| Package           | <code>common-lisp</code>                                                                                                                    |                                                   |
| Initial value     | A list containing <code>:lispworks</code> . The actual value varies depending on the platform.                                              |                                                   |
| Description       | The following features can be used to distinguish between platforms, or characteristics of the platform or of the LispWorks implementation. |                                                   |
|                   | <code>:solaris2</code>                                                                                                                      | Solaris2                                          |
|                   | <code>:aix</code>                                                                                                                           | AIX PowerPC                                       |
|                   | <code>:svr4</code>                                                                                                                          | System 5 Release 4 machine (for example Solaris2) |

|                                    |                                                                                                                                                                                                                                                    |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>:linux</code>                | Linux                                                                                                                                                                                                                                              |
| <code>:darwin</code>               | The variant of FreeBSD underlying Mac OS X.                                                                                                                                                                                                        |
| <code>:unix</code>                 | Unix, including all of the above.                                                                                                                                                                                                                  |
| <code>:mswindows</code>            | Microsoft Windows, including 32-bit and 64-bit.                                                                                                                                                                                                    |
| <code>:lispworks-64bit</code>      | 64-bit LispWorks.                                                                                                                                                                                                                                  |
| <code>:lispworks-32bit</code>      | 32-bit LispWorks.                                                                                                                                                                                                                                  |
| <code>:x86</code>                  | All images that run on the x86 architecture have this feature. This includes Intel Macintosh, FreeBSD, x86/x86_x64 Linux (32-bit), x86/x64 Solaris (32-bit) and Windows (32-bit).<br><br><b>Note:</b> 64-bit LispWorks does not have this feature. |
| <code>:amd64, :x86-64, :x64</code> | Images that run on the amd64/x86_64/x64 architecture have each of these features. This includes x86_x64 Linux (64-bit), FreeBSD (64-bit), x86/x64 Solaris (64-bit) and Windows (64-bit).                                                           |
| <code>:arm</code>                  | Images that run on 32-bit ARM architecture.                                                                                                                                                                                                        |
| <code>:arm64</code>                | Images that run on 64-bit ARM architecture.                                                                                                                                                                                                        |
| <code>:sparc</code>                | Images that run on SPARC architecture.                                                                                                                                                                                                             |
| <code>:powerpc</code>              | Images that run on PowerPC architecture.                                                                                                                                                                                                           |
| <code>:android-delivery</code>     | Images generating Android runtimes.                                                                                                                                                                                                                |
| <code>:ios-delivery</code>         | Images generating iOS runtimes.                                                                                                                                                                                                                    |

**:little-endian** The compiler targets a little-endian machine, for instance x86.

The following features are present in LispWorks with the meanings defined for ANSI CL:

```
:ansi-cl  
:common-lisp  
:ieee-floating-point
```

### Conditionalization for the LispWorks implementations

Code can distinguish the seventeen current LispWorks implementations like this:

```

#+(and :mswindows :x86)
" LispWorks (32-bit) for Windows"
#+(and :mswindows :x86-64)
" LispWorks (64-bit) for Windows"
#+(and :linux :x86)
" LispWorks (32-bit) for x86/x86_64 Linux"
#+(and :linux :x86-64)
" LispWorks (64-bit) for x86_64 Linux"
#+(and :linux :arm
      (not :android-delivery)
      (not :ios-delivery))
" LispWorks (32-bit) for ARM Linux"
#+(and :linux :arm64
      (not :android-delivery)
      (not :ios-delivery))
" LispWorks (64-bit) for ARM Linux"
#+(and :freebsd :x86)
" LispWorks (32-bit) for FreeBSD"
#+(and :freebsd :x86-64)
" LispWorks (64-bit) for FreeBSD"
#+(and :aix :lispworks-32bit)
" LispWorks (32-bit) for AIX"
#+(and :aix :lispworks-64bit)
" LispWorks (64-bit) for AIX"
#+(and :darwin :x86 (not :ios-delivery))
" LispWorks (32-bit) for Macintosh"
#+(and :darwin :x86-64)
" LispWorks (64-bit) for Macintosh"
#+(and :solaris2 :x86)
" LispWorks (32-bit) for x86/x64 Solaris"
#+(and :solaris2 :x86-64)
" LispWorks (64-bit) for x86/x64 Solaris"
#+(and :sparc :lispworks-32bit)
" LispWorks (32-bit) for SPARC Solaris"
#+(and :sparc :lispworks-64bit)
" LispWorks (64-bit) for SPARC Solaris"
#+:android-delivery
" LispWorks (32-bit) for Android Runtime"
#+(and :ios-delivery :x86)
" LispWorks (32-bit) for iOS Runtime simulator"
#+(and :ios-delivery :x86-64)
" LispWorks (64-bit) for iOS Runtime simulator"
#+(and :ios-delivery :arm)
" LispWorks (32-bit) for iOS Runtime"
#+(and :ios-delivery :arm)
" LispWorks (64-bit) for iOS Runtime"

```

## Conditionalization for LispWorks versions

The following features can be used to distinguish between versions of LispWorks:

- `:lispworks4` All major version 4 releases.
- `:lispworks4.4` Release 4.4.x
- `:lispworks5` All major version 5 releases.
- `:lispworks5.0` Release 5.0.x
- `:lispworks5.1` Release 5.1.x
- `:lispworks6` All major version 6 releases.
- `:lispworks6.0` Release 6.0.x
- `:lispworks6.1` Release 6.1.x
- `:lispworks7` All major version 7 releases.
- `:lispworks7.0` Release 7.0.x
- `:lispworks7.1` Release 7.1.x

Code using new LispWorks functionality should be conditionalized only using features representing earlier versions, so as to future-proof your code:

```
(defvar *feature-added-in-LispWorks-7.1*
  #+(or lispworks4 lispworks5 lispworks6 lispworks7.0)
nil
  #-(or lispworks4 lispworks5 lispworks6 lispworks7.0)
t)
```

This is because a feature added in LispWorks 7.1 will generally also be in LispWorks 7.2, LispWorks 8.0 and all later versions.

Similarly:

```
(defvar *feature-added-in-LispWorks-7.0*
  #+(or lispworks4 lispworks5 lispworks6) nil
  #-(or lispworks4 lispworks5 lispworks6) t)
```

or:

```
(defvar *feature-added-in-LispWorks-6.1*
  #+(or lispworks4 lispworks5 lispworks6.0) nil
  #-(or lispworks4 lispworks5 lispworks6.0) t)
```

We have seen several problematic examples like this:

```
(defvar *feature-added-in-LispWorks-6.0*
  #+lispworks6 t
  #-lispworks6 nil)
```

which breaks in LispWorks 7.0, because that release does not contain the `:lispworks6` feature.

In general you should use the `:lispworksx` and `:lisp-worksx.y` features "in reverse". That is, make your code work for the latest version of LispWorks and then add conditionalization for any previous versions that you want to support, if needed.

## Conditionalization for the LispWorks architectures

Every LispWorks 5, LispWorks 6 and LispWorks 7 image has exactly one of the features `:lispworks-32bit` and `:lisp-works-64bit`.

The two LispWorks architectures, 32-bit and 64-bit, can be distinguished by the features `:lispworks-32bit` or `:lisp-works-64bit`.

### Notes

1. For a LispWorks image with the CAPI loaded, `:capi` will appear on `*features*`.
2. LispWorks for Macintosh supports the native Mac OS X Cocoa-based GUI and the X11/GTK+ GUI. If you need to test for which of these libraries is loaded, check for the features `:cocoa` and `:gtk`. The X11/Motif GUI is also available by evaluating (`(require "capi-motif")`) in the GTK+ image.

3. Sometimes it is necessary to write code that examines `*features*` at load-time or run-time. For example this is true when you put platform-dependent code in fasl files that are shared between multiple platforms.

## **input-stream-p** *Generic Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                        |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Summary     | A generic function that determines if an object is an input stream.                                                                                                                                                                                                                                                                                                                                                                                                                    |                        |
| Package     | <code>common-lisp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                        |
| Signature   | <code>input-stream-p stream =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                        |                        |
| Arguments   | <code>stream</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | A stream.              |
| Values      | <code>result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | A generalized boolean. |
| Description | The predicate <code>input-stream-p</code> is implemented as a generic function. The default method returns <code>t</code> if <code>stream</code> is an input stream. If the user wants to implement a stream with no inherent directionality (and thus does not include <code>fundamental-input-stream</code> or <code>fundamental-output-stream</code> ) but for which the directionality depends on the instance, then a method should be provided for <code>input-stream-p</code> . |                        |
| Examples    | There is an example in “Stream directionality” on page 400.                                                                                                                                                                                                                                                                                                                                                                                                                            |                        |
| See also    | <code>fundamental-input-stream</code><br><code>output-stream-p</code>                                                                                                                                                                                                                                                                                                                                                                                                                  |                        |

## **interactive-stream-p** *Function*

|         |                                                                           |
|---------|---------------------------------------------------------------------------|
| Summary | A generic function that determines if an object is an interactive stream. |
|---------|---------------------------------------------------------------------------|

|             |                                                                                                                                                                                           |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>c1</code>                                                                                                                                                                           |
| Signature   | <code>interactive-stream-p stream =&gt; result</code>                                                                                                                                     |
| Arguments   | <code>stream</code> A stream.                                                                                                                                                             |
| Values      | <code>result</code> A generalized boolean.                                                                                                                                                |
| Description | The predicate <code>interactive-stream-p</code> is implemented as a generic function. The <code>fundamental-stream</code> class provides a default method that returns <code>nil</code> . |
| See also    | <code>input-stream-p</code><br><code>output-stream-p</code>                                                                                                                               |

| <b>load-logical-pathname-translations</b> |                                                                                                                                                                | <i>Function</i> |
|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Summary                                   | Searches for and loads the definition of a logical host, if not already defined.                                                                               |                 |
| Package                                   | <code>c1</code>                                                                                                                                                |                 |
| Signature                                 | <code>load-logical-pathname-translations host =&gt; just-loaded</code>                                                                                         |                 |
| Arguments                                 | <code>host</code> A logical host, expressed as a string.                                                                                                       |                 |
| Values                                    | <code>just-loaded</code> A generalized boolean                                                                                                                 |                 |
| Description                               | This function loads the translations for <code>host</code> by loading the file <code>host.lisp</code> from the LispWorks directory <code>translations</code> . |                 |
| Example                                   | <code>(load-logical-pathname-translations "EDITOR-SRC")</code>                                                                                                 |                 |

|                   |                                                                                                                |             |
|-------------------|----------------------------------------------------------------------------------------------------------------|-------------|
| <b>long-float</b> |                                                                                                                | <i>Type</i> |
| Summary           | A subtype of <code>float</code> .                                                                              |             |
| Package           | <code>common-lisp</code>                                                                                       |             |
| Signature         | <code>long-float</code>                                                                                        |             |
| Description       | <code>long-float</code> is the same type as <code>double-float</code> in LispWorks, on all platforms.          |             |
| See also          | <code>double-float</code><br><code>parse-float</code><br><code>short-float</code><br><code>single-float</code> |             |

|                       |                                                                                                                                                                                                                   |                 |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>long-site-name</b> |                                                                                                                                                                                                                   | <i>Function</i> |
| Summary               | Identifies the physical location of the computer.                                                                                                                                                                 |                 |
| Package               | <code>common-lisp</code>                                                                                                                                                                                          |                 |
| Signature             | <code>long-site-name =&gt; description</code><br><code>(setf long-site-name) description =&gt; description</code>                                                                                                 |                 |
| Arguments             | <code>description</code> A string or <code>nil</code> .                                                                                                                                                           |                 |
| Description           | The function <code>long-site-name</code> returns a string identifying the physical location of the computer. This should be set using <code>(setf long-site-name)</code> when you configure your LispWorks image. |                 |
| See also              | <code>short-site-name</code>                                                                                                                                                                                      |                 |

## loop

*Macro*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Summary     | A macro that performs iteration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                       |
| Package     | cl                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                       |
| Signature   | <pre>loop {for as} var [type-spec]       being {the each}{records record}       {in of} query-expression =&gt; result</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                       |
| Arguments   | var                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | A variable.           |
|             | <i>query-expression</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | A SQL query-statement |
| Values      | <i>result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | An object.            |
| Description | <p>The Common Lisp <code>loop</code> macro has been extended with a clause for iterating over query results. This extension is available only when the SQL interface has been loaded. See Chapter 47, “The SQL Package”. For a full description of the rest of the Common Lisp <code>loop</code> facility, see the Common Lisp Hyperspec.</p> <p>Each iteration of the loop assigns the next record of the table to the variable <code>var</code>. The record is represented in Lisp as a list. Destructuring can be used in <code>var</code> to bind variables to specific attributes of the records resulting from <i>query-expression</i>. In conjunction with the panoply of existing clauses available from the <code>loop</code> macro, the new iteration clause provides an integrated report generation facility.</p> |                       |
| Example     | <p>This extended <code>loop</code> example, on each record returned as a result of the query, binds <code>name</code>, finds the salary (if any) from an associated hash-table, and for salaries greater than 20000: increments a count, accumulates the salary, and prints the details. Finally, the average salary is printed.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                       |

```
(loop
  for (name) being each record in
  [select [ename] :from [emp]]
  as salary = (gethash name *salary-table*)
  initially (format t "~&~20A~10D" 'name 'salary)
  when (and salary (> salary 20000))
    count salary into salaries
    and sum salary into total
    and do (format t "~&~20A~10D" name salary)
  else
    do (format t "~&~20A~10A" name "N/A")
  finally
    (format t "~2&Av Salary: ~10D" (/ total salaries)))
```

## See also

`do-query`  
`map-query`  
`query`  
`select`

**make-array***Function*

|           |                                                                                                                                                                                                     |                                                                                                                                     |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| Summary   | Creates and returns a new array which, in addition to the standard functionality, can be a weak array or statically allocated.                                                                      |                                                                                                                                     |
| Package   | <code>common-lisp</code>                                                                                                                                                                            |                                                                                                                                     |
| Signature | <code>make-array dimensions &amp;key element-type initial-element initial-contents adjustable fill-pointer displaced-to displaced-index-offset weak allocation single-thread =&gt; new-array</code> |                                                                                                                                     |
| Arguments | <code>weak</code>                                                                                                                                                                                   | A generalized boolean.                                                                                                              |
|           | <code>allocation</code>                                                                                                                                                                             | <code>nil</code> or one of the keywords <code>:new</code> , <code>:static</code> , <code>:old</code> and <code>:long-lived</code> . |
|           | <code>single-thread</code>                                                                                                                                                                          | A generalized boolean.                                                                                                              |

Description The standard definition of `make-array` is extended to accept the keyword arguments `:weak`, `:allocation` and `:single-thread`.

If `weak` is non-nil, then `displaced-to` must be `nil` and if `element-type` is supplied it must have `upgraded-array-element-type t`, otherwise an error is signaled. That is, you cannot make a weak array which is displaced or has `array-element-type` other than `t`. When `weak` is non-nil, it makes `new-array` weak.

If `weak` is `nil`, then `make-array` behaves in the standard way, and `new-array` is not weak. The value `weak` defaults to `nil`. In 64-bit LispWorks, `allocation` cannot be used with `weak` and the length of a weak array must be less than 4194304 ( $2^{22}$ ) elements.

See `set-array-weak` for a description of weak arrays.

The possible values for `allocation` have the following meanings:

- `:new` Allocate the array normally.
- `nil` Same meaning as `:new`. This is the default value.
- `:static` Allocate the array in a static segment.
- `:long-lived` Allocate the array assuming it is going to be long-lived.
- `:old` Same meaning as `:long-lived`

Arrays (including strings) that are passed by address to foreign functions must be static, and so must should be created with `:allocation :static`.

Allocation with `:old` or `:long-lived` is useful when you know that the array will be long-lived, because your program will avoid the overhead of promoting it to the older generations.

If *single-thread* is true then the system knows that *new-array* will always be accessed in a single thread context. That makes some operations faster, in particular `vector-pop` and `vector-push`. The default value of *single-thread* is `nil`.

|                     |                                                                                                                                                                                                                                                                           |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Compatibility notes | <i>allocation</i> can also be a fixnum <i>n</i> but this is now deprecated. The intent was to allocate the array in generation <i>n</i> , however the allocation is not actually guaranteed to be in the specified generation (although it will be in almost every call). |
| See also            | <a href="#">array-weak-p</a><br><a href="#">set-array-single-thread-p</a><br><a href="#">set-array-weak</a><br>“Freeing of objects by the GC” on page 165                                                                                                                 |

|                      | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |                                                                                                                                                   |                      |                                                                          |                  |                                                                                                                                                                        |                      |                        |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|--------------------------------------------------------------------------|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|------------------------|
| Summary              | Creates and returns a new hash table which, in addition to the standard functionality, can have a user-defined test, a user-defined hash function, and be a weak hash table.                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |                                                                                                                                                   |                      |                                                                          |                  |                                                                                                                                                                        |                      |                        |
| Package              | <code>common-lisp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |                                                                                                                                                   |                      |                                                                          |                  |                                                                                                                                                                        |                      |                        |
| Signature            | <code>make-hash-table &amp;key test size rehash-size rehash-threshold hash-function weak-kind single-thread free-function -&gt; hash-table</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |                                                                                                                                                   |                      |                                                                          |                  |                                                                                                                                                                        |                      |                        |
| Arguments            | <table> <tr> <td><i>test</i></td><td>A designator for a function of two arguments, which returns <code>t</code> if they should be regarded as the same and <code>nil</code> otherwise.</td></tr> <tr> <td><i>hash-function</i></td><td>A designator for a function of one argument, which returns a hash value.</td></tr> <tr> <td><i>weak-kind</i></td><td><code>t</code>, <code>nil</code>, or one of the keywords <code>:value</code>, <code>:key</code>, <code>:both</code>, <code>:one</code> and <code>:either</code>.</td></tr> <tr> <td><i>single-thread</i></td><td>A generalized boolean.</td></tr> </table> | <i>test</i> | A designator for a function of two arguments, which returns <code>t</code> if they should be regarded as the same and <code>nil</code> otherwise. | <i>hash-function</i> | A designator for a function of one argument, which returns a hash value. | <i>weak-kind</i> | <code>t</code> , <code>nil</code> , or one of the keywords <code>:value</code> , <code>:key</code> , <code>:both</code> , <code>:one</code> and <code>:either</code> . | <i>single-thread</i> | A generalized boolean. |
| <i>test</i>          | A designator for a function of two arguments, which returns <code>t</code> if they should be regarded as the same and <code>nil</code> otherwise.                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |                                                                                                                                                   |                      |                                                                          |                  |                                                                                                                                                                        |                      |                        |
| <i>hash-function</i> | A designator for a function of one argument, which returns a hash value.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |                                                                                                                                                   |                      |                                                                          |                  |                                                                                                                                                                        |                      |                        |
| <i>weak-kind</i>     | <code>t</code> , <code>nil</code> , or one of the keywords <code>:value</code> , <code>:key</code> , <code>:both</code> , <code>:one</code> and <code>:either</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |                                                                                                                                                   |                      |                                                                          |                  |                                                                                                                                                                        |                      |                        |
| <i>single-thread</i> | A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |                                                                                                                                                   |                      |                                                                          |                  |                                                                                                                                                                        |                      |                        |

|                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>free-function</i> | A designator for a function of two arguments.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Description          | <p>The standard definition of <code>make-hash-table</code> is extended such that <i>test</i> can be any suitable user-defined function, except that it must not call <code>process-wait</code> or similar <code>mp</code> package functions which suspend the current process. If <i>test</i> is not one of the standard test functions (<code>eq</code>, <code>eq1</code>, <code>equal</code> and <code>equalp</code>), and if <i>hash-function</i> is not supplied, then the hash value is the same as would be used if <i>test</i> were <code>equalp</code>.</p> <p><i>hash-function</i> may be supplied only if <i>test</i> is not one of the standard test functions. It takes a hash key as its argument and returns a hash value to use for hashing.</p> <p>If <i>weak-kind</i> is non-nil, it makes <i>hash-table</i> weak. Its semantics are the same as the second argument of <code>set-hash-table-weak</code>, that is:</p> <pre>(make-hash-table :weak-kind <i>weak-kind</i> &lt;other-args&gt;)</pre> <p>is equivalent to</p> <pre>(let ((ht (make-hash-table &lt;other-args&gt;)))   (set-hash-table-weak ht <i>weak-kind</i>)   ht)</pre> <p>The default value of <i>weak-kind</i> is <code>nil</code>.</p> <p><i>single-thread</i>, if true, tells <code>make-hash-table</code> that the table is going to be used only in single thread contexts, and therefore does not need to be thread-safe. Single thread context means that only one thread can access the table at any point in time. That may be because the table is used only in one thread, but it can also be the case if the table is only ever accessed in the scope of a <code>lock</code>. Making a table with <i>single-thread</i> makes access to this table faster, but not thread-safe. It does not have other effects. The default value of <i>single-thread</i> is <code>nil</code>.</p> <p><i>free-function</i> adds a "free action" for a weak hash table. This has an effect only if <code>make-hash-table</code> is called with <i>weak-kind</i> non-nil. The <i>free-function</i> is called after an entry is auto-</p> |

matically removed by the garbage collector (GC). If *weak-kind* is `nil`, *free-function* is ignored.

*free-function*, if supplied, must take two arguments: *key* and *value*. When an entry is removed from a weak table *hash-table* because the relevant object is not pointed by any other object, the *key* and the *value* are remembered. Some time later (normally short, but not well-defined) the *free-function* is called with *key* and *value* as its arguments.

*free-function* needs to be fast, to avoid delays in unexpected places. Otherwise there are no restrictions on what *free-function* does. In particular, it can keep the *key* or *value* alive by storing them somewhere.

When objects are removed from the table by explicit calls (`remhash`, `clrhash`, (`setf gethash`)), *free-function* is not called.

**Notes** Objects are removed from the table when the GC has identified them as free. For long-lived objects, which normally get promoted to higher generations, that may be quite a long time after the last pointer to them has gone.

*free-function* can also be specified in a call to `set-hash-table-weak`.

**See also** `hash-table-weak-kind`  
`modify-hash`  
`set-hash-table-weak`  
`with-hash-table-locked`  
“Freeing of objects by the GC” on page 165

## make-instance

## Generic Function

**Summary** Creates and returns a new instance of a class.

**Package** `common-lisp`

|                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|
| Signature           | <code>make-instance class &amp;rest initargs &amp;key &amp;allow-other-keys<br/>=&gt; instance</code>                                                                                                                                                                                                                                                                                                                                                       |                                                |
| Arguments           | <code>class</code>                                                                                                                                                                                                                                                                                                                                                                                                                                          | A class, or a symbol that names a class.       |
|                     | <code>initargs</code>                                                                                                                                                                                                                                                                                                                                                                                                                                       | An initialization argument list.               |
| Values              | <code>instance</code>                                                                                                                                                                                                                                                                                                                                                                                                                                       | A fresh instance of class <code>class</code> . |
| Description         | <p><code>make-instance</code> behaves as specified in ANSI Common Lisp. In particular it checks the initialization arguments as calculated by <code>compute-class-potential-initargs</code>. This check can be suppressed by passing <code>:allow-other-keys t</code>. In addition, LispWorks provides global control over the initarg checking via <code>set-clos-initarg-checking</code> and per-class control via <code>class-extra-initargs</code>.</p> |                                                |
| Notes               | In a delivered image, <code>make-instance</code> does not check the initialization arguments.                                                                                                                                                                                                                                                                                                                                                               |                                                |
| Compatibility notes | In LispWorks 4.2 and previous versions, <code>make-instance</code> does not check the initargs. If your code contains invalid initargs, you could use one of the techniques mentioned above to resolve it.                                                                                                                                                                                                                                                  |                                                |
| See also            | <a href="#"><code>class-extra-initargs</code></a><br><a href="#"><code>compute-class-potential-initargs</code></a><br><a href="#"><code>set-clos-initarg-checking</code></a>                                                                                                                                                                                                                                                                                |                                                |

|         | <i>Function</i>                                                                                  |
|---------|--------------------------------------------------------------------------------------------------|
| Summary | Extends the standard <code>make-sequence</code> function allowing it to take any type specifier. |
| Package | <code>common-lisp</code>                                                                         |

|             |                                                                                                                                                                                                                                  |                         |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| Signature   | <code>make-sequence result-type size &amp;key initial-element =&gt; sequence</code>                                                                                                                                              |                         |
| Arguments   | <i>result-type</i>                                                                                                                                                                                                               | A type specifier.       |
|             | <i>size</i>                                                                                                                                                                                                                      | A non-negative integer. |
|             | <i>initial-element</i>                                                                                                                                                                                                           | An object.              |
| Values      | <i>sequence</i>                                                                                                                                                                                                                  | A sequence.             |
| Description | The function <code>make-sequence</code> has been extended to take any Common Lisp type. The <i>sequence</i> will be of type <i>result-type</i> unless this is not possible, in which case a <code>type-error</code> is signaled. |                         |
| See also    | <a href="#">concatenate</a><br><a href="#">map</a><br><a href="#">merge</a>                                                                                                                                                      |                         |

| <b>make-string</b>     | <i>Function</i>                                                                                                                                                                                                                                                                              |             |                         |                        |                                                       |                     |                                                 |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------------------------|------------------------|-------------------------------------------------------|---------------------|-------------------------------------------------|
| Summary                | Creates and returns a string.                                                                                                                                                                                                                                                                |             |                         |                        |                                                       |                     |                                                 |
| Package                | <code>common-lisp</code>                                                                                                                                                                                                                                                                     |             |                         |                        |                                                       |                     |                                                 |
| Signature              | <code>make-string size &amp;key initial-element element-type =&gt; string</code>                                                                                                                                                                                                             |             |                         |                        |                                                       |                     |                                                 |
| Arguments              | <table> <tr> <td><i>size</i></td> <td>A non-negative integer.</td> </tr> <tr> <td><i>initial-element</i></td> <td>A character. The default is implementation-dependent.</td> </tr> <tr> <td><i>element-type</i></td> <td>A type specifier. The default is defined below.</td> </tr> </table> | <i>size</i> | A non-negative integer. | <i>initial-element</i> | A character. The default is implementation-dependent. | <i>element-type</i> | A type specifier. The default is defined below. |
| <i>size</i>            | A non-negative integer.                                                                                                                                                                                                                                                                      |             |                         |                        |                                                       |                     |                                                 |
| <i>initial-element</i> | A character. The default is implementation-dependent.                                                                                                                                                                                                                                        |             |                         |                        |                                                       |                     |                                                 |
| <i>element-type</i>    | A type specifier. The default is defined below.                                                                                                                                                                                                                                              |             |                         |                        |                                                       |                     |                                                 |
| Values                 | <i>string</i>                                                                                                                                                                                                                                                                                |             |                         |                        |                                                       |                     |                                                 |
|                        | A string.                                                                                                                                                                                                                                                                                    |             |                         |                        |                                                       |                     |                                                 |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | The function <code>make-string</code> behaves as specified in the ANSI Common Lisp Standard with one exception: the default value of <code>element-type</code> is the value of <code>*default-character-element-type*</code> or the type of <code>initial-element</code> if that is a supertype of <code>*default-character-element-type*</code> .<br><br>Therefore for strict compliance you must call <code>set-default-character-element-type</code> to set the default string element type to <code>character</code> . |
| See also    | <code>*default-character-element-type*</code><br><code>set-default-character-element-type</code><br><code>simple-string</code>                                                                                                                                                                                                                                                                                                                                                                                             |

## **make-string-output-stream** *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                              |  |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Summary     | Creates a character output stream.                                                                                                                                                                                                                                                                                                                                                                           |  |
| Package     | <code>common-lisp</code>                                                                                                                                                                                                                                                                                                                                                                                     |  |
| Signature   | <code>make-string-output-stream &amp;key element-type =&gt; stream</code>                                                                                                                                                                                                                                                                                                                                    |  |
| Arguments   | <code>element-type</code> A type specifier.                                                                                                                                                                                                                                                                                                                                                                  |  |
| Values      | <code>stream</code> A string output stream.                                                                                                                                                                                                                                                                                                                                                                  |  |
| Description | The function <code>make-string-output-stream</code> behaves as specified in the ANSI Common Lisp Standard with one exception: the default value of <code>element-type</code> is the value of <code>*default-character-element-type*</code> .<br><br>Therefore for strict compliance you must call <code>set-default-character-element-type</code> to set the default string type to <code>character</code> . |  |

See also      `with-output-to-string`  
`*default-character-element-type*`  
`set-default-character-element-type`

## map *Function*

Summary      Redefines the standard `map` function allowing it to take any type specifier.

Package      `common-lisp`

Signature      `map result-type function &rest sequences => result`

Arguments      `result-type`      A sequence type specifier or `nil`.  
`function`      A function designator.  
`sequence`      A sequence.

Values      `result`      A sequence.

Description      The function `map` has been extended to take any Common Lisp type. The `result` will be of type `result-type` unless this is not possible, in which case a `type-error` is signaled.

See also      `concatenate`  
`make-sequence`  
`merge`

## merge *Function*

Summary      Redefines the standard `merge` function allowing it to take any type specifier.

Package      `common-lisp`

|             |                                                                                                                                                                                                                          |                                             |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|
| Signature   | <code>merge result-type sequence1 sequence2 predicate &amp;key key =&gt; sequence</code>                                                                                                                                 |                                             |
| Arguments   | <i>result-type</i>                                                                                                                                                                                                       | A type specifier.                           |
|             | <i>sequence1</i>                                                                                                                                                                                                         | A sequence.                                 |
|             | <i>sequence2</i>                                                                                                                                                                                                         | A sequence.                                 |
|             | <i>predicate</i>                                                                                                                                                                                                         | A function designator.                      |
|             | <i>key</i>                                                                                                                                                                                                               | A function designator or <code>nil</code> . |
| Values      | <i>sequence</i>                                                                                                                                                                                                          | A sequence.                                 |
| Description | The function <code>merge</code> has been extended to take any Common Lisp type. The <i>sequence</i> will be of type <i>result-type</i> unless this is not possible, in which case a <code>type-error</code> is signaled. |                                             |
| See also    | <a href="#">concatenate</a><br><a href="#">make-sequence</a><br><a href="#">map</a>                                                                                                                                      |                                             |

| <b>open</b> |                                                                                                                     | <i>Function</i>                                                                                                                                            |
|-------------|---------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Creates, opens, and returns a file stream that is connected to a specified file.                                    |                                                                                                                                                            |
| Package     | <code>common-lisp</code>                                                                                            |                                                                                                                                                            |
| Signature   | <code>open filespec &amp;key direction element-type external-format if-exists if-does-not-exist =&gt; stream</code> |                                                                                                                                                            |
| Arguments   | <i>filespec</i>                                                                                                     | A file designator.                                                                                                                                         |
|             | <i>direction</i>                                                                                                    | If <i>direction</i> is <code>:probe</code> , <i>external-format</i> is ignored. The element type and external format of the returned stream are undefined. |

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>element-type</i>      | By default, the value of <code>*default-character-element-type*</code> (the ANSI standard default is <code>character</code> ).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <i>external-format</i>   | An external file format designator. By default, this is <code>:default</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <i>if-exists</i>         | What to do if the file stream already exists. The possible values for this are as in the ANSI standard.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <i>if-does-not-exist</i> | What to do if the file stream does not already exist. The possible values for this are as in the ANSI standard.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Values                   | <i>stream</i> A file stream, or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Description              | <p>If <i>external-format</i> has a name which is not <code>:default</code> and the parameters include <code>:eol-style</code>, it is used as is.</p> <p>Otherwise, the system decides which external format to use via <code>guess-external-format</code>. By default, this finds a match based on the filename; or (if that fails), looks in the EMACS-style (-*) attribute line for an option called <code>encoding</code> or <code>external-format</code> or <code>coding</code>; or (if that fails), chooses from among likely encodings by analyzing the bytes near the start of the file. By default, it then also analyzes the start of the file for byte patterns indicating the end-of-line style, and uses a default end-of-line style if no such pattern is found. This behavior is configurable.</p> <p>After the external-format has been determined, it is verified using <code>valid-external-format-p</code>; and an error is signaled if this check fails.</p> <p>If <code>open</code> gets <code>:default</code> as its <i>element-type</i> arg, it chooses the type on the basis of the external format. If <code>open</code> gets an <i>element-type</i> other than <code>:default</code> and the direction is <code>:input</code> or <code>:io</code>, the argument must be a supertype of the type of characters produced by the external format; if the direction is <code>:out-</code></p> |

`put` or `:io`, it must be a subtype of the type of characters accepted by the external format; if it does not satisfy these requirements, an error is signaled.

Standard stream input and output functions for character and binary data generally work in the obvious way on a `file-stream` with `element-type base-char`, `(unsigned-byte 8)` or `(signed-byte 8)`. For example, `read-sequence` can be called with a string buffer and a binary `file-stream`: the character data is constructed from the input as if by `code-char`. Similarly `write-sequence` can be called with a string buffer and a binary `file-stream`: the output is converted from the character data as if by `char-code`. Also, 8-bit binary data can be read from and written to a `base-char file-stream`.

All standard stream I/O functions except for `write-byte` and `read-byte` have this flexibility.

See also      `*default-character-element-type*`  
`guess-external-format`  
`set-file-dates`  
`valid-external-format-p`

## **open-stream-p** *Generic Function*

|           |                                                                 |                        |
|-----------|-----------------------------------------------------------------|------------------------|
| Summary   | A generic function that determines if a stream has been closed. |                        |
| Package   | <code>common-lisp</code>                                        |                        |
| Signature | <code>open-stream-p <i>stream</i> =&gt; <i>result</i></code>    |                        |
| Arguments | <code>stream</code>                                             | A stream.              |
| Values    | <code>result</code>                                             | A generalized boolean. |

|             |                                                                                                                                                                                                              |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | The function <code>open-stream-p</code> is generic. The default method provided by the class <code>fundamental-stream</code> returns <code>t</code> if <code>close</code> has not been called on the stream. |
| See also    | <code>close</code><br><code>fundamental-stream</code>                                                                                                                                                        |

|             | <i>Generic Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | A generic function that determines if an object is an output stream.                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Package     | <code>common-lisp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Signature   | <code>output-stream-p stream =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Arguments   | <code>stream</code> A stream.                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Values      | <code>result</code> A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Description | The predicate <code>output-stream-p</code> is implemented as a generic function. The default method returns <code>t</code> if <code>stream</code> is an output stream. If the user wants to implement a stream with no inherent directionality (and thus does not include <code>fundamental-input-stream</code> or <code>fundamental-output-stream</code> ) but for which the directionality depends on the instance, then a method should be provided for <code>output-stream-p</code> . |
| Examples    | There is an example in “Stream directionality” on page 400.                                                                                                                                                                                                                                                                                                                                                                                                                               |
| See also    | <code>fundamental-output-stream</code><br><code>input-stream-p</code>                                                                                                                                                                                                                                                                                                                                                                                                                     |

| <b>proclaim</b> | <i>Function</i>                                                                                                                                                                                                                                                                                                                            |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary         | Established a specified declaration in the global environment.                                                                                                                                                                                                                                                                             |
| Package         | <code>common-lisp</code>                                                                                                                                                                                                                                                                                                                   |
| Signature       | <code>proclaim <b>declaration-list</b> =&gt; nil</code>                                                                                                                                                                                                                                                                                    |
| Arguments       | <code>declaration-list</code> A list of declaration forms to be put into immediate and pervasive effect.                                                                                                                                                                                                                                   |
| Values          | Returns <code>nil</code> .                                                                                                                                                                                                                                                                                                                 |
| Description     | Unlike <code>declare</code> , <code>proclaim</code> is a function that parses the declarations in the list (usually a quoted list), and puts their semantics and advice into global effect. This can be useful when compiling a file for speedy execution, since a proclamation such as:                                                   |
|                 | <pre>(proclaim '(optimize (speed 3) (space 0) (debug 0)))</pre> means the rest of the file is compiled with these optimization levels in effect. Other ways of doing this are:                                                                                                                                                             |
|                 | <ul style="list-style-type: none"> <li>• use the <code>:optimize</code> option in <code>defsystem</code> to establish default optimization qualities for every member of the system, when compiled via <code>compile-system</code>.</li> <li>• add appropriate <code>declare</code> declarations in every function in the file.</li> </ul> |
|                 | As <code>proclaim</code> involves parsing a list of lists of symbols and is intended to be used a few times per file at most, its implementation is not optimized for speed - it makes little sense to use it other than at top level.                                                                                                     |
|                 | <b>Note:</b> For a top-level call to <code>proclaim</code> or <code>declaim</code> , optimize declarations are omitted from the compiled binary file. This deviates from the ANSI Common Lisp Standard but is useful because you are unlikely to want to change settings outside                                                           |

of that file. To make the global settings, you can call a function which calls `proclaim` (so it is not a top-level call).

See “Compiler control” on page 104 for a more extended description of the compiler optimize qualities.

**Examples**

```
(proclaim '(special *fred*))  
(proclaim '(type single-float x y z))  
(proclaim '(optimize (safety 0) (speed 3)))
```

**Notes**

As `proclaim` involves parsing a list of lists of symbols and is intended to be used a few times per file, its implementation is not optimized for speed — it makes little sense to use it other than at top level.

Remember to quote the argument list if it is a constant list. `(proclaim (special x))` attempts to call function `special`.

Exercise caution if you declare or proclaim variables to be special without regard to the naming convention that surrounds their names with asterisks.

**See also**

`compile`  
`compile-file`  
`declare`  
`declare`

## restart-case

*Macro*

**Summary**

Evaluates a restartable form in a special dynamic environment.

**Package**

`common-lisp`

**Signature**

`restart-case restartable-form {clause} => result*`

```
clause ::= (case-name lambda-list [[:interactive interactive-expression | :report report-expression | :test test-expression] ] declaration* form*)
```

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | The macro <b>restart-case</b> behaves as specified in the ANSI Common Lisp standard.<br><br>In addition to that specification, <i>report-expression</i> may be a form whose <b>car</b> is <b>list</b> . Such a form is evaluated when the restart is set up and is expected to return a list of a format string and format arguments. When the restart is asked to report, this is done by calling <b>format</b> on the stream, the format string and the format arguments. This is more efficient than specifying an equivalent function, because no function object is created. |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|             | <i>Function</i>                                                                                                                                                                                                                                                                                                        |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>room</b> |                                                                                                                                                                                                                                                                                                                        |
| Summary     | Print information about the state of internal memory and its management.                                                                                                                                                                                                                                               |
| Package     | <b>common-lisp</b>                                                                                                                                                                                                                                                                                                     |
| Signature   | <b>room &amp;optional x</b>                                                                                                                                                                                                                                                                                            |
| Arguments   | <b>x</b><br>One of <b>nil</b> , <b>t</b> , or the keyword <b>:default</b> . Additionally in 64-bit LispWorks only, <b>x</b> can be the keyword <b>:full</b> .                                                                                                                                                          |
| Values      | <b>room</b> returns no values.                                                                                                                                                                                                                                                                                         |
| Description | This function provides statistics on the current state of the memory, including the amount of space currently allocated, and the amount available for allocation.<br><br>As outlined in the Common Lisp Hyperspec, the <b>room</b> function takes an optional argument which controls the level of detail it produces. |

The output of `room` differs between 32-bit and 64-bit LispWorks, and is described separately below.

### **Output of `room` in 32-bit LispWorks**

Given an argument of `nil`, a summary of the total allocation in the entire heap (in kilobytes) is produced. The “allocated” figure only represents the amount of space allocated in heap segments that are writable, as opposed to read-only segments that hold some of the system code such as the garbage collector (GC) itself. The free space figure covers all the free space in all segments. To obtain these values programmatically, call `room-values`.

When called without an argument, `room` additionally prints information on the distribution of space between the generations of the heap.

When called with argument `t`, a breakdown of allocation in the individual segments of each generation is produced. Each segment is identified by its start address in memory. For each segment there is a free space threshold (the “minimum free space”)—when the available space in the segment falls below this value, the GC takes action to attempt to free more space in this segment.

Two statistics about promotion are also reported on a per-segment basis: the number of sweeps that an object must survive in this generation before becoming eligible for promotion, and the total volume of objects that have survived for that long and are consequently awaiting promotion to the next generation. These statistics are not relevant for static segments, which are indicated as “static”.

`room` prints numbers in decimal format, except for the segment start addresses which it prints in hexadecimal format.

## Output of room in 64-bit LispWorks

The last line of the output of `room` is always a line containing the total allocated amount (memory occupied by live objects) and the total size (memory that LispWorks has allocated from the OS) (the "total line"). Both numbers are given in decimal followed parenthetically by the same number in hexadecimal. Above the total line is information for each generation.

`(room nil)` does not print any information about generations.

`(room)` prints the amount allocated for each generation in decimal.

`(room :full)` prints for each generation the amount allocated, both in decimal and in hexadecimal, and then the allocated amount of each allocation type in which there is any allocation in this generation.

`(room t)` prints for each generation the same as `(room :full)`, followed by information about the segments in this generation. For each segment it prints the allocation type and the start and end address for allocation in this segment.

Note that information for segments does not correspond to the allocated size, because not all the area in the segment is currently allocated.

See "Memory Management in 64-bit LispWorks" on page 146 for a description of allocation types and segments.

## Output of room in the Mobile GC

The last line of the output of `room` is always a line containing the total allocated amount (memory occupied by live objects) and the total size (memory that LispWorks has allocated from the OS) (the "total line"). Both numbers are given in decimal followed parenthetically by the same number in hexadecimal. Above the total line is information for each generation.

(`room`) and (`room :default`) prints the allocated and free sizes according to these types:

|        |                                                                                                                |
|--------|----------------------------------------------------------------------------------------------------------------|
| Cons   | <code>cons</code> object only.                                                                                 |
| Other  | All other objects, except static objects and large objects (> 1 MB).                                           |
| Static | Static objects.                                                                                                |
| Large  | Large objects (> 1 MB). Note: this threshold may change in the future, but it is fixed in the current version. |

The Cons and Other segments are divided according to their generation and there may also some permanent segments (as a result of a call to `make-current-allocation-permanent`, `make-object-permanent` or `make-permanent-simple-vector`).

In addition, LispWorks also holds some reserved segments that are used during GC, and `room` prints the size of these too.

(`room t`) also prints the segments for each type. For each segment, it prints the start and end addresses (in hex), the allocated area, and whether there is a free "hole" in the middle of it. For the Large and Static segments, it also prints the generation number of each segment. Permanent Static and Large segments have generation number 3.

See “Mobile GC technical details” on page 154 for more technical details.

|       |                                                                                                                                                                                                                                                                                                                                                |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes | The segments information is useful for debugging problems with memory management, but for analysis of application allocation ( <code>room :full</code> ) gives enough information. Especially for very large images, there are many segments, so the output of ( <code>room t</code> ) is very large and not so useful (except for debugging). |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Examples

```

CL-USER 22 > (room nil)

Total Size 39424K, Allocated 32591K, Free 6461K

CL-USER 23 > (room)
Generation 0: Total Size 4394K, Allocated 952K, Free
3433K
Generation 1: Total Size 1397K, Allocated 795K, Free
589K
Generation 2: Total Size 4292K, Allocated 2172K, Free
2111K
Generation 3: Total Size 29009K, Allocated 28885K,
Free 112K

Total Size 39424K, Allocated 32805K, Free 6247K

CL-USER 24 > (room t)
Generation 0: Total Size 4394K, Allocated 1004K, Free
3382K
Segment 2008EC80: Total Size 507K, Allocated
353K, Free 149K
minimum free space 64K,
Awaiting promotion = 23K, sweeps
before promotion =10
Segment 222B4498: Total Size 3886K, Allocated
650K, Free 3232K
minimum free space 0K,
Awaiting promotion = 51K, sweeps
before promotion =2
Generation 1: Total Size 1397K, Allocated 795K, Free
589K
Segment 2070DC18: Total Size 68K, Allocated
64K, Free 0K
minimum free space 3K,
Awaiting promotion = 0K, sweeps
before promotion =4
Segment 21D84498: Total Size 1088K, Allocated
613K, Free 470K
minimum free space 0K,
Awaiting promotion = 0K, sweeps
before promotion =4
Segment 200528D8: Total Size 240K, Allocated
118K, Free 118K
minimum free space 0K, static
Generation 2: Total Size 4292K, Allocated 2172K, Free
2111K
Segment 21E94498: Total Size 4224K, Allocated

```

```

2107K, Free 2111K
                    minimum free space 0K,
                    Awaiting promotion = 0K, sweeps
before promotion =4
    Segment 20E7DC18: Total Size 68K, Allocated
64K, Free 0K
                    minimum free space 117K,
                    Awaiting promotion = 0K, sweeps
before promotion =4
    Generation 3: Total Size 29009K, Allocated 28885K,
Free 112K
    Segment 2071EC90: Total Size 7547K, Allocated
7543K, Free 0K
                    minimum free space 0K,
                    Awaiting promotion = 0K, sweeps
before promotion =10
    Segment 20E8EC90: Total Size 15318K, Allocated
15201K, Free 112K
                    minimum free space 0K,
                    Awaiting promotion = 0K, sweeps
before promotion =10
    Segment 2010DC18: Total Size 6144K, Allocated
6139K, Free 0K
                    minimum free space 3K,
                    Awaiting promotion = 0K, sweeps
before promotion =10

Total Size 39424K, Allocated 32857K, Free 6195K

```

See also      **find-object-size**  
**room-values**  
**total-allocation**  
“Guidance for control of the memory management system”  
on page 130

|           | <i>Type</i>                 |
|-----------|-----------------------------|
| Summary   | A subtype of <b>float</b> . |
| Package   | <b>common-lisp</b>          |
| Signature | <b>short-float</b>          |

|                     |                                                                                                                                                                                                                                                                                                                                                                                 |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description         | A short float is an immediate object.<br><br><b>short-float</b> is disjoint from <b>double-float</b> in all LispWorks implementations in version 5.0 and later.<br><br><b>short-float</b> is disjoint from <b>single-float</b> in all 32-bit LispWorks implementations, version 5.0 and later. In 64-bit LispWorks <b>short-float</b> is the same type as <b>single-float</b> . |
| Compatibility notes | In LispWorks 4.4 and previous on Windows and Linux platforms, <b>short-float</b> is the same type as <b>double-float</b> .                                                                                                                                                                                                                                                      |
| See also            | <b>double-float</b><br><b>long-float</b><br><b>parse-float</b><br><b>single-float</b>                                                                                                                                                                                                                                                                                           |

|             | <i>Function</i>                                                                                                                                                                                                       |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Identifies the physical location of the computer.                                                                                                                                                                     |
| Package     | <b>common-lisp</b>                                                                                                                                                                                                    |
| Signature   | <b>short-site-name</b> => <b>description</b><br><br><code>(setf short-site-name) description =&gt; description</code>                                                                                                 |
| Arguments   | <b>description</b> A string or <b>nil</b> .                                                                                                                                                                           |
| Description | The function <b>short-site-name</b> returns a string briefly identifying the physical location of the computer. This should be set using <code>(setf short-site-name)</code> when you configure your LispWorks image. |
| See also    | <b>long-site-name</b>                                                                                                                                                                                                 |

|             | Type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | The simple string type.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Package     | <code>common-lisp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Signature   | <code>simple-string length element-type</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Arguments   | <p><code>length</code>      The length of the string (or <code>*</code>, meaning any).</p> <p><code>element-type</code>      The type of string element. The default is the value of <code>*default-character-element-type*</code> rather than <code>*</code>.</p>                                                                                                                                                                                                                                                                                                                                                                                                        |
| Description | <p>The union of all simple string types as specified in the standard, but extended with an extra parameter: <code>element-type</code>.<br/> <code>(simple-string length element-type)</code> means all simple string types whose element type is a subtype of <code>element-type</code>. That is:</p> <pre>(simple-string * base-char) = (vector base-char *) (simple-string * lw: bmp-char) = (or (vector base-char *)                                       (vector lw: bmp-char *)) (simple-string * character) = (or (vector base-char *)                                     (vector lw: bmp-char *)                                     (vector character *))</pre> |
| Example     | <pre>CL-USER 235 &gt; (lw: set-default-character-element-type                   'base-char) BASE-CHAR CL-USER 236 &gt; (concatenate 'simple-string "f" "o" "o") "foo" CL-USER 237 &gt; (type-of *) SIMPLE-BASE-STRING</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| See also    | <code>*default-character-element-type*</code><br><code>set-default-character-element-type</code><br><code>string</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

|                     | <i>Type</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary             | A subtype of <code>float</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Package             | <code>common-lisp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Signature           | <code>single-float</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Description         | <p>A <code>single-float</code> is an immediate object in 64-bit LispWorks.</p> <p>A <code>single-float</code> is a boxed object in 32-bit LispWorks.</p> <p><code>single-float</code> is disjoint from <code>double-float</code> in all LispWorks implementations, version 5.0 and later.</p> <p><code>single-float</code> is disjoint from <code>short-float</code> in all 32-bit LispWorks implementations in version 5.0 and later. In 64-bit LispWorks <code>single-float</code> is the same type as <code>short-float</code>.</p> |
| Compatibility notes | In LispWorks 4.4 and previous on Windows and Linux platforms, <code>single-float</code> is the same type as <code>double-float</code> . However, there are distinct specialized array types <code>(array single-float)</code> , with single precision, and <code>(array double-float)</code> , with double precision.                                                                                                                                                                                                                  |
| See also            | <code>double-float</code><br><code>long-float</code><br><code>parse-float</code><br><code>short-float</code>                                                                                                                                                                                                                                                                                                                                                                                                                           |

|           | <i>Function</i>                              |
|-----------|----------------------------------------------|
| Summary   | Identifies the Operating System.             |
| Package   | <code>common-lisp</code>                     |
| Signature | <code>software-type =&gt; description</code> |

|             |                                                                                                                                                                 |                                                                                                                   |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| Values      | <i>description</i>                                                                                                                                              | A string or <code>nil</code> .                                                                                    |
| Description | The function <code>software-type</code> returns a string representing a generic name of the Operating System, or <code>nil</code> if this cannot be determined. |                                                                                                                   |
|             |                                                                                                                                                                 | On Windows, <code>software-type</code> returns "Windows NT". For more detail, use <code>software-version</code> . |
| See also    |                                                                                                                                                                 | <code>software-version</code>                                                                                     |

## **software-version** *Function*

|                     |                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary             | Identifies the version of the Operating System.                                                                                                                                                                                                                                                                                                                                             |
| Package             | <code>common-lisp</code>                                                                                                                                                                                                                                                                                                                                                                    |
| Signature           | <code>software-version =&gt; description</code>                                                                                                                                                                                                                                                                                                                                             |
| Values              | <i>description</i> A string or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                           |
| Description         | The function <code>software-version</code> returns a string giving the version of the Operating System, or <code>nil</code> if this cannot be determined.                                                                                                                                                                                                                                   |
|                     | On Microsoft Windows systems, <i>description</i> begins with the specific Operating System. For supported systems this is "Windows Vista", "Windows Server 2008", "Windows 7", "Windows Server 2008 R2", "Windows 8", "Windows 10", "Windows Server 2012" or "Some Windows NT derivative". This is followed by the version numbers (Major.Minor), build number and optionally service pack. |
| Compatibility notes | On older unsupported operating systems, the <i>description</i> commences with "Windows 95", "Windows 98", "Windows Millennium", "Windows NT", "Windows 2000" or "Windows XP".                                                                                                                                                                                                               |

Prior to LispWorks 7.1, the description begins with "Windows 8" when running on Windows 10.

Example

```
(software-version)
=>
"Windows 8: 6.2 (build 9200) "

(software-version)
=>
"Windows 7: 6.1 (build 7600) "

(software-version)
=>
"Windows Vista: 6.0 (build 6000)"
```

See also

`software-type`

**\*standard-input\***

**\*standard-output\***

**\*trace-output\***

**\*error-output\***

**\*query-io\***

**\*debug-io\***

*Variables*

Summary

These are bound globally to synonyms to the **\*background-\*** streams:

Package

`common-lisp`

Initial value

Synonyms to the **\*background-\*** streams.

Description

The variables **\*standard-input\***, **\*standard-output\***, **\*trace-output\***, **\*error-output\***, **\*query-io\*** and **\*debug-io\*** are bound globally to synonyms to the various default streams as follows:

- **\*standard-input\*** - synonym to **\*background-input\***

- `*standard-output*`, `*trace-output*` and `*error-output*` - synonym to `*background-output*`
- `*query-io*` and `*debug-io*` - synonym to `*background-query-io*`

See `*background-input*` for details.

See also      `*background-input*`

## **step** *Macro*

Summary      Steps through the evaluation of a form.

Package      `common-lisp`

Signature      `step form => result`

Arguments      `form`                  A form to be stepped and evaluated.

Values      `result`                  The values returned by `form`.

Description      `step` evaluates a form and allows you to single-step through it. You can include a call to `step` inside a tricky definition to invoke the stepper every time the definition is used. `step` can also optionally step through macros.

The commands shown below are available. When certain stepper variables (as described below) are set, some of these commands are not relevant and are therefore not available. Use `:help` to get a list of the commands.

`:s n`                  Step this form and all of its subforms (optional positive integer argument).

`:st`                  Step this form without stepping its sub-forms.

|                    |                                                                     |
|--------------------|---------------------------------------------------------------------|
| <code>:su</code>   | Step up out of this form without stepping its subforms.             |
| <code>:sr</code>   | Return a value to use for this form.                                |
| <code>:sq</code>   | Quit from the current stepper level.                                |
| <code>:redo</code> | Redo one of the previous commands.                                  |
| <code>:get</code>  | Get an item from the history list and put it in a variable.         |
| <code>:help</code> | List available commands.                                            |
| <code>:use</code>  | Replace one form with another form in previous command and redo it. |
| <code>:his</code>  | List the commands history.                                          |

The optional integer argument *n* for `:s` means do `:s n` times.

**Note:** `step` is a Listener-based form stepper. LispWorks also offers a graphical source-code Stepper tool. See the *LispWorks IDE User Guide* for details of that.

## Examples

The following examples illustrate some of these commands.

```

USER 12 > (step (+ 1 (* 2 3) 4))
(+ 1 (* 2 3) 4) -> :s
  1 -> :s
  1
  (* 2 3) -> :su
  6
  4 -> :s
  4
11
11

USER 13 > (defun foo (x y) (+ x y))
FOO

```

```

USER 14 > step (foo (+ 1 1) 2)
(FOO (+ 1 1) 2) -> :st
  (+ 1 1) -> :s
    1 -> :s
    1
    1 -> :s
    1
    2
    2 -> :s
    2
    4
    4

USER 15 > :redo (STEP (FOO # 2))
(FOO (+ 1 1) 2) -> :s
  (+ 1 1) -> :s
    1 -> :s
    1
    1
    2
    2 -> :s
    2
    (+ X Y) -> :s
      X -> :s
      2
      Y -> :s
      2
      4
      4
      4

```

You can interact when an evaluated form returns, by setting the variable `*no-step-out*` to `nil`. The prompt changes as shown below:

```

USER 36 > step (cons 1 2)
(CONS 1 2) -> :s
  1 -> :s
  1 = 1 <- :sr 3
  2 -> :s
  2 = 2 <- :sr 4
  (CONS 1 2) = (3 . 4) <- :s
  (3 . 4)

```

To allow expansion of macros, set the variable `*step-macros*` to `t`.

To step through the function calls in compiled code, set the variable `hcl:*step-compiled*` to `t`.

If required, the stepper can print out the step level: set the variable `*print-step-level*` to `t`, as shown in this session:

```
USER 21 > (setq *print-step-level* t)
T
USER 22 > step (cons 1 2)
[1] (cons 1 2) -> :s
[2]   1 -> :s      1
[2]   2 -> :s
      2
      (1 . 2)
(1 . 2)
```

It is not advisable to try to step certain compiled functions, such as `car` and `format`. The variable `hcl:*step-filter*` contains a list of functions which should not be stepped. If you get deep stack overflows inside the stepper, you may need to add a function name to `hcl:*step-filter*`.

By default, the stepper uses the same printing environment as the rest of LispWorks (the same settings of the `*print-...*` variables). To control the stepper printing environment independently, set the variable `hcl:*step-print-env*` to `t`.

The values of the variables `hcl:*step-print-...*` are then used instead of the variables `*print-...*`.

## stream-element-type

## *Generic Function*

Summary      Implements `stream-element-type` as a generic function.

Package      `common-lisp`

Signature      `stream-element-type stream => type`

Arguments      `stream`                  A stream.

|             |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Values      | <i>type</i> | A type specifier.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Description |             | <p>The function <code>stream-element-type</code> is implemented as a generic function. Depending on the stream, a method should be defined for this generic function that returns the element type of the stream.</p> <p>Methods must be implemented for all subclasses of <code>buffered-stream</code>. Typically for character streams, the implementation can return the <code>array-element-type</code> of the buffer.</p> <p>For the class <code>fundamental-character-stream</code> a default method is provided which returns <code>character</code>. A method should be defined for stream classes based on the <code>fundamental-binary-stream</code> class.</p> <p>There is an example in “Recognizing the stream element type” on page 400.</p> |
| See also    |             | <code>buffered-stream</code><br><code>fundamental-binary-stream</code><br><code>fundamental-character-stream</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

|           |                     | Type                                                                                                                               |
|-----------|---------------------|------------------------------------------------------------------------------------------------------------------------------------|
| Summary   |                     | The string type.                                                                                                                   |
| Package   |                     | <code>common-lisp</code>                                                                                                           |
| Signature |                     | <code>string length element-type</code>                                                                                            |
| Arguments | <i>length</i>       | The length of the string (or <code>*</code> , meaning any).                                                                        |
|           | <i>element-type</i> | The type of string element. The default is the value of <code>*default-character-element-type*</code> rather than <code>*</code> . |

|             |                                                                                                                                                                                                                                                                                                                                                          |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | The union of all string types as specified in the standard, but extended with an extra parameter: <i>element-type</i> .<br><br>$(\text{string} \ length \ \text{element-type})$ means all string types whose element type is a subtype of <i>element-type</i> . That is:                                                                                 |
|             | <pre>(string * base-char)      = (vector base-char *)<br/><br/>(string * lw: bmp-char) = (or (vector base-char *)<br/>                           (vector lw: bmp-char *))<br/><br/>(string * character)     = (or (vector base-char *)<br/>                           (vector lw: bmp-char *)<br/>                           (vector character *))</pre> |
| Example     | <pre>CL-USER 235 &gt; (lw: set-default-character-element-type<br/>                  'base-char)<br/>BASE-CHAR<br/>CL-USER 236 &gt; (concatenate 'string "f" "o" "o")<br/>"foo"<br/>CL-USER 237 &gt; (type-of *)<br/>SIMPLE-BASE-STRING</pre>                                                                                                             |
| See also    | <b>*default-character-element-type*</b><br><b>set-default-character-element-type</b><br><b>simple-string</b>                                                                                                                                                                                                                                             |

|           | <i>Macro</i>                                                        |
|-----------|---------------------------------------------------------------------|
| Summary   | Determines the execution time of a form in the current environment. |
| Package   | <code>common-lisp</code>                                            |
| Signature | <code>time form =&gt; result</code>                                 |
| Arguments | <i>form</i> A form to be evaluated.                                 |
| Values    | <i>result</i> The result of the evaluation of the form.             |

**Description** `time` can be used to determine execution times. The macro evaluates the form *form* and returns its value *result*. `time` also prints some timing and size data: *user time*, *system time*, *elapsed time*, and the total amount of heap space allocated in executing the form (in bytes).

The *user time* printed is the time used by LispWorks or any code that it calls in a dynamic library.

The *system time* printed is the time used in the operating system kernel when it is doing work on behalf of the LispWorks process.

The *elapsed time* printed is the time you could in principle measure with a stopwatch.

If LispWorks is 100% busy throughout the execution of the code, then *user time* + *system time* = *elapsed time*.

Each of the times is printed as:

- *secs.micros* if less than 60 seconds
- *hours:minutes:secs.micros* if 60 seconds or more.

The timing and size data covers all stack groups, not just the one that invokes `time`.

**Notes**

1. Note that `time` itself uses a small, constant amount of heap space.
2. `time` measures all threads, so to test accurately for consing in *code* you need to do:  
`(sys:with-other-threads-disabled (time code))`  
This is particularly important when using the LispWorks IDE. Do not use `with-other-threads-disabled` in your application code.

Examples

```
CL-USER 7 > (time (loop for i below 3000000
                           sum (sqrt i)))
Timing the evaluation of (LOOP FOR I BELOW 3000000 SUM
(SQRT I))

User time      =  0:01:04.187
System time    =        0.062
Elapsed time   =  0:01:07.297
Allocation     = 4932022956 bytes
0 Page faults
Calls to %EVAL    72000048
3.4606518E9
```

See also

- `extended-time`
- `with-other-threads-disabled`
- `with-unique-names`
- “Guidance for control of the memory management system”  
on page 130

|              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>trace</b> | <i>Macro</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Summary      | Invoke the Common Lisp tracing facility on the named functions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Package      | <code>common-lisp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Signature    | <code>trace {function-name tracing-desc}* =&gt; trace-result</code><br><code>tracing-desc ::= (function-dspec {keyword form}*)</code><br><code>keyword ::= :after   :allocation   :before   :backtrace  </code><br><code>           :eval-after   :eval-before   :break  </code><br><code>           :break-on-exit   :entrycond   :exitcond  </code><br><code>           :inside   :process   :trace-output   :step  </code><br><code>           :when</code><br><code>qualifier ::= :after   :before   :around</code><br><code>function-name ::= symbol   (setf symbol)</code> |

|           |                       |                                                                                                                                                             |
|-----------|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arguments | <i>function-name</i>  | A symbol whose symbol-function is to be traced, or a <code>setf</code> function name. Functions, macros and generic functions may be specified this way.    |
|           | <i>function-dspec</i> | A function-dspec as described in “Function dspecs” on page 84, which apart from symbols, can specify methods, <code>setf</code> functions and subfunctions. |
|           | <i>tracing-desc</i>   | Specifies the functional definition which is to be traced and specifies any additional options that are required.                                           |

**:after** is followed by a list of forms; these are evaluated upon returning from the function. The values of these forms are also printed out by the tracer. The forms are evaluated after printing out the results of the function call, and if they modify `hcl:*traced-results*` then the values received by the caller of the function are correspondingly altered (see also `hcl:*traced-results*`).

**:allocation** — if non-nil, the memory allocation made during a function-call is printed upon exit from the function. This allocation is counted in bytes. If it is any other symbol (except `nil`), `trace` uses the symbol to accumulate the amount of allocation made between entering and exiting the function. Upon exit from the function, the symbol contains the number of bytes allocated during the function-call. For example,

```
(trace (print :entrycond nil
              :exitcond nil
              :allocation $$print-allocation))
```

results in `$$print-allocation` containing the sum of the allocation made inside `print`.

Note that if the function is called again, `trace` continues to use `$$print-allocation` as an accumulator of memory allo-

cation. It adds to the present value rather than re-initializing it each time the function is called.

**:backtrace** generates a backtrace on each call to the traced function. It is followed by a keyword that can be any of the following values:

- :quick** Like the **:bq** debugger command.
- t** Like the **:b** debugger command.
- :verbose** Like the **:b :verbose** debugger command.
- :bug-form** Like the **:bug-form** debugger command.

**:before** is followed by a list of forms; these are evaluated upon entering the function and their values are printed out by the tracer. The forms are evaluated after printing out the arguments to the function, and if they alter **\*traced-arglist\*** then the values received by the body of the function are changed accordingly (see also **\*traced-arglist\***).

**:eval-after** and **:eval-before** are similar to **:after** and **:before**, without output.

**:break** is followed by a form. This is evaluated after printing the standard information caused by entering the function, and after executing any **:before** forms; if it returns **nil** then tracing continues normally, otherwise **break** is called. This provides a way of entering the debugger through the tracer.

**:break-on-exit** is followed by a form. This is evaluated after printing the standard information caused by returning from the function, and before executing any **:after** forms; if it returns **nil** then tracing continues normally, otherwise **break** is called. This provides a second way of entering the debugger through the tracer.

**:entrycond** controls the printing of the standard entry message (including the function's arguments). If the form following it evaluates to give a non-nil value when the function is entered, then the entry message is printed (but otherwise it is not). If this option is not present then the standard entry mes-

sage is always printed upon calling the function. See also the `:when` option.

`:exitcond` controls the printing of the standard exit message (including the function's results). If the form following it evaluates to give a non-nil value when the function is exited, then the exit message is printed (but otherwise it is not). If this option is not present then the standard exit message is always printed upon returning from the function. See also the `:when` option.

`:inside` restricts the tracing to within one of the functions given as an argument. A single symbolic function name is treated as a list of one element. For example, `:inside format` is equivalent to `:inside (format)`.

`:process` may be used to restrict the tracing to a particular process. If it is followed by a process then the function is only traced when it is invoked from within that process. If it is followed by `t` then it is traced from all processes — this is the default. In any other cases the function is not traced at all.

`:trace-output` should be followed by a stream. All the output from tracing the function is sent to this stream. By default output from the tracer is sent to `*trace-output*`. Use of this argument allows you to dispatch traced output from different functions to different places.

`:step`, when non-nil, invokes the stepper (for evaluated functions).

`:when` overrides all other keywords. It is followed by an expression, and tracing only occurs when that expression evaluates to non-nil. It is useful if you want to combine `:entrycond` and `:exitcond`.

|        |                           |                                                                                                                                                     |
|--------|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| Values | <code>trace-result</code> | If <code>trace</code> is called with no arguments then it returns a list of the names of all the functions currently being traced. When called with |
|--------|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|

one or more arguments, it returns the symbols of the functions specified in those arguments.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p><code>trace</code> is the macro used to invoke the tracing facility. This is a useful debugging tool that enables information about selected calls to be generated by the system. The standard way of invoking <code>trace</code> is to call it with the names of the functions, macros and methods that are to be monitored in this way. Calls to these produce a record of the function that was called, the arguments it received and the results it produced.</p> <p>The arguments to <code>trace</code> each specify a function (or a macro or a method) to be traced. They may also contain further instructions to control how the tracing output is displayed, or to cause particular actions to occur when the functions is called or exited. If <code>trace</code> is called with a function that is already being traced, then the new tracing specification for that function replaces the old version.</p> |
| Notes       | <p>For detailed information about the current tracing state, call <code>tracing-state</code>.</p> <p>For information about problems with tracing and their resolution, see “Troubleshooting tracing” on page 60.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

## Example 1

```

USER 1 > (defvar *number-of-calls-to-max* 0)
*NUMBER-OF-CALLS-TO-MAX*

USER 2 > (trace (max :after
                      ((incf *number-of-calls-to-max*))))
(MAX)

USER 3 > (dotimes (i 2) (max i 1))
0 MAX > (0 1)
0 MAX < (1)
1
0 MAX > (1 1)
0 MAX < (1)
2
NIL

USER 4 > *number-of-calls-to-max*
2

USER 5 > (trace (max
                  :entrycond
                  (> (length compiler:*traced-arglist*)
                      2)
                  :exitcond nil))
(MAX)

USER 6 > (max 2 3 (max 4 5))
0 MAX > (2 3 5)
5

```

## Example 2

This example illustrates the use of `:inside`.

```

CL-USER 2 > (defun outer ()
              (inner))
OUTER

CL-USER 3 > (defun inner ()
              10)
INNER

CL-USER 4 > (trace (inner :inside outer))
              ;, only trace when inside OUTER
(INNER)

CL-USER 5 > (inner)
              ;, no tracing occurs since we are not inside OUTER
10

CL-USER 6 > (outer)    ;, INNER is traced inside OUTER
0 INNER > NIL
0 INNER < (10)
10

CL-USER 7 >

```

Example 3 To trace a method:

```

(defmethod foo (x) x)

(trace ((method foo (t))))

```

Example 4 To trace a setf function:

```

CL-USER 56 > (defvar *a* 0)
*A*

CL-USER 57 > (defun (setf foo) (x y) (set y x))
(SETF FOO)

CL-USER 58 > (trace (setf foo))
((SETF FOO))

CL-USER 59 > (setf (foo '*a*) 42)
0 (SETF FOO) > (42 *A*)
>> X : 42
>> Y : *A*
0 (SETF FOO) < (42)
42

```

See also      **\*disable-trace\***  
**\*max-trace-indent\***  
**\*trace-indent-width\***  
**\*trace-level\***  
**trace-new-instances-on-access**  
**trace-on-access**  
**\*trace-output\***  
**\*trace-print-circle\***  
**\*trace-print-length\***  
**\*trace-print-level\***  
**\*trace-print-pretty\***  
**\*trace-verbose\***  
**\*traced-arglist\***  
**\*traced-results\***  
**tracing-enabled-p**  
**tracing-state**  
**untrace**

| <b>truename</b> | <i>Function</i>                                                                                                                                                                                                                          |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary         | Returns the truename of a pathname.                                                                                                                                                                                                      |
| Package         | <code>common-lisp</code>                                                                                                                                                                                                                 |
| Signature       | <code>truename <i>filespec</i> =&gt; <i>truename</i></code>                                                                                                                                                                              |
| Arguments       | <code>filespec</code> A pathname designator.                                                                                                                                                                                             |
| Values          | <code>truename</code> A fully-specified physical pathname.                                                                                                                                                                               |
| Description     | <p>The function <code>truename</code> behaves as specified in ANSI Common Lisp. The returned value is a fully-specified pathname. Truenames are always fully-specified in LispWorks (this prevents them from ever being corrupted by</p> |

`*default-pathname-defaults*`). Note that this means that the paths returned by `directory` are always fully specified.

See also `directory`

## **untrace** *Macro*

|                      |                                                                                                                                                                                                                                                                                                                                                          |                      |                                                           |                    |                                                                                                                   |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-----------------------------------------------------------|--------------------|-------------------------------------------------------------------------------------------------------------------|
| Summary              | Turns off the Common Lisp tracing facility on the named functions.                                                                                                                                                                                                                                                                                       |                      |                                                           |                    |                                                                                                                   |
| Package              | <code>common-lisp</code>                                                                                                                                                                                                                                                                                                                                 |                      |                                                           |                    |                                                                                                                   |
| Signature            | <code>untrace {function-name / method-desc}* =&gt; untrace-list</code>                                                                                                                                                                                                                                                                                   |                      |                                                           |                    |                                                                                                                   |
| Arguments            | <table><tr><td><i>function-name</i></td><td>A symbol whose symbol-function is no longer to be traced.</td></tr><tr><td><i>method-desc</i></td><td>A method description, as described in the entry for <code>trace</code>. See <code>trace</code> for more details.</td></tr></table>                                                                     | <i>function-name</i> | A symbol whose symbol-function is no longer to be traced. | <i>method-desc</i> | A method description, as described in the entry for <code>trace</code> . See <code>trace</code> for more details. |
| <i>function-name</i> | A symbol whose symbol-function is no longer to be traced.                                                                                                                                                                                                                                                                                                |                      |                                                           |                    |                                                                                                                   |
| <i>method-desc</i>   | A method description, as described in the entry for <code>trace</code> . See <code>trace</code> for more details.                                                                                                                                                                                                                                        |                      |                                                           |                    |                                                                                                                   |
| Values               | When called with no arguments, it returns the symbols of all functions currently being traced. When called with one or more functions as arguments, <code>untrace</code> returns a list of the symbols of those functions. Thus, in all situations, <code>untrace</code> returns a list of the symbols of those functions being untraced.                |                      |                                                           |                    |                                                                                                                   |
| Description          | <code>untrace</code> is used to cease the tracing of functions. If it is called with no arguments then the tracing of all currently traced functions is stopped. If it is called with one or more symbols then the tracing of those functions is stopped. A warning is given if <code>untrace</code> is called with a function that is not being traced. |                      |                                                           |                    |                                                                                                                   |
| Examples             | <pre>USER 12 &gt; (progn (untrace) (trace + - / *))</pre> <code>*</code>                                                                                                                                                                                                                                                                                 |                      |                                                           |                    |                                                                                                                   |

```

USER 13 > (+ 2 3)
0 + > (2 3)
0 + < (5)
5

USER 14 > (untrace + -)
(* |/|)

USER 15 > (+ 2 3)
5

```

To untrace a method:

```
(untrace (clos:method foo (t)))
```

See also

**trace**  
**untrace-new-instances-on-access**  
**untrace-on-access**

## update-instance-for-different-class

## *Generic Function*

Summary

As specified for Common Lisp, and locks the redefined instance.

Package

**common-lisp**

Description

The generic function **update-instance-for-different-class** behaves as specified for ANSI Common Lisp.

During the operation of updating the instance, including the call to **update-instance-for-different-class**, the redefined instance is locked against access. Any other process that tries to access the instance will hang until the operation finishes. Therefore your methods must avoid doing anything that may wait for another process which may access the instance, as this would cause a deadlock.

See also

**update-instance-for-redefined-class**

## **update-instance-for-redefined-class** *Generic Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | As specified for Common Lisp, and locks the redefined instance.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Package     | <code>common-lisp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Description | <p>The generic function <code>update-instance-for-redefined-class</code> behaves as specified for ANSI Common Lisp.</p> <p>During the operation of updating the instance, including the call to <code>update-instance-for-redefined-class</code>, the redefined instance is locked against access. Any other process that tries to access the instance will hang until the operation finishes. Therefore your methods must avoid doing anything that may wait for another process which may access the instance, as this would cause a deadlock.</p> |
| See also    | <code>update-instance-for-different-class</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

## **with-output-to-string** *Macro*

|             |                                                                                                                                                                                                                                       |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Creates a character output stream, performs a series of operations that may send results to this stream, and then closes the stream.                                                                                                  |
| Package     | <code>common-lisp</code>                                                                                                                                                                                                              |
| Signature   | <code>with-output-to-string (var &amp;optional string-form &amp;key element-type) declaration form =&gt; result</code>                                                                                                                |
| Description | The macro <code>with-output-to-string</code> behaves as specified in the ANSI Common Lisp Standard with one exception: the default value of <code>element-type</code> is the value of <code>*default-character-element-type*</code> . |

Therefore for strict compliance you must call `set-default-character-element-type` to set the default string type to `character`.

See also

`compile-file`  
`declare`  
`proclaim`  
`*default-character-element-type*`  
`set-default-character-element-type`

# 34

---

## The COMPILER Package

This chapter describes symbols available in the `COMPILER` package.

The compiler is discussed in detail in Chapter 9, “The Compiler”.

| <b>deftransform</b> |                                                                                                   | <i>Macro</i>                                                                                                                                                        |
|---------------------|---------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary             | Defines a function that computes the expansion of a form.                                         |                                                                                                                                                                     |
| Package             | <code>compiler</code>                                                                             |                                                                                                                                                                     |
| Signature           | <code>deftransform name transform-name lambda-list &amp;body body =&gt; list-of-transforms</code> |                                                                                                                                                                     |
| Arguments           | <i>name</i>                                                                                       | A symbol naming the function to which the transform is to be applied.                                                                                               |
|                     | <i>transform-name</i>                                                                             | The symbol naming the transformation — it should be unique for the function being transformed — and provides a handle with which to redefine an existing transform. |

|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>lambda-list</i> | This must match against the form being expanded before expansion is allowed to take place, in the sense that it must be valid to call a function with such a lambda list using the arguments supplied in the candidate-form for expansion.                                                                                                                                                                                                                                                                                         |
| <i>body</i>        | The body of the expander function, the result of which replaces the original form (unless it evaluates to <code>compiler::%pass%</code> , in which case no transformation is applied).                                                                                                                                                                                                                                                                                                                                             |
| Values             | <i>list-of-transforms</i> A list of the names of transforms defined for the function, including the one just added.                                                                                                                                                                                                                                                                                                                                                                                                                |
| Description        | <code>deftransform</code> , like <code>defmacro</code> , defines a function that computes the expansion of a form. Transforms are only used by the compiler and not by the interpreter. <code>deftransform</code> allows you to add to the optimizations performed by the compiler.                                                                                                                                                                                                                                                |
| Examples           | <pre>(compiler:deftransform +  +-of-2  (x y)   '(system:: +2  ,x ,y)) (compiler:deftransform +  +-of-many (x &amp;rest y)   '(system:: +2  ,x (+ ,@y)))  ;; now an expression like (+ a b c 4 5 7 d e f) ;; compiles to use the binary version ;; of + (inlined by default), ;; rather than the full (slow) version of + (compiler:deftransform list  list-of-1 (x)   '(cons ,x '()))  (compiler:deftransform list  list-of-2 (x y)   '(cons ,x (cons ,y '())))  ;; save having to call list - ;; cons is inlined by default</pre> |

```

(compiler:deftransform constant my-trans (x)
  (cond ((constantp x) x)
        ((consp x) '(quote ,(eval x)))
        (t 'compiler::%pass%)) ; give up if not a
cons

(compile (defun three-list () (constant (list 1 2 3)))))

;; the function three-list returns the
;; same list (1 2 3)
;; every time it is called...

```

The `list-of-2` example returns

```
(LIST-OF-2 LIST-OF-1 COMPILER::LIST-TRANSFORM)
```

as its result, since a similar transform already exists in the compiler, by the name `compiler::list*-transform`.

#### Notes

`deftransform` differs from `defmacro` in various ways:

The evaluation of the body can return `compiler:%pass%` indicating that the form is not to be expanded (in other words, the transform method has elected to give up trying to improve the code).

The compiler only calls the expander function if the arguments match the lambda list — macros are unconditionally expanded.

There can be several `deftransforms` for the same symbol, each having a different name. (The compiler calls each one in turn until one succeeds. This repeats until they all pass, so that the replacement form may itself be transformed.)

If a transform takes keyword arguments the compiler preserves the correct order of evaluation.

A carelessly written `deftransform` may lead the compiler to transform valid Common Lisp into incorrect code — there is no semantic checking of the transform.

#### See also

`compile`  
`compile-file`



# 35

---

## The DBG Package

This chapter describes symbols available in the `DBG` package, used to configure the debugging information produced by LispWorks.

The debugger is discussed in detail in Chapter 3, “The Debugger”.

| <b>close-remote-debugging-connection</b> |                   | <i>Function</i>                                                                                                                                                                                                                                                                                                |
|------------------------------------------|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary                                  |                   | Close the remote debugging connection.                                                                                                                                                                                                                                                                         |
| Package                                  |                   | <code>dbg</code>                                                                                                                                                                                                                                                                                               |
| Signature                                |                   | <code>close-remote-debugging-connection <i>connection</i></code>                                                                                                                                                                                                                                               |
| Arguments                                | <i>connection</i> | A <code>remote-debugging-connection</code> .                                                                                                                                                                                                                                                                   |
| Description                              |                   | The function <code>close-remote-debugging-connection</code> performs all the close cleanup operations that were associated with <i>connection</i> by <code>remote-debugging-connection-add-close-cleanup</code> , closes the underlying stream and clears any other resources that <i>connection</i> is using. |

`close-remote-debugging-connection` may be called on either side (IDE or client) and causes the other side of the connection to call `close-remote-debugging-connection` on its own side.

|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | <p><code>close-remote-debugging-connection</code> is called automatically by LispWorks when the other side closes the connection. It is also called automatically after you call <code>configure-remote-debugging-spec</code> with <code>:setup-default nil</code> when the Debugger or Remote Listener window is closed.</p> <p>During debugging, you probably do not need to worry about closing connections, but if you use the remote debugging connections for other purposes then you will probably need to ensure they are closed, because each connection uses a process as well as some other resources.</p> |
| See also | <p>“Remote debugging” on page 25<br/> <code>remote-debugging-connection-add-close-cleanup</code></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

| <code>configure-remote-debugging-spec</code> |                                                                                                                                                                  | <i>Function</i>                                                                                                           |
|----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| Summary                                      | Client side: Configure how LispWorks opens a connection for remote debugging on the client side.                                                                 |                                                                                                                           |
| Package                                      | <code>dbg</code>                                                                                                                                                 |                                                                                                                           |
| Signature                                    | <code>configure-remote-debugging-spec host &amp;key port log-stream<br/> failure-function timeout open-callback name setup-default enable =&gt;<br/> host</code> |                                                                                                                           |
| Arguments                                    | <code>host</code><br><code>port</code><br><code>log-stream</code>                                                                                                | A string specifying the IDE side hostname, or <code>nil</code> .<br>An integer.<br>An output stream or <code>nil</code> . |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                     |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|             | <i>failure-function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <code>nil</code> or a function of two arguments: host and port.                     |
|             | <i>timeout</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | A non-negative <code>real</code> or <code>nil</code> .                              |
|             | <i>open-callback</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <code>nil</code> or a function that takes one argument (a newly opened connection). |
|             | <i>name</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Any object.                                                                         |
|             | <i>setup-default</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <code>:delayed</code> , <code>nil</code> or <code>t</code> .                        |
|             | <i>enable</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <code>nil</code> or <code>t</code> .                                                |
| Values      | <i>host</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | A string or <code>nil</code> .                                                      |
| Description | <p>The function <code>configure-remote-debugging-spec</code> tells LispWorks how to open a connection for remote debugging on the client side if there is no existing connection to use (see <code>set-remote-debugging-connection</code> for details). <code>configure-remote-debugging-spec</code> changes the global settings, unless it is called inside the dynamic extent of <code>with-remote-debugging-spec</code>, in which case its effects last until the exit from this extent (except for <code>setup-default</code> and <code>enable</code>, see below).</p> <p>If <i>port</i>, <i>log-stream</i>, <i>failure-function</i>, <i>timeout</i>, <i>open-callback</i> or <i>name</i> are supplied then they configure the corresponding settings, otherwise the settings are not changed.</p> <p><i>host</i> and <i>port</i> configure the hostname and TCP port to connect to (see the <i>hostspec</i> and <i>service</i> arguments to <code>open-tcp-stream</code>). <i>host</i> can also be <code>nil</code>, which specifies that LispWorks must not try to open a debugging connection. The initial configured value of <i>port</i> is the value of <code>*default-ide-remote-debugging-server-port*</code>, which is 21101 initially.</p> <p><i>timeout</i> configure the timeout in seconds, or <code>nil</code> for indefinite. If a connection to the IDE side cannot be made within the specified timeout then remote debugging is not used.</p> |                                                                                     |

*log-stream* configures logging for communication problems, including failure to open the connection (unless the configured value of *failure-function* is non-nil) and errors when communicating across the connection. Failure to open the stream can happen if the host is not ready, the communication is blocked or the network/host are overloaded. Later failures should not happen as long as the underlying operating system is not broken. When the configured value of *log-stream* is non-nil, LispWorks writes error messages to it. Otherwise (the default) LispWorks does not log errors when communicating across the connection.

When the configured value of *failure-function* is non-nil, it will be called with the values of *host* and *port* in case of failure to open the connection, instead of writing to *log-stream*. The initial value of *failure-function* is `nil`.

The configured value of *name* is used as the name of the connection. It affects how the connection object is printed and also the name of the Lisp process that handles communication for the connection. It initially defaults to "Remote debugging".

When the configured value of *open-callback* is non-nil, it is called after the new connection has been opened, with the new connection as its argument. The initial configured value of *open-callback* is `nil`.

*setup-default* and *enable* determine whether the new connection becomes the default, and when it should be used. Note that they always have a global effect, even when `configure-remote-debugging-spec` is called in the dynamic extent of `with-remote-debugging-spec`.

When *setup-default* is `:delayed` (the default if the configured *open-callback* is `nil`) or `t`, the new connection will become the default connection, by a call to `set-default-remote-debugging-connection`. If *enable* is non-nil (the default), then the enabling switch is turned on as if by calling `set-remote-debugging-connection` with argument `t`. As a

result, assuming no other calls to `set-remote-debugging-connection` or `set-default-remote-debugging-connection` are made, the new connection will be used in the future whenever a connection is needed. See `set-remote-debugging-connection` for more details. If `setup-default` is `:delayed`, then the connection will be opened the first time it is needed. If `setup-default` is `t`, then `configure-remote-debugging-spec` opens the connection immediately. Thus with the default arguments, the connection will be opened the first time it is needed, and will then be used whenever a connection is needed.

When `setup-default` is `nil` (the default if the configured `open-callback` is non-`nil`), the connection is not made a default. If it is created when entering the debugger or for a Remote Listener, then it will be closed automatically when exiting the debugger or closing the Listener. See `remote-inspect` for how it deals with connections.

|       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes | <p>For the connection to open successfully, the machine which is addressed by <code>host</code> must be listening for TCP connections on <code>port</code>. Normally that should happen as result of calling <code>start-ide-remote-debugging-server</code>, but you can reasonably easily write your own version of it if required.</p> <p>Using <code>configure-remote-debugging-spec</code> requires the ability to use <code>open-tcp-stream</code>, which at OS level means using the C library function <code>connect</code>.</p> <p>Sometimes it is easier to make the connection in the other direction. For example, the Android SDK allows you to redirect sockets from a host to the android device, by using <code>adb forward</code>, so when the Android device is the client side, it is easier to connect the other way, in which case you should use <code>start-client-remote-debugging-server</code> on the client side (instead of using <code>configure-remote-debugging-spec</code>), and call <code>ide-connect-remote-debugging</code> on the IDE side.</p> |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Opening a connection once and then re-using it is probably more efficient in most cases and also has the advantage that remote object handles remain valid. However, if opening a connection is relatively rare, using one-off connections removes the (quite small) overhead of keeping a connection open.

When you do not re-use the connection, the configured values are used each time you open a connection.

If you wish to open a connection yourself, then note that you cannot implement the delayed automatic opening that `configure-remote-debugging-spec` implements when `setup-default` is `:delayed` (the default) or `nil`. You can, however, implement the equivalent of `:setup-default t` (that is opening the connection before it is needed) by making the underlying stream yourself using `open-tcp-stream` or some other mechanism, using `create-client-remote-debugging-connection` to create the client connection and then using `set-default-remote-debugging-connection`, `set-remote-debugging-connection` and `with-remote-debugging-connection` as appropriate.

See also

`with-remote-debugging-spec`  
`start-ide-remote-debugging-server`  
`start-client-remote-debugging-server`  
`start-remote-listener`  
`remote-inspect`  
“Remote debugging” on page 25

## `create-client-remote-debugging-connection`

## `create-ide-remote-debugging-connection`

*Functions*

Summary

Create a client or ide remote debugging connection (advanced).

Package

`dbg`

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                              |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| Signature   | <pre><code>create-client-remote-debugging-connection <b>name</b> &amp;key <b>socket</b> <b>stream</b> <b>ssl</b> <b>log-stream</b> =&gt; <b>client-side-connection</b>  create-ide-remote-debugging-connection <b>name</b> &amp;key <b>socket</b> <b>stream</b> <b>ssl</b> <b>log-stream</b> =&gt; <b>ide-side-connection</b></code></pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                              |
| Arguments   | <i>name</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | A string.                                                                                    |
|             | <i>socket</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | A socket or <code>nil</code> .                                                               |
|             | <i>stream</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | An <code>base-char</code> stream stream opened for<br><code>:io</code> or <code>nil</code> . |
|             | <i>ssl</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | A SSL specification.                                                                         |
|             | <i>log-stream</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | An output stream or <code>nil</code> .                                                       |
| Values      | <p><i>client-side-connection</i>A <code>client-remote-debugging</code>.</p> <p><i>ide-side-connection</i>An <code>ide-remote-debugging</code>.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                              |
| Description | <p>The function <code>create-client-remote-debugging-connection</code> creates a client side remote debugging connection. The function <code>create-ide-remote-debugging-connection</code> creates an IDE side remote debugging connection.</p> <p>Normally you would use the higher level interface functions <code>start-client-remote-debugging-server</code> or <code>configure-remote-debugging-spec</code> to open a client side connection, and <code>start-ide-remote-debugging-server</code> or <code>ide-connect-remote-debugging</code> to open an IDE side connection. The higher level functions call these functions to create the connection.</p> <p><i>name</i> specifies a name for the connection, but otherwise does not affect its behavior. On the IDE side it is used in the title of Remote Listener and Remote Debugger tools. On both sides it is used in the name of the process that handles communication across the connection.</p> <p>Either <i>socket</i> or <i>stream</i> (but not both) must be non-nil.</p> |                                                                                              |

If *socket* is non-nil, it must be a socket handle, like the one that `start-up-server` passes to its *function* argument or the socket that `accept-tcp-connections-creating-async-io-states`, when called with `:create-state nil`, passes to its *connection-function*. A `socket-stream` is created with this socket and used as the stream in the connection. *socket* defaults to `nil`.

If *stream* is non-nil, it must be an `base-char` stream opened for `:io` and it is used directly in the connection. Typically it will be a `socket-stream`, but that is not a requirement. *stream* defaults to `nil`.

If *ssl* is non-nil, then `attach-ssl` is called on the stream, passing *ssl* as the `:ssl-ctx` argument. Note that this will work only if the stream is a `socket-stream`. *ssl* defaults to `nil`.

*log-stream*, if non-nil, must be an output stream. The connection writes messages to it in situations when communication fails. *log-stream* defaults to `nil`.

For the connection to work, the other side of the socket or stream must be the opposite kind of connection, that is for a client side connection the other side needs to be an IDE connection and vice versa.

The "ownership" of *socket* or *stream* is transferred to the connection by these functions. That means that no further I/O operations are allowed on *socket* or *stream* by other code, and they must not be closed. They will be closed when the connection is closed.

The value of *client-side-connection* that is returned by `create-client-remote-debugging-connection` can be used as the *connection* argument to `with-remote-debugging-connection`, `set-remote-debugging-connection` or `set-default-remote-debugging-connection`, or as the `:connection` keyword to `start-remote-listener` or `remote-inspect`. It is not remembered by LispWorks anywhere.

The value of *ide-side-connection* that is returned by `create-ide-remote-debugging-connection` is remembered by LispWorks, and is returned by `ide-list-remote-debugging-connections` or `ide-find-remote-debugging-connection` when appropriate. As a result, it may be used by any of the IDE side functions. It can also be passed explicitly to any of these functions. It is forgotten when it is closed.

Both *client-side-connection* and *ide-side-connection* can be manipulated by these functions:

- `close-remote-debugging-connection` closes it.
- `remote-debugging-connection-add-close-cleanup` adds a cleanup callback that is called when the connection is closed.
- `remote-debugging-connection-peer-address` finds the peer address of the connection.
- `remote-debugging-connection-name` returns its name.
- `ensure-remote-debugging-connection` checks if it is still open.

See also

`start-client-remote-debugging-server`  
`configure-remote-debugging-spec`  
`start-ide-remote-debugging-server`  
`ide-connect-remote-debugging`  
`close-remote-debugging-connection`  
`remote-debugging-connection-add-close-cleanup`  
`remote-debugging-connection-peer-address`  
`remote-debugging-connection-name`  
`ensure-remote-debugging-connection`  
“Remote debugging” on page 25

| <b>*debug-print-length*</b> |                                                                                                                                                                                                                                                                                                                                                                                                                 | <i>Variable</i> |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Summary                     | Controls the number of object components printed in debugger output.                                                                                                                                                                                                                                                                                                                                            |                 |
| Package                     | <code>dbg</code>                                                                                                                                                                                                                                                                                                                                                                                                |                 |
| Initial value               | <code>40</code>                                                                                                                                                                                                                                                                                                                                                                                                 |                 |
| Description                 | This variable is used to control the number of components of an object which are printed during output from the debugger. If its value is a positive integer then the components up to that number are printed. If it is <code>nil</code> then all the parts of an object are shown.                                                                                                                            |                 |
| Examples                    | <pre>USER 83 &gt; (setq dbg:*debug-print-length* 3)  3 USER 84 &gt; (aref   '(1 2 3 4 "Jenny" "cottage" "door")   2)  Error: (1 2 3 4 Jenny cottage door) must be        an array 1 (abort) return to top loop level 0.  Type :c followed by a number to proceed  USER 85 : 1 &gt; :v Call to ARRAY-ACCESS : Arg 0 (ARRAY) : (1 2 3 ...) Arg 1 (SUBSCRIPTS) : (2) Arg 2 (SET-P) : NIL Arg 3 (VALUE) : NIL</pre> |                 |
| Notes                       | <code>*debug-print-length*</code> is an extension to Common Lisp.                                                                                                                                                                                                                                                                                                                                               |                 |

| <b>*debug-print-level*</b> |                                                                            | <i>Variable</i> |
|----------------------------|----------------------------------------------------------------------------|-----------------|
| Summary                    | Controls the depth to which nested objects are printed in debugger output. |                 |

|               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package       | <code>dbg</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Initial value | <code>4</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Description   | <code>dbg:*debug-print-level*</code> controls the depth to which nested objects are printed during output from the debugger. If its value is a positive integer then components at or above that level are printed. By definition an object to be printed is considered to be at level 0, its components are at level 1, their subcomponents are at level 2, and so on. If <code>dbg:*debug-print-level*</code> is <code>nil</code> then objects are printed to arbitrary depth.        |
| Example       | <pre>USER 89 &gt; (setq dbg:*debug-print-level* 2) 2 USER 90 &gt; (subseq 3 '(cat (dog) ((goldfish)                                   (((hamster)))))  Error: Illegal START argument (CAT (DOG)                                ((GOLDFISH))                                (((HAMSTER)))) 1 (abort) return to top loop level 0.  Type :c followed by a number to proceed  USER 91 : 1 &gt; :v Call to CHECK-START-AND-END : Arg 0 (START) : (CAT (DOG) (#) (#)) Arg 1 (END) : NIL</pre> |
| Notes         | <code>*debug-print-level*</code> is an extension to Common Lisp.                                                                                                                                                                                                                                                                                                                                                                                                                        |

| <b>*default-client-remote-debugging-server-port*</b> |                                                                          | <i>Variable</i> |
|------------------------------------------------------|--------------------------------------------------------------------------|-----------------|
| Summary                                              | The default TCP port number for the client side remote debugging server. |                 |
| Package                                              | <code>dbg</code>                                                         |                 |

|               |                                                                                                                                                                                                                                                                                                                                          |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Initial Value | 21102.                                                                                                                                                                                                                                                                                                                                   |
| Description   | <p>The value of the variable <code>*default-client-remote-debugging-server-port*</code> is the default port for <code>start-client-remote-debugging-server</code> and <code>ide-connect-remote-debugging</code>.</p> <p>Note that if you change the port number on one side you must change it to the same number on the other side.</p> |
| See also      | <code>start-client-remote-debugging-server</code><br><code>ide-connect-remote-debugging</code><br>“Remote debugging” on page 25                                                                                                                                                                                                          |

| <b>*default-ide-remote-debugging-server-port*</b> |                                                                                                                                                                                                                                                                                                                                                                                                           | <i>Variable</i> |
|---------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Summary                                           | The default TCP port number for the IDE side remote debugging server.                                                                                                                                                                                                                                                                                                                                     |                 |
| Package                                           | <code>dbg</code>                                                                                                                                                                                                                                                                                                                                                                                          |                 |
| Initial Value                                     | 21101.                                                                                                                                                                                                                                                                                                                                                                                                    |                 |
| Description                                       |                                                                                                                                                                                                                                                                                                                                                                                                           |                 |
| Description                                       | <p>The value of the variable <code>*default-ide-remote-debugging-server-port*</code> is the default port for <code>start-ide-remote-debugging-server</code> and the initial default for <code>configure-remote-debugging-spec</code> and <code>with-remote-debugging-spec</code>.</p> <p>Note that if you change the port number on one side you must change it to the same number on the other side.</p> |                 |
| See also                                          | <code>start-ide-remote-debugging-server</code><br><code>configure-remote-debugging-spec</code>                                                                                                                                                                                                                                                                                                            |                 |

`with-remote-debugging-spec`  
“Remote debugging” on page 25

## ensure-remote-debugging-connection *Function*

|             |                                                                                                                                                                                                                                                                                                                                             |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Ensures that an object is a working remote debugging connection.                                                                                                                                                                                                                                                                            |
| Package     | <code>dbg</code>                                                                                                                                                                                                                                                                                                                            |
| Signature   | <code>ensure-remote-debugging-connection object =&gt; connection-or-nil</code>                                                                                                                                                                                                                                                              |
| Arguments   | <i>object</i> An object.                                                                                                                                                                                                                                                                                                                    |
| Values      | <i>connection-or-nil</i> A <code>remote-debugging-connection</code> or <code>nil</code> .                                                                                                                                                                                                                                                   |
| Description | The function <code>ensure-remote-debugging-connection</code> checks that <i>object</i> is a remote debugging connection (either IDE or client side) and that it is opened, and if so returns it. Otherwise it returns <code>nil</code> .                                                                                                    |
| Notes       | The main purpose of <code>ensure-remote-debugging-connection</code> is to check that the connection is still open. Debugging connections may close unexpectedly when the other side closes or the Lisp image quits or the machine is shut down, or (less likely) if something is wrong with the underlying connection between the machines. |
| See also    | “Remote debugging” on page 25                                                                                                                                                                                                                                                                                                               |

## executable-log-file *Function*

|         |                                        |
|---------|----------------------------------------|
| Summary | Returns the default bug form log file. |
|---------|----------------------------------------|

|             |                                                                                                                                                                                                                            |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>dbg</code>                                                                                                                                                                                                           |
| Signature   | <code>executable-log-file =&gt; log-file</code>                                                                                                                                                                            |
| Values      | <code>log-file</code> A pathname.                                                                                                                                                                                          |
| Description | <p>The function <code>executable-log-file</code> returns the default bug form log file for the current executable, which is the default path for <code>*hidden-packages*</code></p> <p>The path is also user specific.</p> |
| See also    | <code>log-bug-form</code><br><code>logs-directory</code>                                                                                                                                                                   |

### **\*hidden-packages\*** *Variable*

|               |                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary       | A list of packages whose symbols should not be displayed in debugger output.                                                                                                                                                                                                                                                                                                                 |
| Package       | <code>dbg</code>                                                                                                                                                                                                                                                                                                                                                                             |
| Initial value | A list containing the <code>dbg</code> and <code>conditions</code> packages.                                                                                                                                                                                                                                                                                                                 |
| Description   | <p><code>dbg:*hidden-packages*</code> is used by the debugger. It should be bound to a list of package specifiers. If a package is included in the list then any symbols in it are not shown by the debugger. Thus during backtraces the call frames corresponding to functions in these packages are not displayed. This can be useful in restricting the debugger to particular areas.</p> |

Example

```
CL-USER 1 > unbound

Error: The variable UNBOUND is unbound.
  1 (continue) Try evaluating UNBOUND again.
  2 Return the value of :UNBOUND instead.
  3 Specify a value to use this time instead of
evaluating UNBOUND.
  4 Specify a value to set UNBOUND to.
  5 (abort) Return to level 0.
  6 Return to top loop level 0.

Type :b for backtrace or :c <option number> to proceed.
Type :bug-form "<subject>" for a bug report template or
?: for other options.

CL-USER 2 : 1 > :b 3
Call to ERROR
Call to EVAL
Call to CAPI::CAPI-TOP-LEVEL-FUNCTION

CL-USER 3 : 1 > (push "COMMON-LISP" dbg:*hidden-
packages*)
("COMMON-LISP" #<The COMPILER package, 3131/4096
internal, 41/64 external> #<The SYSTEM package,
6258/8192 internal, 1266/2048 external> "DBG"
"CONDITIONS")

CL-USER 4 : 1 > :b 3
Call to CAPI::CAPI-TOP-LEVEL-FUNCTION
Call to CAPI::INTERACTIVE-PANE-TOP-LOOP
Call to MP::PROCESS-SG-FUNCTION

CL-USER 5 : 1 >
```

Notes

1. \*hidden-packages\* can be set to *value* by  
`(set-debugger-options :hidden value)`
2. \*hidden-packages\* is an extension to Common Lisp.

See also

`set-debugger-options`

|                   | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |               |                   |                   |                                                            |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-------------------|-------------------|------------------------------------------------------------|
| Summary           | IDE side: Create a stream on the client side (a "client stream") attached to an IDE side stream.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |               |                   |                   |                                                            |
| Package           | <code>dbg</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |               |                   |                   |                                                            |
| Signature         | <code>ide-attach-remote-output-stream stream &amp;key connection =&gt; stream-remote-object</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |                   |                   |                                                            |
| Arguments         | <table> <tr> <td><i>stream</i></td><td>An output stream.</td></tr> <tr> <td><i>connection</i></td><td>An <code>ide-remote-debugging</code> or <code>nil</code>.</td></tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <i>stream</i> | An output stream. | <i>connection</i> | An <code>ide-remote-debugging</code> or <code>nil</code> . |
| <i>stream</i>     | An output stream.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |               |                   |                   |                                                            |
| <i>connection</i> | An <code>ide-remote-debugging</code> or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |               |                   |                   |                                                            |
| Values            | <i>stream-remote-object</i> A remote object handle.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |               |                   |                   |                                                            |
| Description       | <p>The function <code>ide-attach-remote-output-stream</code> creates an output stream on the client side which is attached to <i>stream</i>, such that any output written to the output stream on the client side is sent to the IDE side and written to <i>stream</i>. The returned <i>stream-remote-object</i> is a remote object handle corresponding to a client side output stream.</p> <p><code>ide-attach-remote-output-stream</code> must be called on the IDE side.</p> <p><i>connection</i> can be used to specify which connection to use. If <i>connection</i> is <code>nil</code>, then <code>ide-find-remote-debugging-connection</code> is called to find a connection. See <code>ide-find-remote-debugging-connection</code> for more details about finding a connection.</p> <p><code>ide-attach-remote-output-stream</code> returns the same <i>stream-remote-object</i> if it is called again for the same <i>stream</i> and <i>connection</i>.</p> <p><i>stream-remote-object</i> is returned on the IDE side, but must be used on the client side, so you need to pass it to the client, normally by one of <code>ide-set-remote-symbol-value</code>, <code>ide-</code></p> |               |                   |                   |                                                            |

`funcall-in-remote` or `ide-eval-form-in-remote`. For example, you can call:

```
(dbg:ide-set-remote-symbol-value
  '*my-log-stream*
  (dbg:ide-attach-remote-output-stream
    mp:*background-standard-output*))
```

After this call, anything that is written to `*my-log-stream*` on the client side will appear in the background output in the IDE.

Notes      `ide-funcall-in-remote` and `ide-eval-form-in-remote` themselves use this mechanism to bind their *output-stream* around the evaluation/function call.

If there are any errors when writing to *stream*, they are reported to the *log-stream* of the IDE side connection (as specified by `ide-connect-remote-debugging` and `start-ide-remote-debugging-server`). Possible reasons for such errors are:

- Writing a non `base-char` to a `base-char` stream. *stream-remote-object* itself can handle any `character`, but if *stream* is a `base-char` stream then an error will be signaled if the client writes a non `base-char` into it.
- Writing to a file that fills the disk.
- Other I/O errors.

See also    `ide-find-remote-debugging-connection`  
              “Remote debugging” on page 25

## ide-connect-remote-debugging

*Function*

Summary     IDE side: Connect to a client remote debugging server.

Package     `dbg`

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                        |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|
| Signature   | <code>ide-connect-remote-debugging host &amp;key port timeout open-a-listener name log-stream =&gt; connection</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                        |
| Arguments   | <code>host</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | A string.                                              |
|             | <code>port</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | An integer.                                            |
|             | <code>timeout</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | A non-negative <code>real</code> or <code>nil</code> . |
|             | <code>open-a-listener</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | A boolean.                                             |
|             | <code>name</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | A string.                                              |
|             | <code>log-stream</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | An output stream or <code>nil</code> .                 |
| Values      | <code>connection</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | An <code>ide-remote-debugging</code> .                 |
| Description | <p>The function <code>ide-connect-remote-debugging</code> attempts to open a TCP stream to the client machine named by <code>host</code> on port number <code>port</code>. If this is successful within <code>timeout</code> seconds, then <code>create-ide-remote-debugging-connection</code> is called with the new stream, <code>log-stream</code> and a name constructed from <code>name</code>, <code>host</code> and a counter to create and return <code>connection</code>.</p> <p><code>port</code> defaults to the value of <code>*default-client-remote-debugging-server-port*</code>, which is 21102 initially.</p> <p><code>timeout</code> defaults to <code>nil</code>, which means waiting indefinitely (or until the operating system reports an error).</p> <p>If <code>open-a-listener</code> is non-nil, <code>ide-open-a-listener</code> is called to open a Remote Listener. <code>open-a-listener</code> defaults to <code>nil</code>.</p> |                                                        |
| Notes       | <p>The client machine (specified by <code>host</code>) must be accepting TCP connections on port number <code>port</code>, which would normally be done by calling <code>start-client-remote-debugging-server</code>. Normally you do not need to supply <code>port</code> because both <code>start-client-remote-debugging-server</code> and <code>ide-connect-remote-debugging</code> default it to the value of <code>*default-client-remote-debugging-server-port*</code>.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                        |

The underlying TCP stream functionality must be working between the machines, that is they must be able to connect by TCP.

When using the Remote Debugger, Remote Listener or Inspector, you do not need to access the connection directly because the tools make one for you. In addition, `create-ide-remote-debugging-connection` remembers the connection, so all the IDE side functions that look for connections will find it.

You could easily implement your own version of `ide-connect-remote-debugging` if needed using `open-tcp-stream` and `create-ide-remote-debugging-connection`.

The editor command `Connect Remote Debugging` calls `ide-connect-remote-debugging`.

See also      `start-client-remote-debugging-server`  
                 `open-tcp-stream`  
                 “Remote debugging” on page 25

### `ide-eval-form-in-remote`

### `ide-funcall-in-remote`

### `ide-set-remote-symbol-value`

### *Functions*

Summary      IDE side: Evaluate a Lisp form, call a function or set a variable, all on the client side.

Package      `dbg`

Signature      `ide-eval-form-in-remote form &key encoded-result timeout connection output-stream force-simple => results`

`ide-funcall-in-remote func-and-args &key encoded-result timeout connection output-stream => results`

`ide-set-remote-symbol-value symbol value &key connection => value`

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                       |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arguments   | <i>form</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | A Lisp form.                                                                                                                                          |
|             | <i>encoded-result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | One of <code>nil</code> , <code>t</code> , <code>:symbols</code> or <code>:not-cons</code> .                                                          |
|             | <i>timeout</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | A non-negative <code>real</code> or <code>nil</code> .                                                                                                |
|             | <i>connection</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | An <code>ide-remote-debugging</code> or <code>nil</code> .                                                                                            |
|             | <i>output-stream</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | An output stream.                                                                                                                                     |
|             | <i>force-simple</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | A boolean.                                                                                                                                            |
|             | <i>func-and-args</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A list.                                                                                                                                               |
|             | <i>symbol</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | A symbol.                                                                                                                                             |
|             | <i>value</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | An object.                                                                                                                                            |
| Values      | <i>results</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | The values returned by evaluating the form or calling the function, or the two values <code>nil</code> and <code>:timeout-waiting-for-remote</code> . |
|             | <i>value</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | An object.                                                                                                                                            |
| Description | <p>The function <code>ide-eval-form-in-remote</code> evaluates <i>form</i> on the client side and returns the result(s). Evaluation is done by <code>(eval form)</code>, unless either the evaluator has been eliminated (delivery with <code>:keep-eval nil</code>) or <i>force-simple</i> is non-nil, in which case a (very) simple evaluator is used. The simple evaluator recognizes symbols and conses, and returns all other objects. For a symbol, it returns the symbol-value (not recognizing symbol-macros). For a cons, if the car is one of <code>quote</code>, <code>if</code> or <code>progn</code> then it uses the Common Lisp semantics (using itself for recursion), otherwise it uses itself to evaluate all the elements of the cons's cdr and applies the car to those values.</p> <p>The function <code>ide-funcall-in-remote</code> applies the car of <i>func-and-args</i> to the cdr of <i>func-and-args</i> and returns the result(s). Note that it does not do any evaluation of the elements of <i>func-and-args</i>.</p> |                                                                                                                                                       |

The function `ide-set-remote-symbol-value` calls `ide-funcall-in-remote` to set the client side *symbol* to *value* as in:

```
(dbg:ide-funcall-in-remote '(set symbol value)
                           :connection connection)
```

*encoded-result* affects how the results are represented, where an "encoded" object is represented as a remote object handle and an "unencoded" object is represented as a normal object on the IDE side. Numbers, characters and strings are always unencoded, and all other objects except symbols and conses are always encoded. The value of *encoded-result* affects symbols and conses as follows:

|                            |                                                                                                                                                                                                                                                                       |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>nil</code> (default) | The top-level conses are unencoded, which means that a result that is a list is returned as an unencoded list on the IDE side. Symbols that are in packages that exist on the IDE side are returned as unencoded symbols. Note that non top-level conses are encoded. |
| <code>:symbols</code>      | The top-level conses are unencoded, but symbols and all other conses are encoded.                                                                                                                                                                                     |
| <code>:not-cons</code>     | All conses, and symbols that are in packages that exist on the IDE side, are unencoded.                                                                                                                                                                               |
| <code>t</code>             | All conses and symbols are encoded.                                                                                                                                                                                                                                   |

*timeout* determines how long to wait for the result(s). If the client side does not return result(s) within *timeout* seconds, then `ide-eval-form-in-remote` and `ide-funcall-in-remote` return the two values `nil` and `:timeout-waiting-for-remote`.

*connection* can be used to specify which connection to use. If *connection* is `nil`, then `ide-find-remote-debugging-connection` is called to find a connection. See `ide-find-remote-debugging-connection` for more details about finding a connection.

*output-stream* must be an output stream, and defaults to the value of `*standard-output*`. During the evaluation or call on the client side, the variables `*standard-output*`, `*error-output*` and `*trace-output*` are bound to a stream that sends anything that is written to it back to the IDE side where it is written to *output-stream*. This is done using `ide-attach-remote-output-stream` to create a client side stream.

|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | <p><i>form</i>, <i>func-and-args</i>, <i>symbol</i> and <i>value</i> are printed on the IDE side and read on the client side, and therefore must be objects that can be printed and read correctly. If the client is shaken (for example, delivered at level 2 or more), some symbols may not exist on the client side and will cause errors. If you want to ensure that specific symbols will work correctly with these functions, then use <code>deliver-keep-symbols</code> to keep them in the client.</p> <p>Any remote object handle inside any of <i>form</i>, <i>func-and-args</i>, <i>symbol</i> or <i>value</i> is replaced by the object itself on the client side.</p> |
| See also | <p><code>ide-find-remote-debugging-connection</code><br/> “Remote debugging” on page 25</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

## ide-find-remote-debugging-connection ide-set-default-remote-debugging-connection ide-list-remote-debugging-connections *Functions*

|           |                                                                                      |
|-----------|--------------------------------------------------------------------------------------|
| Summary   | IDE side: Find or set as default an IDE side remote debugging connection.            |
| Package   | <code>dbg</code>                                                                     |
| Signature | <code>ide-find-remote-debugging-connection =&gt; connection-or-nil, default-p</code> |

```
ide-set-default-remote-debugging-connection connection =>  
connection
```

```
ide-list-remote-debugging-connections &optional match-string => connections
```

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arguments   | <i>connection</i> An <b>ide-remote-debugging</b> .<br><i>match-string</i> A string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Values      | <i>connection-or-nil</i> An <b>ide-remote-debugging</b> or <b>nil</b> .<br><i>default-p</i> A boolean.<br><i>connection</i> An <b>ide-remote-debugging</b> .<br><i>connections</i> A list of <b>ide-remote-debugging</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Description | <p>The function <b>ide-find-remote-debugging-connection</b> tries to find a useful IDE remote debugging connection. If <b>ide-set-default-remote-debugging-connection</b> was called, and the connection argument in the last call is still open, then <b>ide-find-remote-debugging-connection</b> returns this connection as <i>connection-or-nil</i> and <i>default-p</i> is <b>t</b>. Otherwise it returns the connection that was opened last and is still open as <i>connection-or-nil</i> and <i>default-p</i> is <b>nil</b>. If there are no opened connections then it returns <i>connection-or-nil</i> and <i>default-p</i> both as <b>nil</b>.</p> <p>The function <b>ide-set-default-remote-debugging-connection</b> sets the default connection that <b>ide-find-remote-debugging-connection</b> will return to <i>connection</i>. <i>connection</i> must be a valid IDE side remote debugging connection, that is an instance of <b>ide-remote-debugging</b> that is still open. You can obtain one by calling <b>create-ide-remote-debugging-connection</b>, <b>ide-find-remote-debugging-connection</b>, <b>ide-list-remote-debugging-connections</b> or <b>remote-object-connection</b>.</p> <p>The function <b>ide-list-remote-debugging-connections</b> returns a list of opened connections. If <i>match-string</i> is <b>nil</b>, the list contains all the connections. If <i>match-string</i> is non-<b>nil</b>, the</p> |

list contains only the connections whose name contains *match-string* as a substring (plain match, case-insensitive).

|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | <p><code>ide-find-remote-debugging-connection</code> is used by all the IDE side remote debugging interface functions like <code>ide-open-a-listener</code> and <code>ide-eval-form-in-remote</code> when their <i>connection</i> argument is <code>nil</code> (the default).</p> <p>The various Editor commands (starting with "Remote"), except those ending with "In Listener", use <code>ide-eval-form-in-remote</code>, and therefore also use <code>ide-find-remote-debugging-connection</code>. The Editor command <code>Set Default Remote Debugging Connection</code> uses <code>ide-list-remote-debugging-connections</code> and <code>ide-set-default-remote-debugging-connection</code>.</p> <p>The Remote Debugger and Remote Listener tools, and all remote object handles, are each associated with a specific connection, and therefore do not use <code>ide-find-remote-debugging-connection</code>.</p> <p><code>ide-find-remote-debugging-connection</code> and <code>ide-list-remote-debugging-connections</code> can find the connections because <code>create-ide-remote-debugging-connection</code> remembers each connection it creates. The higher level interface functions <code>start-ide-remote-debugging-server</code> and <code>ide-connect-remote-debugging</code> use <code>create-ide-remote-debugging-connection</code>.</p> |
| See also | <code>ide-open-a-listener</code><br><code>ide-eval-form-in-remote</code><br><code>ide-funcall-in-remote</code><br><code>ide-set-remote-symbol-value</code><br><code>ide-attach-remote-output-stream</code><br><code>create-ide-remote-debugging-connection</code><br><code>ide-connect-remote-debugging</code><br><code>start-ide-remote-debugging-server</code><br>“Remote debugging” on page 25                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

|             | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | IDE side: Open a Remote Listener tool.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Package     | <code>dbg</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Signature   | <code>ide-open-a-listener &amp;key connection timeout =&gt; process-remote-object</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Arguments   | <p><i>connection</i>      An <code>ide-remote-debugging</code> or <code>nil</code>.</p> <p><i>timeout</i>        A non-negative <code>real</code> or <code>nil</code>.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Values      | <i>process-remote-object</i> A remote object handle or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Description | <p>The function <code>ide-open-a-listener</code> opens a Remote Listener, by calling <code>start-remote-listener</code> on the client side of the connection.</p> <p>If <i>connection</i> is non-<code>nil</code>, it is used, otherwise <code>ide-open-a-listener</code> calls <code>ide-find-remote-debugging-connection</code> to find a connection. See <code>ide-find-remote-debugging-connection</code> for further details.</p> <p><i>timeout</i> specifies the length of time (in seconds) to wait before returning. <i>timeout</i> defaults to 10 and <code>nil</code> means waiting indefinitely.</p> <p>When successful, <code>ide-open-a-listener</code> returns <i>process-remote-object</i>, which is a remote object (see <code>remote-object-p</code>) corresponding to the client process object that runs the read-eval-print loop. When a timeout occurs, <i>process-remote-object</i> is <code>nil</code>.</p> |
| Notes       | When <i>process-remote-object</i> is <code>nil</code> it does not necessarily mean a failure and the Remote Listener may open later anyway. In particular, you can use <code>:timeout 0</code> to avoid any waiting.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

See also [ide-find-remote-debugging-connection](#)  
 “Remote debugging” on page 25

## log-bug-form Function

Summary Writes a log of an error. This is useful in an application’s error handlers.

Package `dbg`

Signature `log-bug-form description &key log-file message-stream => path`

Arguments `description` A string.

`log-file` A pathname designator.

`message-stream` An output stream, `t` or `nil`.

Values `path` A pathname.

Description The function `log-bug-form` is a simple interface for writing a log of an error. Your application’s error handlers can call it.

`log-bug-form` opens the file `log-file` for output. It writes the current date followed by a bug form. The bug form contains `description`, and debugging information generated by the system. When it finishes it writes to the stream `message-stream` a single line reporting that a bug form was written.

If `log-file` is supplied it must be a valid path, and it is used to open the file. The default value of `log-file` is the value returned by `executable-log-file`.

`log-bug-form` calls `ensure-directories-exist` before opening the log file, therefore so the directory where the `log-file` is written does not need to exist before `log-bug-form` is called.

If `message-stream` is `t` the message is written to standard output. If `message-stream` is a stream the message is written to it,

and if *message-stream* is `nil` then no message is written. *message-stream* defaults to the value of `*error-output*`.

If there is an error during the operation, `log-bug-form` silently fails and returns `nil`.

On success `log-bug-form` returns the path where the log file was written.

See also the section "Reporting bugs" in the *LispWorks Release Notes and Installation Guide*.

|                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes               | <p><code>log-bug-form</code> is invoked automatically if the debugger decides to use the console (the terminal) rather than use the LispWorks IDE debugging tools. This means that after such an error the user can always find a bug form in the default log file, which can be found by using <code>executable-log-file</code>. <code>log-bug-form</code> always appends, so if it is called frequently the log file grows continuously. You may need to clear it periodically. It may be a good idea to move the file rather than delete it, so a record of errors remains.</p> <p>When editing the log file it should be noted that each bug form is preceded by the time it was written, and that the bug forms are in chronological order. That means that the interesting bug form is most often the last one in the file.</p> |
| Compatibility notes | In LispWorks 7.0 and earlier, <i>message-stream</i> defaulted to the value of <code>*debug-io*</code> , but this was not documented.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| See also            | <code>executable-log-file</code><br><code>logs-directory</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

|         | <i>Function</i>                                          |
|---------|----------------------------------------------------------|
| Summary | Returns the directory in which LispWorks puts log files. |
| Package | <code>dbg</code>                                         |

|             |                                                                                                                        |
|-------------|------------------------------------------------------------------------------------------------------------------------|
| Signature   | <code>logs-directory =&gt; dir</code>                                                                                  |
| Values      | <code>dir</code> A directory pathname.                                                                                 |
| Description | The function <code>logs-directory</code> returns the directory in which LispWorks puts log files for the current user. |
| See also    | <code>executable-log-file</code><br><code>log-bug-form</code>                                                          |

## **output-backtrace** *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Summary     | Prints a backtrace of the current stack. For use in exception handling routines.                                                                                                                                                                                                                                                                                                                                                                                                  |  |
| Package     | <code>dbg</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |
| Signature   | <code>output-backtrace keyword &amp;key stream printer-bindings</code>                                                                                                                                                                                                                                                                                                                                                                                                            |  |
| Arguments   | <p><code>keyword</code> Defines how verbose the output should be.<br/>           It can be one of <code>:quick</code>, <code>:brief</code>, <code>:verbose</code> or <code>:bug-form</code>, in increasing order of verbosity.</p> <p><code>stream</code> An output stream designator.</p> <p><code>printer-bindings</code> A list of conses.</p>                                                                                                                                 |  |
| Description | <p>The function <code>output-backtrace</code> prints a backtrace of the current stack.</p> <p>The output goes to the stream designated by <code>stream</code>. <code>printer-bindings</code>, if supplied, must be a list of conses, where the car of each cons is a symbol. <code>printer-bindings</code> is ignored if <code>keyword</code> is <code>:quick</code>. Otherwise, around the actual printing it binds each symbol to the value in the cdr of the cons. This is</p> |  |

intended to override the bindings that are used in the functions that `output-backtrace` uses.

`output-backtrace` should be used by applications in their exception handling routines to log a backtrace whenever an unexpected situation arises. In general, any application that is not intended to be used by Lisp programmers should have error handlers to deal with unexpected situations, and all these handlers should use `output-backtrace`.

|          |                                                                                                                                 |
|----------|---------------------------------------------------------------------------------------------------------------------------------|
| Notes    | The symbols that can be bound are not limited to "printer" symbols, so the name <i>printer-bindings</i> is slightly misleading. |
| See also | <code>log-bug-form</code>                                                                                                       |

## \*print-binding-frames\* *Variable*

|               |                                                                                                                                                                                                                                                                                             |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary       | Controls whether binding frames are printed in debugger output.                                                                                                                                                                                                                             |
| Package       | <code>dbg</code>                                                                                                                                                                                                                                                                            |
| Initial value | <code>nil</code>                                                                                                                                                                                                                                                                            |
| Description   | This variable is used by the debugger when it displays the stack frames. Binding frames are formed when special variables are bound, but are normally not shown by the debugger. However if the value of <code>dbg:*print-binding-frames*</code> is true then the binding frames are shown. |
| Notes         | <ol style="list-style-type: none"><li>1. <code>*print-binding-frames*</code> can be set to <i>value</i> by<br/><code>(set-debugger-options :bindings value)</code></li><li>2. <code>*print-binding-frames*</code> is an extension to Common Lisp.</li></ol>                                 |

## Example

```

CL-USER 16 > (defun print-to-length (object length)
    (let ((*print-length* length))
      (prinnt object)))
PRINT-TO-LENGTH

CL-USER 17 > (setf dbg:*print-binding-frames* t)
T

CL-USER 18 > (print-to-length '(x y z) 2)

Error: Undefined operator PRINNT in form (PRINNT
OBJECT) .
  1 (continue) Try invoking PRINNT again.
  2 Return some values from the form (PRINNT OBJECT) .
  3 Try invoking something other than PRINNT with the
same arguments.
  4 Set the symbol-function of PRINNT to another
function.
  5 Set the macro-function of PRINNT to another
function.
  6 (abort) Return to level 0.
  7 Return to top loop level 0.

Type :b for backtrace, :c <option number> to proceed,
or :? for other options

CL-USER 19 : 1 > :n print-to-length
Interpreted call to PRINT-TO-LENGTH

CL-USER 20 : 1 > :b :verbose 5
Interpreted call to PRINT-TO-LENGTH:
  OBJECT          : (X Y Z)
  LENGTH          : 2
  *PRINT-LENGTH* : 2

  Block environment contour:
  Tag environment contour:
  Function environment contour
  Variable environment contour: ()

  Tag environment contour:
  Block environment contour:
  Function environment contour
  Variable environment contour: ()

Call to EVAL (offset 184)
  EXP : (PRINT-TO-LENGTH (QUOTE (X Y Z)) 2)

```

```

Binding frame:
  SYSTEM::*:TOP-LOOP-ACTIVE*      : -1
  COMPILER::*:IN-COMPILER-HANDLER* : #<Unbound
Marker>
  *                               : NIL
  **                             : NIL
  ***                            : NIL
  -                               : NIL
  +                               : NIL
  ++                             : NIL
  +++                            : NIL
  ///                            : NIL
  //                             : NIL
  /                               : NIL
  SYSTEM::*:TOP-LOOP-HOOK*        : NIL
  SYSTEM::*:USER-COMMANDS*        : NIL
  SYSTEM::*:IN-TOP-LEVEL-READ-A-COMMAND* : NIL

```

CL-USER 21 : 1 >

See also [set-debugger-options](#)

## \*print-catch-frames\*

*Variable*

|               |                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary       | Controls whether catch frames are printed in debugger output.                                                                                                                                                                                                                                                                                                                         |
| Package       | dbg                                                                                                                                                                                                                                                                                                                                                                                   |
| Initial value | t                                                                                                                                                                                                                                                                                                                                                                                     |
| Description   | This variable is used by the debugger when it displays the stack frames. Catch frames are created when the special form <code>catch</code> is used. They are set up so that throws to the matching tag can be received. By default the debugger displays these frames, but if <code>*print-catch-frames*</code> is set to <code>nil</code> then the catch frames are no longer shown. |

|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | <ol style="list-style-type: none"> <li>1. *print-catch-frames* can be set to <i>value</i> by<br/> <code>(set-debugger-options :catchers value)</code></li> <li>2. *print-catch-frames* is an extension to Common Lisp.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                          |
| Examples | <pre> USER 17 &gt; (setq dbg:*print-catch-frames* nil)  NIL USER 18 &gt; (defun catch-it ()              (catch 'tag (throw-it) (print "Not caught")))  CATCH-IT USER 19 &gt; (defun throw-it ()               (throw 'tag (break)))  THROW-IT USER 20 &gt; (catch-it)  break   1 (continue) return from break.   2 (abort) return to top loop level 0.  Type :c followed by a number to proceed  USER 21 : 1 &gt; :b 5 Interpreted call to (DEFUN THROW-IT): Call to *%APPLY-INTERPRETED-FUNCTION  : Interpreted call to (DEFUN CATCH-IT): Call to *%APPLY-INTERPRETED-FUNCTION  : Call to %EVAL  :</pre> |
| See also | <code>set-debugger-options</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

## \*print-handler-frames\*

*Variable*

|               |                                                                 |
|---------------|-----------------------------------------------------------------|
| Summary       | Controls whether handler frames are printed in debugger output. |
| Package       | <code>dbg</code>                                                |
| Initial value | <code>nil</code>                                                |

Description This variable is used by the debugger when it displays the stack frames. Handler frames are created by error handlers (see “The stack in the debugger” on page 12), and are normally not shown by the debugger. However if `*print-handler-frames*` is set to `t` then the handler frames are displayed.

- Notes
1. `*print-handler-frames*` can be set to *value* by  
`(set-debugger-options :handler value)`
  2. `*print-handler-frames*` is an extension to Common Lisp.

Example

```
USER 162 > (setq lw:*print-handler-frames* t)

T
USER 163 > (defun test (n)
  (handler-case (fn-to-use n)
    (type-error () (format t "~%Type error~%") 0)))

TEST
USER 164 > (test #C(1 1))

Error: Undefined function: FN-TO-USE, with args
  (#C(1 1))

1 (continue) Call FN-TO-USE again
2 (abort) return to top loop level 0.

Type :c followed by a number to proceed
```

```

USER 165 : 1 > :b 10
Catch frame: (NIL)
Catch frame: #::|block-catcher-1854|
Call to *%UNDEFINED-FUNCTION-FUNCTION   :
Call to %EVAL   :
Call to RETURN-FROM   :
Call to %EVAL   :
Call to EVAL-AS-PROGN   :
Handler frame: ((TYPE-ERROR %LEXICAL-CLOSURE%
(LAMBDA
 (CONDITIONS::TEMP)
 (GO #:|lambda-633|))
((#:|lambda-632|) (N . #))
NIL ((#:|lambda-631|) (TEST)))
((#:|lambda-633| # #))))
Catch frame: "<* Catch All Object *>"
Call to LET   :

```

See also      **`set-debugger-options`**

## \*print-invisible-frames\* *Variable*

Summary      Controls whether invisible frames are printed in debugger output.

Package      **dbg**

Initial value      **nil**

Description      This variable is used by the debugger when it displays the stack frames.

Invisible frames are those for functions with **hcl:invisible-frame** declarations. These are normally not shown by the debugger. However if **\*print-invisible-frames\*** is true then these frames are displayed.

Notes      1. **\*print-invisible-frames\*** can be set to *value* by  
`(set-debugger-options :invisible value)`

2. **\*print-invisible-frames\*** is an extension to Common Lisp.

See also      **set-debugger-options**

**\*print-open-frames\***                                            *Variable*

Summary      Controls whether open frames are printed in debugger output.

Package      **dbg**

Initial value      **nil**

Description      This variable is used by the debugger when it displays the stack frames. Open frames are made by the system and are normally not shown by the debugger. However if **\*print-open-frames\*** is set to **t** then the open frames are displayed. It is unlikely that you need to examine open frames: their use is connected with implementation details.

Examples      **USER 52 > (setq dbg:\*print-open-frames\* t)**

**T**

**USER 53 > (car 2)**

**Error: Cannot take CAR of 2**

**1 (abort) return to top loop level 0.**

**Type :c followed by a number to proceed**

**USER 54 : 1 > :b 3**

**Open frame (5)**

**Open frame (5)**

**Call to CAR-FRAME :**

Notes      **\*print-open-frames\*** is an extension to Common Lisp.

|               | <b>*print-restart-frames*</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Variable |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Summary       | Controls whether restart frames are printed in debugger output.                                                                                                                                                                                                                                                                                                                                                                                                                              |          |
| Package       | <code>dbg</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |          |
| Initial value | <code>nil</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |          |
| Description   | This variable is used by the debugger when it displays the stack frames. Restart frames are formed when restarts are established (see “The stack in the debugger” on page 12), but are normally not shown by the debugger. However if <b>*print-restart-frames*</b> is set to <code>t</code> then the restart frames are shown.                                                                                                                                                              |          |
| Example       | <pre>USER 43 &gt; (setq dbg:*print-restart-frames* t) T USER 44 &gt; (truncate 12.5 0.0)  Error: Division-by-zero caused by TRUNCATE       of (12.5 0.0) 1 (continue) Return a value to use 2 Supply new arguments to use 3 (abort) return to top loop level 0.  Type :c followed by a number to proceed  USER 45 : 1 &gt; :b 5 Restart frame: (ABORT) Catch frame: (NIL) Catch frame: #:: block-catcher-3223  Call to DIVISION-BY-ZERO-ERROR : Call to TRUNCATEANY : USER 46 : 1 &gt;</pre> |          |
| Notes         | <ol style="list-style-type: none"> <li>1. <b>*print-restart-frames*</b> can be set to <i>value</i> by<br/> <code>(set-debugger-options :restarts value)</code></li> <li>2. <b>*print-restart-frames*</b> is an extension to Common Lisp.</li> </ol>                                                                                                                                                                                                                                          |          |

See also [set-debugger-options](#)

## **remote-debugging-connection**

### **client-remote-debugging**

### **ide-remote-debugging**

### *System Classes*

Summary Classes of the connections in the remote debugging APIs.

Package `dbg`

Superclasses `t`

Description The system class `remote-debugging-connection` is a super-class of all the connection classes in the remote debugging APIs. `client-remote-debugging` and `ide-remote-debugging` are subclasses of `remote-debugging-connection`.

All client side connections are instances of `client-remote-debugging`, and all IDE side connections are instances of `ide-remote-debugging`.

You should not try to instantiate these classes or inherit from them. In typical use, you do not need to access instances of these classes.

See “Remote debugging” on page 25 for how to create and use remote debugging connections.

See also “Remote debugging” on page 25

## **remote-debugging-connection-add-close-cleanup**

## **remote-debugging-connection-remove-close-cleanup**

### *Functions*

Summary Add or remove a function that is called when a remote debugging connection is closed.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>dbg</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Signature   | <code>remote-debugging-connection-add-close-cleanup connection</code><br><code>function =&gt; changed-p</code><br><code>remote-debugging-connection-remove-close-cleanup</code><br><code>connection function =&gt; changed-p</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Arguments   | <p><code>connection</code> A <code>remote-debugging-connection</code>.</p> <p><code>function</code> A function designator or a list whose car is a function designator.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Values      | <code>changed-p</code> Boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Description | <p>The function <code>remote-debugging-connection-add-close-cleanup</code> records <code>function</code> as a cleanup in <code>connection</code>. When <code>connection</code> is closed, for whatever reason, each recorded <code>function</code> is invoked (by <code>funcall</code> for a <code>function</code> or <code>symbol</code>, or by applying the car to the cdr for a <code>list</code>). <code>function</code> is added only if it is not already in the list (tested by <code>equal</code>).</p> <p>The function <code>remote-debugging-connection-remove-close-cleanup</code> removes <code>function</code> from the cleanups if it was already added (tested by <code>equal</code>).</p> <p><code>changed-p</code> is <code>t</code> if the cleanups were modified and <code>nil</code> otherwise.</p> <p>Both functions may be called on either side (IDE or client).</p> |
| Notes       | <p>You should not assume anything about the order of calls to the cleanup functions.</p> <p>Unhandled errors during the call to <code>function</code> are handled and reported to the <code>log-stream</code> of the connection.</p> <p><code>remote-debugging-connection-remove-close-cleanup</code> is needed when you repeatedly create some objects that do not live for long but you still want cleanups for them. In this situation, the cleanup list would grow indefinitely unless you</p>                                                                                                                                                                                                                                                                                                                                                                                          |

call `remote-debugging-connection-remove-close-cleanup` when an object is discarded.

See also “Remote debugging” on page 25  
`close-remote-debugging-connection`

## **remote-debugging-connection-name** *Function*

|             |                                                                                                                                                                                                                                                                                               |                                           |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| Summary     | Return the name of a remote debugging connection.                                                                                                                                                                                                                                             |                                           |
| Package     | <code>dbg</code>                                                                                                                                                                                                                                                                              |                                           |
| Signature   | <code>remote-debugging-connection-name connection =&gt; name</code>                                                                                                                                                                                                                           |                                           |
| Arguments   | <code>connection</code>                                                                                                                                                                                                                                                                       | A <code>remote-object-connection</code> . |
| Values      | <code>name</code>                                                                                                                                                                                                                                                                             | An object.                                |
| Description | <p>The function <code>remote-debugging-connection-name</code> returns the name was supplied (or defaulted) when <code>connection</code> was made.</p> <p><code>remote-debugging-connection-peer-address</code> may be called on either side (IDE or client).</p>                              |                                           |
| See also    | <code>ide-connect-remote-debugging</code><br><code>start-ide-remote-debugging-server</code><br><code>create-ide-remote-debugging-connection</code><br><code>create-client-remote-debugging-connection</code><br><code>configure-remote-debugging-spec</code><br>“Remote debugging” on page 25 |                                           |

|             | <b>remote-debugging-connection-peer-address</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <i>Function</i>                           |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| Summary     | Return the address of the other side of a remote debugging connection.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                           |
| Package     | <code>dbg</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                           |
| Signature   | <code>remote-debugging-connection-peer-address connection -&gt; remote-host, remote-port</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                           |
| Arguments   | <i>connection</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | A <code>remote-object-connection</code> . |
| Values      | <i>remote-host</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | A string.                                 |
|             | <i>remote-port</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | An integer.                               |
| Description | The function <code>remote-debugging-connection-peer-address</code> returns the "peer address" of <i>connection</i> .<br><br>Normally debugging connections are implemented over socket streams, so <i>remote-host</i> and <i>remote-port</i> are the results of calling <code>socket-stream-peer-address</code> on the underlying stream.<br><br><code>remote-debugging-connection-peer-address</code> is implemented by calling <code>remote-debugging-stream-peer-address</code> on the stream of the connection, which has a method specialized on <code>socket-stream</code> that calls <code>socket-stream-peer-address</code> . |                                           |
|             | If <i>connection</i> does not use a socket stream (for example, if it was created by <code>create-ide-remote-debugging-connection</code> or <code>create-client-remote-debugging-connection</code> with a <i>stream</i> that is not a <code>socket-stream</code> ), then <i>remote-host</i> and <i>remote-port</i> will both be <code>nil</code> unless you define a method on <code>remote-debugging-stream-peer-address</code> for the stream. That will not affect the behavior of the connection otherwise.                                                                                                                       |                                           |

`remote-debugging-connection-peer-address` may be called on either side (IDE or client).

See also `remote-debugging-stream-peer-address`  
“Remote debugging” on page 25

## `remote-debugging-stream-peer-address` *Generic Function*

Summary Advanced: Return the peer address of a remote debugging stream.

Package `dbg`

Signature `remote-debugging-stream-peer-address stream => remote-host, remote-port`

Method signatures `remote-debugging-stream-peer-address (stream t)`  
`remote-debugging-stream-peer-address (stream socket-stream)`

Arguments `stream` A stream.

Values `remote-host` A string.

`remote-port` An integer.

Description The generic function `remote-debugging-stream-peer-address` returns the “peer address” of `stream` as two values:

`remote-host` The hostname of the remote host.

`remote-port` The port number on the remote host.

`remote-debugging-stream-peer-address` is called by `remote-debugging-connection-peer-address` with the stream that its `connection` uses to communicate with the other side. It is intended to allow you to implement remote debugging with other types of stream by calling `create-client-remote-debugging-connection` and `create-ide-remote-`

`debugging-connection`. In typical usage you do not need to define a method on `remote-debugging-stream-peer-address`.

The method specialized on `t` returns `nil` and `nil`.

The method specialized on `socket-stream` returns the peer hostname and port using `socket-stream-peer-address`.

`remote-debugging-stream-peer-address` may be called on either side (IDE or client).

See also

`remote-debugging-connection-peer-address`  
“Remote debugging” on page 25

## **remote-inspect** *Function*

**Summary** Client side: inspect a client side object in an Inspector tool on the IDE side.

**Package** `dbg`

**Signature** `remote-inspect object &key connection`

**Arguments** `object` Any object.

`connection` A `client-remote-debugging`.

**Description** The function `remote-inspect` causes an Inspector tool on the IDE side to inspect a client side object. The actual object in the Inspector is a remote object handle to the client side `object`. The Inspector tool itself is an ordinary Inspector tool, and there is nothing that makes it a “remote” tool in any way.

`connection` specifies which connection to use. If it is supplied and is a valid open client connection, it is used.

If `connection` is `nil` (the default) or is not a valid connection, `remote-inspect` first checks if there is a default connection

that is enabled (by default, if there is a default connection then it is enabled, see `set-remote-debugging-connection`) and uses that, the same as the Debugger and Listener do. However, if there is no default connection enabled, `remote-inspect` behaves differently from the Debugger and Listener, because there is no obvious time-point to close temporary connections.

If there is no enabled default connection, `remote-inspect` does the following:

- If a previous call to `remote-inspect` already opened a connection, then `remote-inspect` re-uses it.
- Otherwise, if there a default connection then `remote-inspect` uses it anyway (even though it is not enabled).
- Otherwise, if there is a remote debugging spec (configured either by `configure-remote-debugging-spec` or `with-remote-debugging-spec`), then `remote-inspect` tries to open a connection using that spec. If this works, it uses the new connection, and unless it is configured as the default (`setup-default` non-nil in `configure-remote-debugging-spec`) it also records it for future calls of `remote-inspect`.

#### Notes

With the default setting, the connection opening function (`start-client-remote-debugging-server` or `configure-remote-debugging-spec`) both configures and enables the default connection, so `remote-inspect` will just use that connection (maybe opening it the first time).

An ordinary inspector can inspect a remote object because the generic function `get-inspector-values` has a method that specializes on remote object handles to invoke `get-inspector-values` on the client side and return the results. Thus `remote-inspect` can work only if `get-inspector-values` works on the client side, which is not guaranteed when delivering an application at higher values of the `level` argument to `deliver`.

The only way to close a non-default connection that was opened by `remote-inspect` is to terminate the process that runs it on either the IDE or client side.

You can also inspect a remote object from the Remote Debugger or Remote Listener.

See also

`set-remote-debugging-connection`  
`start-client-remote-debugging-server`  
`configure-remote-debugging-spec`  
`get-inspector-values`  
“Remote debugging” on page 25

## `remote-object-p`

## `remote-object-connection`

### *Functions*

Summary      IDE side: Test for a remote object handle and return its connection.

Package      `dbg`

Signature      `remote-object-p object => boolean`  
`remote-object-connection remote-object => connection`

Arguments      `object`      Any object.

`remote-object`      A remote object handle.

Values      `boolean`      A boolean.

`connection`      An `ide-remote-debugging`.

Description      The function `remote-object-p` is a predicate, returning true if `object` is a remote object handle and false otherwise.

The function `remote-object-connection` returns the `ide-remote-debugging` that `remote-object` is associated with.

See also “Remote debugging” on page 25

|                             | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                 |                                     |                 |                                   |                 |                                |                |                                     |                 |                                     |                 |                        |                  |                        |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-------------------------------------|-----------------|-----------------------------------|-----------------|--------------------------------|----------------|-------------------------------------|-----------------|-------------------------------------|-----------------|------------------------|------------------|------------------------|
| <b>set-debugger-options</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                 |                                     |                 |                                   |                 |                                |                |                                     |                 |                                     |                 |                        |                  |                        |
| Summary                     | Sets debugger printing control variables.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                 |                                     |                 |                                   |                 |                                |                |                                     |                 |                                     |                 |                        |                  |                        |
| Signature                   | <code>set-debugger-options &amp;key <i>all</i> <i>bindings</i> <i>catchers</i> <i>hidden</i> <i>handler</i> <i>restarts</i> <i>invisible</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                 |                                     |                 |                                   |                 |                                |                |                                     |                 |                                     |                 |                        |                  |                        |
| Arguments                   | <table><tr><td><i>all</i></td><td>A generalized boolean.</td></tr><tr><td><i>bindings</i></td><td>A generalized boolean.</td></tr><tr><td><i>catchers</i></td><td>A generalized boolean.</td></tr><tr><td><i>hidden</i></td><td>A generalized boolean.</td></tr><tr><td><i>handler</i></td><td>A generalized boolean.</td></tr><tr><td><i>restarts</i></td><td>A generalized boolean.</td></tr><tr><td><i>invisible</i></td><td>A generalized boolean.</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                           | <i>all</i>      | A generalized boolean.              | <i>bindings</i> | A generalized boolean.            | <i>catchers</i> | A generalized boolean.         | <i>hidden</i>  | A generalized boolean.              | <i>handler</i>  | A generalized boolean.              | <i>restarts</i> | A generalized boolean. | <i>invisible</i> | A generalized boolean. |
| <i>all</i>                  | A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                                     |                 |                                   |                 |                                |                |                                     |                 |                                     |                 |                        |                  |                        |
| <i>bindings</i>             | A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                                     |                 |                                   |                 |                                |                |                                     |                 |                                     |                 |                        |                  |                        |
| <i>catchers</i>             | A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                                     |                 |                                   |                 |                                |                |                                     |                 |                                     |                 |                        |                  |                        |
| <i>hidden</i>               | A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                                     |                 |                                   |                 |                                |                |                                     |                 |                                     |                 |                        |                  |                        |
| <i>handler</i>              | A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                                     |                 |                                   |                 |                                |                |                                     |                 |                                     |                 |                        |                  |                        |
| <i>restarts</i>             | A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                                     |                 |                                   |                 |                                |                |                                     |                 |                                     |                 |                        |                  |                        |
| <i>invisible</i>            | A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                                     |                 |                                   |                 |                                |                |                                     |                 |                                     |                 |                        |                  |                        |
| Description                 | <p>A call to <b>set-debugger-options</b> allows you to set the various debugger printing control variables without having the inconvenience of setting each variable individually with a call to <b>setq</b> and without having to remember the names for each of the variables.</p> <p><i>all</i> affects the state of the debugger command <code>:all</code>.</p> <p>The other arguments set the debugger printing control variables as listed below:</p> <table><tr><td><i>bindings</i></td><td><code>*print-binding-frames*</code></td></tr><tr><td><i>catchers</i></td><td><code>*print-catch-frames*</code></td></tr><tr><td><i>hidden</i></td><td><code>*hidden-packages*</code></td></tr><tr><td><i>handler</i></td><td><code>*print-handler-frames*</code></td></tr><tr><td><i>restarts</i></td><td><code>*print-restart-frames*</code></td></tr></table> | <i>bindings</i> | <code>*print-binding-frames*</code> | <i>catchers</i> | <code>*print-catch-frames*</code> | <i>hidden</i>   | <code>*hidden-packages*</code> | <i>handler</i> | <code>*print-handler-frames*</code> | <i>restarts</i> | <code>*print-restart-frames*</code> |                 |                        |                  |                        |
| <i>bindings</i>             | <code>*print-binding-frames*</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                 |                                     |                 |                                   |                 |                                |                |                                     |                 |                                     |                 |                        |                  |                        |
| <i>catchers</i>             | <code>*print-catch-frames*</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |                                     |                 |                                   |                 |                                |                |                                     |                 |                                     |                 |                        |                  |                        |
| <i>hidden</i>               | <code>*hidden-packages*</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                 |                                     |                 |                                   |                 |                                |                |                                     |                 |                                     |                 |                        |                  |                        |
| <i>handler</i>              | <code>*print-handler-frames*</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                 |                                     |                 |                                   |                 |                                |                |                                     |                 |                                     |                 |                        |                  |                        |
| <i>restarts</i>             | <code>*print-restart-frames*</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                 |                                     |                 |                                   |                 |                                |                |                                     |                 |                                     |                 |                        |                  |                        |

*invisible*                    \*print-invisible-frames\*

|          |                                                                              |
|----------|------------------------------------------------------------------------------|
| Notes    | The call frames are always displayed, so there is no option to control that. |
| See also | <code>set-debugger-options</code>                                            |

## **set-default-remote-debugging-connection**                    *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Client side (advanced): Sets the client side default connection to use when remote debugging is enabled.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Package     | <code>dbg</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Signature   | <code>set-default-remote-debugging-connection connection =&gt; return-connection</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Arguments   | <i>connection</i> A <code>client-remote-debugging</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Values      | <i>return-connection</i> The value of <i>connection</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Description | <p>The function <code>set-default-remote-debugging-connection</code> sets <i>connection</i> as the default connection for the remote debugging interface on the client side (used when entering the debugger and by calls to <code>start-remote-listener</code> and <code>remote-inspect</code>).</p> <p>The default connection is used when the enabling switch is <code>t</code>, which it typically is because that is the default in <code>start-client-remote-debugging-server</code> and <code>configure-remote-debugging-spec</code>. The switch can also be set by <code>set-remote-debugging-connection</code> and in a dynamic scope by <code>with-remote-debugging-connection</code> and <code>with-remote-debugging-spec</code>.</p> <p>See <code>set-remote-debugging-connection</code> for a discussion about the enabling switch.</p> |

Notes In typical usage, you will not need to use `set-default-remote-debugging-connection`.

See also `set-remote-debugging-connection`  
“Remote debugging” on page 25

## **set-remote-debugging-connection** *Function*

Summary Client side (advanced): Set the remote debugging connection to use on the client side.

Package `dbg`

Signature `set-remote-debugging-connection connection => res`

Arguments `connection`     `nil`, `t` or a `client-remote-debugging`.

Values `res`         The value of `connection` if it is valid.

Description The function `set-remote-debugging-connection` sets an enabling switch controlling which remote debugging connection will be used by the remote debugging interface (entering the debugger, `start-remote-listener` or `remote-inspect`) on the client side.

If `connection` is `t`, then the default connection will be used (which may be set by `set-default-remote-debugging-connection`, `start-client-remote-debugging-server`, or `configure-remote-debugging-spec`). If `connection` is an instance of `client-remote-debugging`, then `connection` itself will be used. If `connection` is `nil`, then no connection is specified (the API may open one when needed).

The setting is global, unless it is called within the dynamic extent of `with-remote-debugging-connection`, in which case its effects last until the exit from this extent.

When entering the debugger, the connection is used when `invoke-debugger` is called and no hook blocks it. Possible hooks include `*debugger-hook*` and `with-debugger-wrapper`. For the Remote Listener and Inspector, the functions `start-remote-listener` and `remote-inspect` use the connection.

|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | <p>In typical usage, you will not need to explicitly call <code>set-default-remote-debugging-connection</code>, because <code>start-client-remote-debugging-server</code> and <code>configure-remote-debugging-spec</code> (with the default parameters) both set the default connection.</p> <p>In all cases, if the debugger is invoked and there is no connection to use, LispWorks may open a connection if it was configured to do so by <code>configure-remote-debugging-spec</code> or <code>with-remote-debugging-spec</code>.</p> <p>You can obtain a client remote debugging connection by using the <code>:open-callback</code> keyword with <code>start-client-remote-debugging-server</code> or <code>configure-remote-debugging-spec</code>.</p> |
| See also | <p><code>with-remote-debugging-connection</code><br/> <code>set-default-remote-debugging-connection</code><br/> <code>start-client-remote-debugging-server</code><br/> <code>configure-remote-debugging-spec</code><br/> “Remote debugging” on page 25</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

|         |                                                                      | <i>Function</i> |
|---------|----------------------------------------------------------------------|-----------------|
| Summary | Client side: Start a remote debugging TCP server on the client side. |                 |
| Package | <code>dbg</code>                                                     |                 |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                 |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|
| Signature   | <code>start-client-remote-debugging-server &amp;key port open-callback log-stream setup-default enable =&gt; process</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                 |
| Arguments   | <i>port</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | An integer.                                                     |
|             | <i>open-callback</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <code>nil</code> or a function of one argument: the connection. |
|             | <i>log-stream</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | An output stream or <code>nil</code> .                          |
|             | <i>setup-default</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <code>nil</code> or <code>t</code> .                            |
|             | <i>enable</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <code>nil</code> or <code>t</code> .                            |
| Values      | <i>process</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | A process.                                                      |
| Description | <p>The function <code>start-client-remote-debugging-server</code> starts a client side server for remote debugging, which will create a client side remote debugging connection when a remote machine connects to it. With the default settings, this remote debugging connection will become the default connection and will be enabled for re-use whenever a connection is needed (entering the debugger, or calls to <code>start-remote-listener</code> or <code>remote-inspect</code>).</p> <p>The main operation of <code>start-client-remote-debugging-server</code> is calling <code>start-up-server</code> with <i>port</i> and a function that calls <code>create-client-remote-debugging-connection</code> to create a client for every connection to the server. <i>port</i> defaults to the value of <code>*default-client-remote-debugging-server-port*</code>, which is 21102 initially.</p> <p>The other keyword arguments affect what else <code>start-client-remote-debugging-server</code> does.</p> <p>If <i>open-callback</i> is non-<code>nil</code>, it is called with the each new connection that is created. <i>open-callback</i> defaults to <code>nil</code>.</p> <p>If <i>setup-default</i> is non-<code>nil</code> (the default when <i>open-callback</i> is <code>nil</code>), every new connection is made the default connection by a call to <code>set-default-remote-debugging-connection</code>, and if <i>enable</i> is non-<code>nil</code> (the default), it will be enabled for re-</p> |                                                                 |

use by `set-remote-debugging-connection` with argument `t`. If `setup-default` is `nil` (the default when `open-callback` is non-nil) then `enable` is ignored. `setup-default` defaults to `(not open-callback)`.

If `log-stream` is non-nil, LispWorks writes error messages to it relating to failures during communication on a connection. These failures should not happen normally, but may happen if something writes to the remote debugging connection not through the remote debugging interface. `log-stream` defaults to `nil`.

`start-client-remote-debugging-server` returns `process`, which is the result of `start-up-server`. You can use `server-terminate` to stop it.

#### Notes

To have a connection, the IDE side needs to connect to the client hostname on port number `port` using `ide-connect-remote-debugging`, or code that does similar things.

In normal operation, it is assumed that the IDE side will connect once, and from that point onward this connection will be used for all remote debugging. If the IDE subsequently opens another connection without first closing the first connection, then the first connection will "leak" on the client side. It is the responsibility of the IDE to close it in this case.

`open-callback` allows more complex usage, for example to store the connection somewhere and use it when required by `with-remote-debugging-connection` or `set-remote-debugging-connection`. Note that `setup-default` is `nil` by default when `open-callback` is non-nil.

`start-client-remote-debugging-server` is implemented using the other functions discussed in this section, so you can reasonably easily write your own version of it if you need to.

#### See also

`start-up-server`  
`create-client-remote-debugging-connection`

`set-default-remote-debugging-connection`  
`set-remote-debugging-connection`  
`ide-connect-remote-debugging`  
“Remote debugging” on page 25

|                            | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                   |                       |                            |                                                  |                   |           |                         |                                        |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----------------------|----------------------------|--------------------------------------------------|-------------------|-----------|-------------------------|----------------------------------------|
| Summary                    | IDE side: Start an IDE side remote debugging server, so clients can connect to it.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                   |                       |                            |                                                  |                   |           |                         |                                        |
| Package                    | <code>dbg</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                   |                       |                            |                                                  |                   |           |                         |                                        |
| Signature                  | <code>start-ide-remote-debugging-server &amp;key port socket-filter<br/>name log-stream -&gt; server-process</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                   |                       |                            |                                                  |                   |           |                         |                                        |
| Arguments                  | <table><tr><td><code>port</code></td><td>An integer or string.</td></tr><tr><td><code>socket-filter</code></td><td>A function of one argument or <code>nil</code>.</td></tr><tr><td><code>name</code></td><td>A string.</td></tr><tr><td><code>log-stream</code></td><td>An output stream or <code>nil</code>.</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <code>port</code> | An integer or string. | <code>socket-filter</code> | A function of one argument or <code>nil</code> . | <code>name</code> | A string. | <code>log-stream</code> | An output stream or <code>nil</code> . |
| <code>port</code>          | An integer or string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                   |                       |                            |                                                  |                   |           |                         |                                        |
| <code>socket-filter</code> | A function of one argument or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                   |                       |                            |                                                  |                   |           |                         |                                        |
| <code>name</code>          | A string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                   |                       |                            |                                                  |                   |           |                         |                                        |
| <code>log-stream</code>    | An output stream or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                   |                       |                            |                                                  |                   |           |                         |                                        |
| Values                     | <code>server-process</code> A process handling incoming connections.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                   |                       |                            |                                                  |                   |           |                         |                                        |
| Description                | <p>The function <code>start-ide-remote-debugging-server</code> starts a TCP server (by calling <code>start-up-server</code>) that creates IDE remote debugging connections.</p> <p><code>port</code> must be an integer port number or string service name. It is supplied as the <code>service</code> argument to <code>start-up-server</code>. <code>port</code> defaults to the value of <code>*default-ide-remote-debugging-server-port*</code>, which is 21101 initially.</p> <p><code>name</code> is used in the name of the created connections.</p> <p>If <code>log-stream</code> is non-nil, LispWorks writes error messages to it relating to failures during communication on a connection. These failures should not happen normally, but may happen if something writes to the remote debugging connection not</p> |                   |                       |                            |                                                  |                   |           |                         |                                        |

through the remote debugging interface. *log-stream* defaults to `nil`.

If *socket-filter* is non-`nil`, it is called with the connected socket before creating the connection, and if it returns `nil` then the socket is closed and no connection is created. *socket-filter* defaults to `nil`.

The server creates IDE remote debugging connections by calling `create-ide-remote-debugging-connection` with the connected socket, a name (constructed from *name*, the peer address of the socket and a counter) and *log-stream*.

`start-ide-remote-debugging-server` returns *server-process*, which is the first result of `start-up-server`. You can terminate the server by calling `server-terminate` with *server-process*.

#### Notes

The client would normally open a connection using `configure-remote-debugging-spec` with host specifying the machine on which `start-ide-remote-debugging-server` has been called with the same port as *port* (which defaults to the value of `*default-ide-remote-debugging-server-port*` for both functions).

The underlying TCP stream functionality must be working between the machines, that is they must be able to connect by TCP.

When using the Remote Debugger, Remote Listener or Inspector, you do not need to access the connection directly because the tools do it for you. In addition, `create-ide-remote-debugging-connection` remembers the connection, so all the IDE side functions that look for connections will find it.

*socket-filter* can call `get-socket-peer-address` to check who is connecting. It can also be used just to log that a connection has been made, but must return `t` in this case.

You could easily implement your own version of `start-ide-remote-debugging-server` if needed using `start-up-server` and `create-ide-remote-debugging-connection`.

See also      `start-up-server`  
`create-ide-remote-debugging-connection`  
“Remote debugging” on page 25

## **start-remote-listener** *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                              |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
| Summary     | Client side: Start a Remote Listener on the IDE side.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                              |
| Package     | <code>dbg</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                              |
| Signature   | <code>start-remote-listener &amp;key new-process-p message connection close-on-exit =&gt; started-p</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                              |
| Arguments   | <code>new-process-p</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A boolean, default <code>t</code> .                          |
|             | <code>message</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | A string or <code>nil</code> .                               |
|             | <code>connection</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | A <code>client-remote-debugging</code> or <code>nil</code> . |
|             | <code>close-on-exit</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A boolean.                                                   |
| Values      | <code>started-p</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | A boolean.                                                   |
| Description | <p>The function <code>start-remote-listener</code> starts a Remote Listener tool on the IDE side, such that reading and evaluation is done on the client side where the <code>start-remote-listener</code> was called.</p> <p><code>start-remote-listener</code> first tells the IDE to start the Listener, and then runs a read-eval-print loop that communicates with the IDE's Listener over the connection.</p> <p>If <code>new-process-p</code> is non-<code>nil</code> (the default), then a new Lisp process is created to start the Listener and run the read-eval-print loop. This process runs until the read-eval-print loop</p> |                                                              |

exits. If *new-process-p* is `nil`, then the read-eval-print loop runs in the current process and `start-remote-listener` does not return until the read-eval-print loop exits.

*message*, when is not `nil`, is printed into the Listener tool before the first prompt appears.

*connection* (default `nil`) controls which connection to use. If *connection* is non-`nil` and is connected then it is used. Otherwise `start-remote-listener` uses the same mechanism as the debugger to find the connection, which by default means re-using an existing connection if one exists, or opening a new one (under the control of the remote debugging spec). In typical usage, this be set up by either `configure-remote-debugging-spec` or `start-client-remote-debugging-server`. See “Simple usage” on page 26 and “Advanced usage - multiple connections” on page 33 for details.

*close-on-exit* is used only when *connection* is non-`nil`. When *close-on-exit* is non-`nil`, the connection is closed when the read-eval-print loop exits. Otherwise (the default), the connection remains open for later re-use.

If the Listener tool on the IDE side is closed, then the read-eval-print loop exits. Normally this is the only way that the loop exits, but you could also exit it by throwing to a surrounding catch (when *new-process-p* is `nil`) or by terminating the process (by `current-process-kill`).

`start-remote-listener` returns `nil` if *connection* is not a valid connection (either `nil` or already closed) and it cannot find the connection to use. Otherwise, if *new-process-p* is non-`nil` (the default) it returns `t` immediately, and if *new-process-p* is `nil` it returns `nil` only when the Listener is closed.

## Notes

Using *message* is an easy way for the client to write some text to the IDE even when you do not need a Listener.

See also      **set-remote-debugging-connection**  
**configure-remote-debugging-spec**  
“Remote debugging” on page 25

**\*terminal-debugger-block-multiprocessing\***                            *Variable*

|               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary       | Controls blocking of multiprocessing in the terminal debugger.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Package       | <b>dbg</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Initial value | <b>t</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Description   | <p>When the debugger is entered on the terminal, multiprocessing is blocked if the value of <b>*terminal-debugger-block-multiprocessing*</b> is <b>t</b>. This is the default value.</p> <p>If you set this variable to <b>nil</b> then other processes, including timers, will continue to run in parallel to the process that entered the terminal debugger (as they did before the debugger was entered). Beware that this will make it more difficult to debug multi-process activities.</p> <p>The other allowed value is <b>:maybe</b>. This means that multiprocessing is blocked in the terminal debugger unless the debugger was entered from the CAPI environment.</p> <p>The value of <b>*terminal-debugger-block-multiprocessing*</b> affects the behavior of a REPL started by <b>start-tty-listener</b>.</p> |
| Example       | <p>This listener session illustrates the effect of <b>*terminal-debugger-block-multiprocessing*</b>.</p> <p>Firstly we see the default behavior whereby a call to <b>print</b> in another process is blocked by the debugger.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

```
CL-USER 1 > dbg:*terminal-debugger-block-
multiprocessing*
T

CL-USER 2 > unbound

Error: The variable UNBOUND is unbound.
 1 (continue) Try evaluating UNBOUND again.
 2 Specify a value to use this time instead of
evaluating UNBOUND.
 3 Specify a value to set UNBOUND to.
 4 (abort) Return to level 0.
 5 Return to top-level loop.
 6 Return from multiprocessing.

Type :b for backtrace, :c <option number> to proceed,
or :? for other options

CL-USER 3 : 1 > (setq *timer* (mp:make-timer 'print
10))
Warning: Setting unbound variable *TIMER*
#<Time Event : PRINT>

CL-USER 4 : 1 > (mp:schedule-timer-relative *timer* 1)
#<Time Event : PRINT>

CL-USER 5 : 1 > :a
```

On leaving the debugger the output 10 from the call to `print` appears. Then we set `*terminal-debugger-block-multiprocessing*` to `nil` and repeat the commands:

```

CL-USER 6 >
10
(setf dbg:*terminal-debugger-block-multiprocessing*
nil)
NIL

CL-USER 7 > unbound

Error: The variable UNBOUND is unbound.
 1 (continue) Try evaluating UNBOUND again.
 2 Specify a value to use this time instead of
evaluating UNBOUND.
 3 Specify a value to set UNBOUND to.
 4 (abort) Return to level 0.
 5 Return to top-level loop.
 6 Return from multiprocessing.

Type :b for backtrace, :c <option number> to proceed,
or :? for other options

CL-USER 8 : 1 > (setq *timer* (mp:make-timer 'print
10))
#<Time Event : PRINT>

CL-USER 9 : 1 > (mp:schedule-timer-relative *timer* 1)
#<Time Event : PRINT>

CL-USER 10 : 1 >
10

```

Notice above that the output 10 from the call to `print` appears after 1 second, in the debugger. Multiprocessing was not blocked.

See also [start-tty-listener](#)

## `with-debugger-wrapper` *Macro*

|         |                                                                                                               |
|---------|---------------------------------------------------------------------------------------------------------------|
| Summary | Executes code with a "debugger wrapper" which is called only if the debugger is invoked during the execution. |
| Package | <code>dbg</code>                                                                                              |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| Signature   | <code>with-debugger-wrapper wrapper &amp;body body =&gt; results</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                |
| Arguments   | <code>wrapper</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A function designator.         |
|             | <code>body</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Forms.                         |
| Values      | <code>results</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Results of <code>body</code> . |
| Description | <p>The macro <code>with-debugger-wrapper</code> executes forms in <code>body</code> with the function <code>wrapper</code> bound as a "debugger wrapper". This debugger wrapper takes effect only if the code in <code>body</code> tries to invoke the debugger (by a call to <code>invoke-debugger</code>), typically indirectly as a result of an error. Instead of entering the debugger, the debugger wrapper is called with two arguments: a function to call to enter the debugger, and the condition. The wrapper can do whatever is needed. If it wants to enter the debugger, it does it by calling its first argument with the second argument:</p> <pre>(funcall function condition)</pre> |                                |
| Example     | <p>Suppose that you run many processes in parallel with the same code. If the code is broken then every process will get an error. This example shows how a debugger wrapper can be used to keep a <code>lock</code> around entry to the debugger, so that the processes enter the debugger one by one. It contains firstly the "application code", then the debugger wrapper, and lastly forms which execute the application with or without the debugger wrapper.</p>                                                                                                                                                                                                                               |                                |

```

;;;;;;;;;; application code ;;;;;;;
(in-package "CL-USER")

(defglobal-parameter *a* 0)

(defun foo (index cons)
  (sys:atomic-push (* index *a*) (cdr cons)))

;; This gets the process function so we can pass
;; the wrapper function instead.
(defun my-run-processes (do-error &optional
                                (process-function 'foo))
  (setq *a* (if do-error :do-error 7))
  (let ((cons (cons nil nil)))
    (dotimes (x 10)
      (mp:process-run-function
        (format nil "My test process ~d" x)
        ()
        process-function
        x cons))
    (sleep 0.2)
    (print (cdr cons)))))

;;;;;;;;;; debugger wrapper ;;;;;;;
(defglobal-parameter *my-debugger-lock*
  (mp:make-lock :name "Debugger Lock"))

(defun my-debugger-wrapper (func condition)
  (mp:with-lock (*my-debugger-lock*)
    (funcall func condition)))

(defun foo-wrapper (index cons)
  (dbg:with-debugger-wrapper 'my-debugger-wrapper
    (foo index cons)))

;; Running the application without the wrapper fills
;; your screen with notifiers
(my-run-processes t)

;; Running with the wrapper raises the notifiers one by
;; one. You can use the Process Browser kill them all.
(my-run-processes t 'foo-wrapper)

```

See also “Debugger troubleshooting” on page 23

## **with-remote-debugging-connection** *Macro*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                               |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| Summary     | Client side (advanced): Dynamically bind the remote debugging connection to use on the client side.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                               |
| Package     | <code>dbg</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                               |
| Signature   | <code>with-remote-debugging-connection (<i>connection</i>) &amp;body <i>body</i><br/>=&gt; <i>body-values</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                               |
| Arguments   | <i>connection</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <code>nil</code> , <code>t</code> or a <code>client-remote-debugging</code> . |
|             | <i>body</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Lisp forms.                                                                   |
| Values      | <i>body-values</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | The values returned by <i>body</i> .                                          |
| Description | The macro <code>with-remote-debugging-connection</code> dynamically binds an enabling switch controlling which remote debugging connection will be used by the remote debugging interface (entering the debugger, <code>start-remote-listener</code> , <code>remote-inspect</code> ) on the client side while evaluating the forms in <i>body</i> as an implicit <code>progn</code> .<br><br>See <code>set-remote-debugging-connection</code> for details of how <i>connection</i> is interpreted.<br><br>Inside the dynamic extent of <i>body</i> , calls to <code>set-remote-debugging-connection</code> affect the switch only until the end of the <code>with-remote-debugging-connection</code> form. |                                                                               |
| Notes       | In typical usage, you will not need to use <code>with-remote-debugging-connection</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                               |
| See also    | <code>set-remote-debugging-connection</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                               |

## with-remote-debugging-spec Macro

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                    |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Summary     | Client side: Tell LispWorks how to open a connection for remote debugging on the client side within a dynamic extent.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                    |
| Package     | <code>dbg</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                    |
| Signature   | <code>with-remote-debugging-spec (host &amp;key port log-stream<br/>failure-function timeout open-callback) &amp;body body =&gt; body-values</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                    |
| Arguments   | <code>host</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | A string specifying the IDE side hostname, or <code>nil</code> .                   |
|             | <code>port</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | An integer.                                                                        |
|             | <code>log-stream</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | An output stream or <code>nil</code> .                                             |
|             | <code>failure-function</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <code>nil</code> or a function of two arguments: Host and Port.                    |
|             | <code>timeout</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | A non-negative <code>real</code> or <code>nil</code> .                             |
|             | <code>open-callback</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <code>nil</code> or a function that takes one argument, a newly opened connection. |
|             | <code>body</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Lisp forms.                                                                        |
| Values      | <code>body-values</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | The values returned by <code>body</code> .                                         |
| Description | <p>The macro <code>with-remote-debugging-spec</code> establishes a dynamic extent of connection specification, calls <code>configure-remote-debugging-spec</code> passing it <code>host</code>, any supplied keywords (<code>port</code>, <code>log-stream</code>, <code>failure-function</code>, <code>timeout</code>, <code>open-callback</code>) and also <code>:setup-default nil :enable nil</code>. <code>body</code> is evaluated as an implicit <code>progn</code> in this dynamic extent. On exiting <code>with-remote-debugging-spec</code>, the connection specification reverts to what it was on entry.</p> <p>The effect is to have a configured connection specification in the dynamic extent of <code>body</code> that is different from the global one, without having any effect on the global settings.</p> |                                                                                    |

**with-remote-debugging-spec** returns the values returned by *body*.

See **configure-remote-debugging-spec** for the meaning of *host* and the other keywords.

See also

**configure-remote-debugging-spec**

# 36

---

## The DSPEC Package

This chapter describes symbols available in the `DSPEC` package.

The `dspec` system is discussed in detail in Chapter 7, “Dspecs: Tools for Handling Definitions”.

| <b>*active-finders*</b> |                                                                                                                                                                                                                                                                                                                          | <i>Variable</i> |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Summary                 | Controls how source finding operates.                                                                                                                                                                                                                                                                                    |                 |
| Package                 | <code>dspec</code>                                                                                                                                                                                                                                                                                                       |                 |
| Initial value           | <code>(:internal)</code>                                                                                                                                                                                                                                                                                                 |                 |
| Description             | The variable <code>*active-finders*</code> controls how the functions <code>find-name-locations</code> and <code>find-dspec-locations</code> operate. This in turn controls source the finding commands in the LispWorks IDE. You can switch between different sources of location information by setting this variable. |                 |
|                         | The legal values for the elements of <code>*active-finders*</code> are:                                                                                                                                                                                                                                                  |                 |

|                                                                                                                                                                                                                                                                                       |                                                                                                                                                         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>:internal</b>                                                                                                                                                                                                                                                                      | The internal database of definitions performed in this image.                                                                                           |
| <b>:tags</b>                                                                                                                                                                                                                                                                          | Prompt for a tags file, when first used.                                                                                                                |
| <b>pathname</b>                                                                                                                                                                                                                                                                       | Either a tags file or a tags database.<br>A tags database is a fasl file generated by <code>save-tags-database</code> .                                 |
| The order of this list determines the order that the results from the finders are combined in — you would usually want <b>:internal</b> to be the first item on this list, as it contains the up-to-date information about the state of the image. More than one pathname is allowed. |                                                                                                                                                         |
| <b>Notes</b>                                                                                                                                                                                                                                                                          | The value of <code>*active-finders*</code> is affected by editor commands such as <code>Rotate Active Finders</code> and <code>visit Tags File</code> . |
| <b>See also</b>                                                                                                                                                                                                                                                                       | <code>discard-source-info</code><br><code>find-dspec-locations</code><br><code>find-name-locations</code><br><code>save-tags-database</code>            |

|                  |                                                                                      | <i>Macro</i>                     |
|------------------|--------------------------------------------------------------------------------------|----------------------------------|
| <b>Summary</b>   | Tells the dspec system of the source location.                                       |                                  |
| <b>Package</b>   | <code>dspec</code>                                                                   |                                  |
| <b>Signature</b> | <code>at-location (<i>location</i>) &amp;body <i>body</i> =&gt; <i>result</i></code> |                                  |
| <b>Arguments</b> | <b><i>location</i></b>                                                               | A pathname or a keyword.         |
|                  | <b><i>body</i></b>                                                                   | Forms, including defining forms. |
| <b>Values</b>    | <b><i>result</i></b>                                                                 | The result of <i>body</i> .      |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | The macro <code>at-location</code> informs the dspec system that the source for definitions done during the execution of <i>body</i> are at the location <i>location</i> .<br><br><i>location</i> is usually a pathname, for definitions occurring in a file or editor buffer with that pathname.<br><br>Other locations are reserved for internal use. These are:<br><br>An editor buffer Defined in an editor buffer with no pathname.<br><br><code>:listener</code> Interactively defined.<br><br><code>:unknown</code> Defined without dspec information being recorded.<br><br><code>:implicit</code> An aggregate defined by the existence of a part.<br><br><code>(:inside dspec loc)</code><br>A subform of <i>dspec</i> at location <i>loc</i> . |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                           | <i>Function</i>                                                                                                                                                                                                                                                                           |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>canonicalize-dspec</b> |                                                                                                                                                                                                                                                                                           |
| Summary                   | Returns the canonical form for a dspec.                                                                                                                                                                                                                                                   |
| Package                   | <code>dspec</code>                                                                                                                                                                                                                                                                        |
| Signature                 | <code>canonicalize-dspec dspec =&gt; canonical-dspec</code>                                                                                                                                                                                                                               |
| Arguments                 | <code>dspec</code> A dspec.                                                                                                                                                                                                                                                               |
| Values                    | <code>canonical-dspec</code> A canonical dspec.                                                                                                                                                                                                                                           |
| Description               | The function <code>canonicalize-dspec</code> checks that <i>dspec</i> is syntactically correct and returns its canonical form if <i>dspec</i> is valid. Otherwise <code>canonicalize-dspec</code> returns <code>nil</code> .<br><br><code>canonicalize-dspec</code> expands dspec aliases |

|          |                                                                                                                                                                       |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Example  | <pre>CL-USER 12 &gt; (dspec:canonicalize-dspec 'foo) (FUNCTION FOO)  CL-USER 13 &gt; (dspec:canonicalize-dspec '(defmethod bar (list t))) (METHOD BAR (LIST T))</pre> |
| See also | <b>define-dspec-alias</b>                                                                                                                                             |

## **def** *Macro*

|              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |              |          |             |                                                     |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------|-------------|-----------------------------------------------------|
| Summary      | Informs the system of a name for a definition.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |              |          |             |                                                     |
| Package      | <b>dspec</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |              |          |             |                                                     |
| Signature    | <b>def dspec &amp;body body =&gt; result</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |              |          |             |                                                     |
| Arguments    | <table border="0"> <tr> <td style="vertical-align: top;"><i>dspec</i></td> <td>A dspec.</td> </tr> <tr> <td style="vertical-align: top;"><i>body</i></td> <td>Lisp forms, evaluated as an implicit <b>progn</b>.</td> </tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <i>dspec</i> | A dspec. | <i>body</i> | Lisp forms, evaluated as an implicit <b>progn</b> . |
| <i>dspec</i> | A dspec.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |              |          |             |                                                     |
| <i>body</i>  | Lisp forms, evaluated as an implicit <b>progn</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |              |          |             |                                                     |
| Values       | <i>result</i> The result of <i>body</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |              |          |             |                                                     |
| Description  | <p>The macro <b>def</b> informs the system that any definitions within <i>body</i> should be recorded as being within the dspec <i>dspec</i>. This means that when something attempts to locate such a definition, it should look for a definition named <i>dspec</i>.</p> <p>Use <b>def</b> to wrap a group of definitions so that source location for one of the group causes the LispWorks Editor to look for the dspec in the <b>def</b> instead. Typically you will also need a <b>define-form-parser</b> definition for the macro that expands into the <b>def</b>.</p> <p><i>dspec</i> can be non-canonical.</p> <p>You can also use <b>def</b> to provide a dspec for a definition that has its own class that has been defined with <b>define-dspec-</b></p> |              |          |             |                                                     |

`class`. In this case, you arrange to call `record-definition` with the same dspec as in the example below.

It is also possible to mix these cases, recording a dspec and also grouping inner definitions. For example `defstruct` does this, recording itself and also grouping definitions such as the constructor function.

In all cases, to make source location work in the LispWorks editor you typically also need a `define-form-parser` definition for the macro that expands into the `def`.

Example

```
(defmacro define-wibble (x y)
  `(~(dspec:def (define-wibble ,x)
    (set-wibble-definition ',x ',y (dspec:location)))))

(defun set-wibble-definition (x y loc)
  (when (record-definition `(define-wibble ,x) loc)
    ;; defining code here
    ))
```

See also

`location`

## define-dspec-alias

*Macro*

Summary

Informs the dspec system that a definer expands into another definer.

Package

`dspec`

Signature

`define-dspec-alias name lambda-list &body body`

Arguments

*name*      A symbol naming a definer.

*lambda-list*      A list representing the parameters of a *name* dspec.

*body*      Forms evaluated to yield a dspec.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The macro <code>define-dspec-alias</code> works rather like <code>deftype</code>. Dspecs whose <code>car</code> is <i>name</i> should have parameters that match <i>lambda-list</i>. They will be canonicalized into the dspec returned by <i>body</i>.</p> <p><code>define-dspec-alias</code> is useful when you add a new way of making existing definitions with a new defining form that expands into a system-provided defining form. The dspec system should consider the new and system-provided definers as variant forms of the same dspec class. <code>define-dspec-alias</code> is used to convert one of them to the other during canonicalization by <code>canonicalize-dspec</code>.</p> |
| Example     | <code>defparameter</code> is pre-defined as an alias for <code>defvar</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| See also    | <code>canonicalize-dspec</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

| <b>define-dspec-class</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <i>Macro</i> |                                  |                   |                                 |                      |                                      |                  |                                                              |                     |                                                                |  |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------------------------|-------------------|---------------------------------|----------------------|--------------------------------------|------------------|--------------------------------------------------------------|---------------------|----------------------------------------------------------------|--|
| Summary                   | Defines a dspec class.                                                                                                                                                                                                                                                                                                                                                                                                                                                            |              |                                  |                   |                                 |                      |                                      |                  |                                                              |                     |                                                                |  |
| Package                   | <code>dspc</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |              |                                  |                   |                                 |                      |                                      |                  |                                                              |                     |                                                                |  |
| Signature                 | <code>define-dspec-class name superspace documentation &amp;key pretty-name undefiner canonicalize prettify definedp object-dspec defined-parts aggregate-class</code>                                                                                                                                                                                                                                                                                                            |              |                                  |                   |                                 |                      |                                      |                  |                                                              |                     |                                                                |  |
| Arguments                 | <table> <tr> <td><i>name</i></td><td>A symbol naming the dspec class.</td></tr> <tr> <td><i>superspace</i></td><td>A symbol naming the superspace.</td></tr> <tr> <td><i>documentation</i></td><td>A string describing the dspec class.</td></tr> <tr> <td><i>undefiner</i></td><td>A function that generates the undefining form for the class.</td></tr> <tr> <td><i>canonicalize</i></td><td>A function to canonicalize a dspec if it belongs to the class.</td></tr> </table> | <i>name</i>  | A symbol naming the dspec class. | <i>superspace</i> | A symbol naming the superspace. | <i>documentation</i> | A string describing the dspec class. | <i>undefiner</i> | A function that generates the undefining form for the class. | <i>canonicalize</i> | A function to canonicalize a dspec if it belongs to the class. |  |
| <i>name</i>               | A symbol naming the dspec class.                                                                                                                                                                                                                                                                                                                                                                                                                                                  |              |                                  |                   |                                 |                      |                                      |                  |                                                              |                     |                                                                |  |
| <i>superspace</i>         | A symbol naming the superspace.                                                                                                                                                                                                                                                                                                                                                                                                                                                   |              |                                  |                   |                                 |                      |                                      |                  |                                                              |                     |                                                                |  |
| <i>documentation</i>      | A string describing the dspec class.                                                                                                                                                                                                                                                                                                                                                                                                                                              |              |                                  |                   |                                 |                      |                                      |                  |                                                              |                     |                                                                |  |
| <i>undefiner</i>          | A function that generates the undefining form for the class.                                                                                                                                                                                                                                                                                                                                                                                                                      |              |                                  |                   |                                 |                      |                                      |                  |                                                              |                     |                                                                |  |
| <i>canonicalize</i>       | A function to canonicalize a dspec if it belongs to the class.                                                                                                                                                                                                                                                                                                                                                                                                                    |              |                                  |                   |                                 |                      |                                      |                  |                                                              |                     |                                                                |  |

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>prettyf</i>         | A function to return a prettier form of a dspec of the class.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <i>definedp</i>        | A function to decide if a dspec of the class currently has a definition.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <i>object-dspec</i>    | A function to return the dspec from an object if it was defined by the class.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <i>defined-parts</i>   | A function to return all the currently defined parts in the class for a given a primary-name.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <i>aggregate-class</i> | The aggregate dspec class for a part dspec.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Description            | <p>The macro <code>define-dspec-class</code> defines a dspec class, providing handlers for definitions in that dspec class.</p> <p><code>define-dspec-class</code> defines <i>name</i> as a dspec class, inheriting from the dspec class <i>superspace</i>. <i>superspace</i> should be <code>nil</code> to define a new top-level dspec class.</p> <p><i>documentation</i> should be a string documenting the dspec class. For example "<code>My Objects</code>".</p> <p>After evaluating a <code>define-dspec-class</code> form, <i>name</i> can be used by defining forms to record locations of definitions of that dspec class name by calling <code>record-definition</code>.</p> <p>All of the remaining arguments described below can be omitted if not needed. The most important arguments for the LispWorks IDE are <i>definedp</i> and <i>undefiner</i>.</p> <p>If <i>undefiner</i> is supplied, its value must be a function of one argument. When LispWorks wants to remove a definition, it will call the function with a canonical dspec of class <i>name</i>. The function should return a form that removes the current definition of that dspec. For example, the undefining form for package dspecs might be <code>delete-package</code>. If <i>undefiner</i> is omitted, then definitions of this class cannot be undefined.</p> <p>If <i>canonicalize</i> is supplied, its value must be a function of one argument. The function will be called by <code>canonicalize-</code></p> |

`dspec` for a dspec of the given class. The value returned by the canonicalize function must be a fully canonical dspec of the given class. A typical use for the canonicalize function would be to remove extra options from the dspec which are not required to make the dspec unique. The canonicalize function should return `nil` for malformed dspecs and should take care not to signal an error. The default canonicalize function returns the dspec if it has the form

`(name symbol)`

If `prettify` is supplied, its value must be a function of one argument. When LispWorks wants to print a dspec, for example in an error message, it will call the prettify function for the class of the dspec. The argument will be the canonical dspec and the function should return a dspec which is considered "prettier" for a user to see. The default prettify function returns the dspec unchanged.

If `definedp` is supplied, its value must be function of one argument. When LispWorks wants to discover if a given dspec is defined, it calls the function with the `dspec-primary-name` of the dspec. The `definedp` function should return true if the primary name is defined in this dspec class and `nil` otherwise. The default `definedp` function always returns `nil`.

If `object-dspec` is supplied, its value must be a function of one argument. When LispWorks wants to find the dspec that created a given object (for example a package object created by a `defpackage` form), it calls the `object-dspec` functions in all dspec classes. The function should return a dspec for the object if that object was defined by the dspec class or `nil` otherwise. For example, the `object-dspec` function for package dspecs might be:

```
#'(lambda (obj)
  (and (packagep obj)
       `(package ,(package-name obj))))
```

The *object-dspec* function is used by the menu command **Find Source** in the LispWorks IDE Inspector tool to find where the current object was defined.

If *defined-parts* is supplied, its value must be a function of one argument. When LispWorks wants to find all the definitions that are parts of a given aggregate dspec class, it calls the *defined-parts* functions with the **dspec-primary-name** of the dspec in each class that aggregates with it. The function should return a list of dspecs which are defined parts of the primary name in the class *name*. If *defined-parts* is supplied, *aggregate-class* must also be supplied.

If *aggregate-class* is supplied and non-nil, its value must be a symbol naming a dspec class that is the aggregate class of the parts defined by *name* dspecs. For example, the aggregate class of **method** is **defgeneric** because methods are the defined parts of a particular generic function. If *aggregate-class* is supplied, the *defined-parts* must also be supplied. If *aggregate-class* is nil then *name* is not a part class.

To make **c1:documentation** work for your dspec class, add a suitable method as described for **documentation**.

Example See “Dspec classes” on page 77.

See also **canonicalize-dspec**  
**def**  
**dspec-primary-name**  
**record-definition**

## define-form-parser

*Macro*

Summary Establishes a parser for top level forms with the given definer.

Package **dspec**

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signature         | <code>define-form-parser definer-and-options &amp;optional parameters<br/>&amp;body body =&gt; parser</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Arguments         | <p><i>definer-and-options</i></p> <p>A symbol <i>definer</i> naming a definer of functions, macros, variables and so on, or a list (<i>definer options</i>) where <i>options</i> is a plist of keys and values.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <i>parameters</i> | <code>nil</code> , or list of parameters <i>params</i> in the top level form, optionally ending with <code>&amp;rest param-getter</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <i>body</i>       | The body of a parser function.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Values            | <i>parser</i> A form parser function.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Description       | <p>The macro <code>define-form-parser</code> defines a form parser for forms beginning with <i>definer</i>.</p> <p><i>options</i> is a property list with the following keys allowed:</p> <ul style="list-style-type: none"> <li><code>:parser</code> A parser function <i>parser-function</i>.</li> <li><code>:alias</code> A dspec class or alias <i>alias</i>.</li> <li><code>:anonymous</code> A boolean.</li> </ul> <p>The parser function defined is named by <i>parser-function</i>. If the <code>:parser</code> option is omitted then the name defaults to a symbol in the current package whose symbol name is the symbol name of <i>definer</i> with "<code>-FORM-PARSER</code>" appended.</p> <p>If <i>parameters</i> and <i>body</i> are given, then <i>parser-function</i> is defined as a global function that is expected to return a dspec for the defining form or <code>nil</code> if this is not possible. Within <i>body</i>, <i>definer</i> is bound to the <code>car</code> of the actual form being parsed. In simple cases, this is just <i>definer</i>, but if the form parser is used as in the <code>:alias</code> option of another form parser then the symbol will be bound to the <code>car</code> of that form instead.</p> |

The *params* are bound to subsequent subforms of the defining form. If `&rest param-getter` is supplied, then it is bound to a function of no arguments that returns two values: the next subform if there is one and a boolean to indicate if a subform was found.

If *parameters* and *body* are omitted, then *parser-function* is expected to be a form parser defined by a different `define-form-parser` form, or you can specify as an alias a definer with an existing form parser via the value *alias* of the `:alias` key in *options*.

If the `:anonymous` option is non-nil then *definer* is not associated with the form parser. This is useful in conjunction with *parameters* and *body* for defining generic form parsers that can be used in other `define-form-parser` forms.

LispWorks contains pre-defined form parser functions for the Common Lisp definers `defun`, `defmethod`, `defgeneric`, `defvar`, `defparameter`, `defconstant`, `defstruct`, `defclass`, `defmacro` and `deftype` and for LispWorks definers such as `fli:define-foreign-type` and `dspec:define-form-parser` itself.

When a defining symbol *definer* has an associated form parser, this parser function is used by the source location commands such as **Expression > Find Source** in the LispWorks IDE. Having identified the file where the definition was recorded, LispWorks parses the top level forms in the file looking for the one which matches the definition spec. When found, this match is displayed.

**Example** Define a parser for `def-foo` forms which have a single name as the second element in the form:

```
(dspec:define-form-parser def-foo (name)
  `(&,def-foo ,name))
```

Define a parser for `def-other-foo` forms which are like `def-foo` forms:

```
(dspec:define-form-parser
  (def-other-foo (:parser def-foo-form-parser)))
```

Define a parser for **def-bar** forms whose name is made from the second element of the form and any subsequent keywords:

```
(dspec:define-form-parser def-bar (name &rest details)
  `(~(,def-bar ,name
    ,(loop for detail = (funcall details)
           while (keywordp detail)
           collect detail))))
```

Define a parser for forms which have another name as the second element in the form:

```
(dspec:define-form-parser (two-names
  (:anonymous t)) (name1 name2)
  `(~(,two-names ,name1 ,name2)))
```

Define a new way to define CLOS methods, and tell the dspec system to treat them the same. Note the use of **define-dspec-alias** to inform the dspec system that **my-defmethod** is another way of naming **defmethod** dspecs:

```
(defmacro my-defmethod (name args &body body)
  `(~(defmethod ,name ,args
    ,@body))

(dspec:define-dspec-alias my-defmethod
  (name &rest args)
  `(~(defmethod ,name ,@args)))

(my-defmethod foo ((x number))
  42)

(dspec:define-form-parser
  (my-defmethod
    (:parser
      #.(dspec:get-form-parser 'defmethod))))
```

A simpler way to write the last form is:

```
(dspec:define-form-parser
  (my-defmethod
    (:alias defmethod)))
```

See also      **get-form-parser**  
                **parse-form-dspec**

## discard-source-info

*Function*

Summary      Clears the internal dspec database.

Package      **dspec**

Signature      **discard-source-info => nil**

Arguments      None.

Values      Returns **nil**.

Description      The function **discard-source-info** removes all source location information from the internal dspec database.

Example      To build **my-image** which does not contain source locations for the definitions loaded, but retaining a tags database of those definitions:

```
(load-all-patches)
(load "my-code")
(dsdp:save-tags-database
  (compile-file-pathname #P"my-tags-database"))
(dsdp:discard-source-info)
(save-image "my-image")
```

See also      **save-tags-database**

## dspec-class

*Function*

Summary      Returns the dspec class of a dspec.

Package      **dspec**

|             |                                                                                                                                                                                      |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signature   | <code>dspec-class dspec =&gt; class</code>                                                                                                                                           |
| Arguments   | <code>dspec</code> A dspec.                                                                                                                                                          |
| Values      | <code>class</code> A dspec class name.                                                                                                                                               |
| Description | The function <code>dspec-class</code> returns the dspec class name for <code>dspec</code> .                                                                                          |
| Example     | <pre>CL-USER 14 &gt; dspec:dspec-class 'foo FUNCTION  CL-USER 15 &gt; dspec:dspec-class '(defmacro foo) DEFMACRO  CL-USER 16 &gt; dspec:dspec-class '(defmethod foo) DEFMETHOD</pre> |
| See also    | <code>dspec-name</code>                                                                                                                                                              |

### \***dspec-classes\*** *Variable*

|             |                                                                                                  |
|-------------|--------------------------------------------------------------------------------------------------|
| Summary     | Lists all the dspec classes.                                                                     |
| Package     | <code>dspec</code>                                                                               |
| Signature   | <code>*dspec-classes*</code>                                                                     |
| Description | The variable <code>*dspec-classes*</code> contains a list of the names of all the dspec classes. |

### **dspec-defined-p** *Function*

|         |                                                     |
|---------|-----------------------------------------------------|
| Summary | The predicate for whether a dspec has a definition. |
| Package | <code>dspec</code>                                  |

|             |                                                                                                                                                                                                                                                          |                                                                                               |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| Signature   | <b>dspec-defined-p</b> <i>dspec</i> => <i>definedp</i>                                                                                                                                                                                                   |                                                                                               |
| Arguments   | <i>dspec</i>                                                                                                                                                                                                                                             | A dspec.                                                                                      |
| Values      | <i>definedp</i>                                                                                                                                                                                                                                          | The canonical form of <i>dspec</i> if <i>dspec</i> is defined, or <code>nil</code> otherwise. |
| Description | <p>The function <b>dspec-defined-p</b> determines whether the dspec <i>dspec</i> has a definition. If so, it returns the canonical form of <i>dspec</i>.</p> <p>If <i>dspec</i> has no definitions, <b>dspec-defined-p</b> returns <code>nil</code>.</p> |                                                                                               |
| Example     | <pre>CL-USER 23 &gt; (dspec:dspec-defined-p '(function list)) (DEFUN LIST)</pre>                                                                                                                                                                         |                                                                                               |

## dspec-definition-locations

*Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                     |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|
| Summary     | Returns the locations of the known definitions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                     |
| Package     | <b>dspec</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                     |
| Signature   | <b>dspec-definition-locations</b> <i>dspec</i> => <i>locations</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                     |
| Arguments   | <i>dspec</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | A dspec.                                            |
| Values      | <i>locations</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | A list of pairs ( <i>recorded-dspec location</i> ). |
| Description | <p>The function <b>dspec-definition-locations</b> returns the locations of the definitions recorded for the dspec <i>dspec</i>.</p> <p>For each known definition <i>recorded-dspec</i> names the definition that defined <i>dspec</i> in <i>location</i>, and <i>location</i> is a pathname or keyword as described in <b>at-location</b>.</p> <p>Note that non-file locations, such as <code>:unknown</code>, can occur in the list. The locations in <i>locations</i> are all basic locations: that is, there are no <code>(:inside ...)</code> locations.</p> |                                                     |

If *dspec* is a local dspec, the parent function is located.

Example      `CL-USER 6 > (dspec:dspec-definition-locations  
                  '(defun foo-bar))  
      (((DEFSTRUCT FOO) #P"C:/temp/hack.lisp"))`

See also      `name-definition-locations`

## **dspec-equal** *Function*

Summary      Tests two dspecs for equality as dspecs.

Package      `dspec`

Signature      `dspec-equal dspec1 dspec2 => result`

Arguments      `dspec1, dspec2`    Dspecs.

Values      `result`            A boolean.

Description      The function `dspec-equal` compares *dspec1* and *dspec2* for equality as dspecs.

Both arguments are canonicalized before the comparison.

Dspecs in different subclasses of the same namespace are `dspec-equal` if their names match.

Unknown dspecs are compared simply by `equal`.

Example      `CL-USER 44 > (dspec:dspec-equal '(deftype foo)  
                  '(defclass foo))`  
                  T

## **dspec-name** *Function*

Summary      Extracts the name from a canonical dspec.

|             |                                                                                                                                                                                                                                                                                    |                    |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| Package     | <code>dspec</code>                                                                                                                                                                                                                                                                 |                    |
| Signature   | <code>dspec-name dspec =&gt; name</code>                                                                                                                                                                                                                                           |                    |
| Arguments   | <code>dspec</code>                                                                                                                                                                                                                                                                 | A canonical dspec. |
| Values      | <code>name</code>                                                                                                                                                                                                                                                                  | A dspec name.      |
| Description | The function <code>dspec-name</code> extracts the name from the canonical dspec <code>dspec</code> .<br><br>Note that for part classes this is a list starting with the primary name.<br><br>If <code>dspec</code> is not canonicalized, <code>dspec-name</code> signals an error. |                    |
| See also    | <code>dspec-class</code>                                                                                                                                                                                                                                                           |                    |

|             |                                                                                                                                                                                                                                                                           | <i>Function</i>    |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| Summary     | Extracts the primary name from a canonical dspec.                                                                                                                                                                                                                         |                    |
| Package     | <code>dspec</code>                                                                                                                                                                                                                                                        |                    |
| Signature   | <code>dspec-primary-name dspec =&gt; name</code>                                                                                                                                                                                                                          |                    |
| Arguments   | <code>dspec</code>                                                                                                                                                                                                                                                        | A canonical dspec. |
| Values      | <code>name</code>                                                                                                                                                                                                                                                         | A dspec name.      |
| Description | The function <code>dspec-primary-name</code> extracts the primary name from the canonical dspec <code>dspec</code> .<br><br>Note that for part classes this is the name of the aggregate definition, for example for methods it returns the name of the generic function. |                    |
| See also    | <code>dspec-class</code>                                                                                                                                                                                                                                                  |                    |

| <b>dspec-progenitor</b> | <i>Function</i>                                                                                                                                                                                                                                                                                                   |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary                 | Returns the ultimate parent of a <b>subfunction</b> dspec.                                                                                                                                                                                                                                                        |
| Signature               | <b>dspec-progenitor</b> <i>dspec</i> => <i>result</i>                                                                                                                                                                                                                                                             |
| Package                 | <b>dspec</b>                                                                                                                                                                                                                                                                                                      |
| Arguments               | <i>dspec</i> A dspec.                                                                                                                                                                                                                                                                                             |
| Values                  | <i>result</i> A dspec.                                                                                                                                                                                                                                                                                            |
| Description             | <p>The function <b>dspec-progenitor</b> returns a dspec <i>result</i> which is the ultimate parent of a <b>subfunction</b> dspec argument <i>dspec</i>.</p> <p>If the argument <i>dspec</i> is not a local dspec, it is simply returned.</p> <p>Note that <i>result</i> is not necessarily a canonical dspec.</p> |
| Example                 | ( <b>dspec-progenitor</b><br>'(subfunction 1 (subfunction (flet a) (defun foo))))<br>=><br>(defun foo)                                                                                                                                                                                                            |
| See also                | <b>local-dspec-p</b>                                                                                                                                                                                                                                                                                              |

| <b>dspec-subclass-p</b> | <i>Function</i>                                                      |
|-------------------------|----------------------------------------------------------------------|
| Summary                 | Tests whether one dspec class is a subclass of another.              |
| Package                 | <b>dspec</b>                                                         |
| Signature               | <b>dspec-subclass-p</b> <i>class1</i> <i>class2</i> => <i>result</i> |
| Arguments               | <i>class1</i> , <i>class2</i> Symbols naming dspec classes.          |

|             |                                                                                                                                                                      |                                                                                                                                                                                  |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Values      | <i>result</i>                                                                                                                                                        | A boolean.                                                                                                                                                                       |
| Description | The function <code>dspec-subclass-p</code> determines whether the <code>dspec</code> class denoted by <i>class1</i> is a subclass of that denoted by <i>class2</i> . |                                                                                                                                                                                  |
| Example     |                                                                                                                                                                      | <pre>CL-USER 55 &gt; (dspec:dspec-subclass-p 'defmacro 'type) NIL  CL-USER 56 &gt; (dspec:dspec-subclass-p 'defmacro                                          'function) T</pre> |

## **dspec-undefiner** *Function*

|             |                                                                                                                                                                                                                                     |  |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Summary     | Returns an undefining expression for a <code>dspec</code> .                                                                                                                                                                         |  |
| Package     | <code>dspec</code>                                                                                                                                                                                                                  |  |
| Signature   | <code>dspec-undefiner <i>dspec</i> =&gt; <i>form</i></code>                                                                                                                                                                         |  |
| Arguments   | <p><i>dspec</i>      A <code>dspec</code>.</p>                                                                                                                                                                                      |  |
| Values      | <i>form</i> A Lisp form.                                                                                                                                                                                                            |  |
| Description | <p>The function <code>dspec-undefiner</code> returns a form which would undefine <code>dspec</code>, whether or not <i>dspec</i> is currently defined.</p> <p>If no such form can be constructed, <code>nil</code> is returned.</p> |  |
| Example     | <pre>CL-USER 66 &gt; (dspec:dspec-undefiner '(defun foo)) (PROGN (FMAKUNBOUND (QUOTE FOO)) (SETF (DOCUMENTATION (QUOTE FOO) (QUOTE FUNCTION)) NIL))</pre>                                                                           |  |

## **find-dspec-locations** *Function*

|         |                                                                    |
|---------|--------------------------------------------------------------------|
| Summary | Returns the locations of the definitions of a <code>dspec</code> . |
|---------|--------------------------------------------------------------------|

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                     |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|
| Package     | <b>dspec</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                     |
| Signature   | <b>find-dspec-locations</b> <i>dspec</i> => <i>locations</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                     |
| Arguments   | <i>dspec</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | A dspec.                                            |
| Values      | <i>locations</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | A list of pairs ( <i>recorded-dspec location</i> ). |
| Description | <p>The function <b>find-dspec-locations</b> returns the locations of the relevant definitions for the dspec <i>dspec</i>.</p> <p>For each known definition <i>recorded-dspec</i> names the definition that defined <i>dspec</i> in <i>location</i>, and <i>location</i> is a pathname or keyword as described in <b>at-location</b>.</p> <p>If <i>dspec</i> is a local dspec, the parent function is located.</p> <p>The location information is collected from all finders on <b>*active-finders*</b>, that is, the relevant definitions are those known to at least one of these finders.</p> <p>If two or more finders return the same pair (<i>recorded-dspec location</i>), as compared by <b>dspec-equal</b> and location equality, then only the first occurrence of the pair (in the order of <b>*active-finders*</b>) appears in <i>locations</i>.</p> |                                                     |
| See also    | <b>*active-finders*</b><br><b>dspec-definition-locations</b><br><b>dspec-equal</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                     |

|           | <b>Function</b>                                                           |
|-----------|---------------------------------------------------------------------------|
| Summary   | Returns the locations of the definitions of a name.                       |
| Package   | <b>dspec</b>                                                              |
| Signature | <b>find-name-locations</b> <i>classes</i> <i>name</i> => <i>locations</i> |

|             |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arguments   | <i>classes</i>   | A list of dspec class names.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|             | <i>name</i>      | A name.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Values      | <i>locations</i> | A list of pairs ( <i>recorded-dspec location</i> ).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Description |                  | <p>The function <code>find-name-locations</code> returns the locations of the relevant definitions for <i>name</i> in the classes listed in <i>classes</i>.</p> <p>For each known definition <i>recorded-dspec</i> names the definition that defined <i>name</i> in <i>location</i>, and <i>location</i> is a pathname or keyword as described in <code>at-location</code>.</p> <p>The location information is collected from all finders on <code>*active-finders*</code>, that is, the relevant definitions are those known to at least one of these finders.</p> <p>If two or more finders return the same pair (<i>recorded-dspec location</i>), as compared by <code>dspec-equal</code> and location equality, then only the first occurrence of the pair (in the order of <code>*active-finders*</code>) appears in <i>locations</i>.</p> |
| See also    |                  | <code>*active-finders*</code><br><code>name-definition-locations</code><br><code>dspec-equal</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

| get-form-parser |                | <i>Function</i>                                    |
|-----------------|----------------|----------------------------------------------------|
| Summary         |                | Returns the form parser associated with a definer. |
| Package         |                | <code>dspec</code>                                 |
| Signature       |                | <code>get-form-parser definer =&gt; parser</code>  |
| Arguments       | <i>definer</i> | A symbol naming a definer.                         |
| Values          | <i>parser</i>  | A form parser function, or <code>nil</code> .      |

|             |                                                                                                                                                                                                                                                                                                                                                                     |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The function <code>get-form-parser</code> returns a form parser function if there is one associated with <code>definer</code>.</p> <p>This is the case for predefined definers and for those for which you have established a form parser using <code>define-form-parser</code>.</p> <p>If there is no associated form parser, <code>nil</code> is returned.</p> |
| Example     | <pre>CL-USER 1 &gt; dspec:get-form-parser 'defun DSPEC:NAME-ONLY-FORM-PARSER</pre>                                                                                                                                                                                                                                                                                  |
| See also    | <code>define-form-parser</code><br><code>parse-form-dspec</code>                                                                                                                                                                                                                                                                                                    |

|             | <i>Function</i>                                                                                                                                                                                                                                                                    |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | The predicate for local dspecs.                                                                                                                                                                                                                                                    |
| Package     | <code>dspec</code>                                                                                                                                                                                                                                                                 |
| Signature   | <code>local-dspec-p dspec =&gt; localp</code>                                                                                                                                                                                                                                      |
| Arguments   | <code>dspec</code> A dspec.                                                                                                                                                                                                                                                        |
| Values      | <code>localp</code> A boolean.                                                                                                                                                                                                                                                     |
| Description | <p>The function <code>local-dspec-p</code> determines whether the dspec <code>dspec</code> is a local dspec.</p> <p>Local dspecs name local definitions, such as local functions.</p> <p>Currently a local dspec is a list whose <code>car</code> is <code>subfunction</code>.</p> |
| See also    | <code>dspec-progenitor</code>                                                                                                                                                                                                                                                      |

| <b>location</b> | <i>Macro</i>                                                                                                                                                                                                                                                                                                                        |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary         | Returns the source location.                                                                                                                                                                                                                                                                                                        |
| Package         | <code>dspec</code>                                                                                                                                                                                                                                                                                                                  |
| Signature       | <code>location =&gt; location</code>                                                                                                                                                                                                                                                                                                |
| Values          | <code>location</code> A pathname or a keyword.                                                                                                                                                                                                                                                                                      |
| Description     | The macro <code>location</code> returns a location suitable for passing to <code>record-definition</code> . This is usually done via a separate defining function. You will need to use <code>location</code> only if you create your own ways of making definitions (and not if your definers call only system-provided definers). |
| Example         | <pre>(defmacro define-wibble (x y)   `(dspec:def (define-wibble ,x)     (set-wibble-definition ',x ',y (dspec:location)))))  (defun set-wibble-definition (x y loc)   (when (record-definition `(define-wibble ,x) loc)     ;; defining code here   ))</pre>                                                                        |
| See also        | <code>at-location</code><br><code>def</code><br><code>record-definition</code>                                                                                                                                                                                                                                                      |

| <b>name-defined-dspecs</b> | <i>Function</i>                                            |
|----------------------------|------------------------------------------------------------|
| Summary                    | Returns defined dspecs matching a name.                    |
| Package                    | <code>dspec</code>                                         |
| Signature                  | <code>name-defined-dspecs classes name =&gt; dspecs</code> |
| Arguments                  | <code>classes</code> A list of dspec class names.          |

|             |               |                                                                                                                                                                                                                                                                         |
|-------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <i>name</i>   | A name.                                                                                                                                                                                                                                                                 |
| Values      | <i>dspecs</i> | A list of canonical dspecs.                                                                                                                                                                                                                                             |
| Description |               | <p>The function <code>name-defined-dspecs</code> looks in each of the dspec classes <i>classes</i> for definitions of <i>name</i>.</p> <p>For each definition found (as if by <code>dspec-defined-p</code>), the result <i>dspecs</i> contains the canonical dspec.</p> |
| See also    |               | <code>dspec-defined-p</code>                                                                                                                                                                                                                                            |

## **name-definition-locations** *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                      |                                                     |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|
| Summary     | Returns the locations of the known definitions.                                                                                                                                                                                                                                                                                                                                                      |                                                     |
| Package     | <code>dspec</code>                                                                                                                                                                                                                                                                                                                                                                                   |                                                     |
| Signature   | <code>name-definition-locations classes name =&gt; locations</code>                                                                                                                                                                                                                                                                                                                                  |                                                     |
| Arguments   | <i>classes</i>                                                                                                                                                                                                                                                                                                                                                                                       | A list of dspec class names.                        |
|             | <i>name</i>                                                                                                                                                                                                                                                                                                                                                                                          | A name.                                             |
| Values      | <i>locations</i>                                                                                                                                                                                                                                                                                                                                                                                     | A list of pairs ( <i>recorded-dspec location</i> ). |
| Description | <p>The function <code>name-definition-locations</code> returns the locations of the definitions recorded for the name <i>name</i> in any of the dspec classes in <i>classes</i>.</p> <p>For each known definition <i>recorded-dspec</i> names the definition that defined <i>name</i> in <i>location</i>, and <i>location</i> is a pathname or keyword as described in <code>at-location</code>.</p> |                                                     |
| Notes       | <code>name-definition-locations</code> does not use <code>*active-finders*</code> .                                                                                                                                                                                                                                                                                                                  |                                                     |

Example      CL-USER 7 > (dspec:name-definition-locations  
                  '(function) 'foo-bar)  
                  (((DEFSTRUCT FOO) #P"C:/temp/hack.lisp"))

See also     [dspec-definition-locations](#)

## **name-only-form-parser** *Function*

Summary     A pre-defined form parser.

Package     [dspec](#)

Signature    **name-only-form-parser** *top-level-form* *getter* => *dspec*

Arguments    *top-level-form*    A top level defining form.

*getter*        The subform getter function.

Values       *dspec*        A dspec.

Description    The function **name-only-form-parser** is a predefined form parser for use with **define-form-parser**. The parser consumes one subform and returns it.

**name-only-form-parser** can be used for function definitions where the function name is an abbreviation for the full dspec. It is the predefined parser for **defun**, **defmacro** and **defgeneric** forms.

You can define it to be the parser for your defining forms. using **define-form-parser**.

Example      (defmacro my-definer (name &body body)  
                  `(defun ,name (x)  
                  ,@body))

```
(dspec:define-form-parser
  (my-definer (:parser
    dspec:name-only-form-parser)))
```

See also [define-form-parser](#)

| object-dspec |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Function                      |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| Summary      | Returns the dspec of an object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                               |
| Package      | dspec                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                               |
| Signature    | <code>object-dspec object =&gt; dspec</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                               |
| Arguments    | <code>object</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Any object.                   |
| Values       | <code>dspec</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | A dspec or <code>nil</code> . |
| Description  | <p>The function <code>object-dspec</code> returns a dspec for <i>object</i> if there is one, or <code>nil</code> otherwise. When the result <code>dspec</code> is not <code>nil</code>, it is a dspec as described in “Forms of dspecs” on page 76.</p> <p>An object has a dspec only when it represents the result of some definition. The most useful cases are functions (of any kind) and methods, because their dspecs can be used to trace and advise them. Classes and packages also have dspecs.</p> <p>Dspecs can also be useful for finding where the definition of the object originated, either by using dspec functions like <code>find-dspec-locations</code>, which returns the location, or using the editor command <code>Find Source For Dspec</code>, which edits them. The Common Lisp function <code>ed</code> also recognizes dspecs and goes to the source.</p> <p>If <i>object</i> does not have a dspec then <code>object-dspec</code> returns <code>nil</code>.</p> |                               |
| See also     | <code>trace</code><br><code>defadvice</code><br><code>find-dspec-locations</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                               |

## parse-form-dspec

*Function*

|             |                                                                                                                                   |                               |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| Summary     | Parses the dspec from a defining form.                                                                                            |                               |
| Package     | <code>dspec</code>                                                                                                                |                               |
| Signature   | <code>parse-form-dspec form =&gt; result</code>                                                                                   |                               |
| Arguments   | <code>form</code>                                                                                                                 | A form.                       |
| Values      | <code>result</code>                                                                                                               | A dspec or <code>nil</code> . |
| Description | The function <code>parse-form-dspec</code> invokes the defined form parser for <code>form</code> and returns the resulting dspec. |                               |
| Example     | <pre>(parse-form-dspec '(def-foo my-foo (arg) (foo-it arg))) =&gt; (def-foo my-foo)</pre>                                         |                               |
| See also    | <code>define-form-parser</code><br><code>get-form-parser</code>                                                                   |                               |

## record-definition

*Function*

|           |                                                                                          |                        |
|-----------|------------------------------------------------------------------------------------------|------------------------|
| Summary   | Checks for existing definitions and records a new definition.                            |                        |
| Package   | <code>dspec</code>                                                                       |                        |
| Signature | <code>record-definition dspec location &amp;key check-redefinition-p =&gt; result</code> |                        |
| Arguments | <code>dspec</code>                                                                       | A dspec.               |
|           | <code>location</code>                                                                    | A pathname or keyword. |
|           | <code>check-redefinition-p</code>                                                        | A boolean.             |

|                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                        |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Values              | <i>result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | A generalized boolean. |
| Description         | <p>The function <b>record-definition</b> tells the system that <i>dspec</i> is defined at <i>location</i>.</p> <p>The system-provided definer macros call the function <b>record-definition</b> with the current location.</p> <p><i>location</i> should be a pathname or keyword as returned by <b>location</b>.</p> <p>When <i>check-redefinition-p</i> is true, it checks for existing definitions and reports these according to the value of <b>*redefinition-action*</b>. The default value of <i>check-redefinition-p</i> is <i>t</i>.</p> <p>If the definition is made, then <i>result</i> is true. If the definition is not made then <i>result</i> is <i>nil</i>. This can happen if you choose the "Don't redefine ..." restart at a redefinition error.</p> |                        |
| Notes               | You should not usually call <b>record-definition</b> , since all the system-provided definers call it. However, for new classes of definition which you add with <b>define-dspec-class</b> , you should call <b>record-definition</b> for dspecs in their new classes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                        |
| Compatibility notes | <b>record-definition</b> was documented in the <b>lispworks</b> package in LispWorks 4.3 and earlier. Although it is currently still available there, this may change in future releases and you should now reference it via the <b>dspec</b> package.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                        |
| See also            | <b>define-dspec-class</b><br><b>*redefinition-action*</b><br><b>location</b><br>“Recording definitions and redefinition checking” on page 87                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                        |

### **\*record-source-files\*** *Variable*

Summary      Controls whether the locations of definitions are recorded.

|                     |                                                                                                                                                                                                                                                                               |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package             | <code>dspec</code>                                                                                                                                                                                                                                                            |
| Initial value       | <code>t</code>                                                                                                                                                                                                                                                                |
| Description         | The variable <code>*record-source-files*</code> controls whether locations of definitions are recorded in the internal tags database.                                                                                                                                         |
| Compatibility notes | <code>*record-source-files*</code> was documented in the <code>lisp-works</code> package in LispWorks 4.3 and earlier. Although it is currently still available there, this may change in future releases and you should now reference it via the <code>dspec</code> package. |
| See also            | <code>*active-finders*</code>                                                                                                                                                                                                                                                 |

## **\*redefinition-action\*** *Variable*

|               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary       | Specifies the action on some redefinitions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Package       | <code>dspec</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Initial value | <code>:warn</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Description   | <code>*redefinition-action*</code> controls messages about redefinitions seen by the source location system.<br><br>If <code>*redefinition-action*</code> is set to <code>:warn</code> then you are warned. If it is set to <code>:quiet</code> or <code>nil</code> , the redefinition is done quietly. If, however, it is set to <code>:error</code> , then LispWorks signals an error.<br><br>These messages are triggered by defining forms provided, but they could also be from any call to <code>record-definition</code> . |
| Notes         | <code>*redefinition-action*</code> does not affect the behavior of <code>cl:defstruct</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                    |

|                     |                                                                                                                                                                                                                                                                             |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Compatibility notes | <code>*redefinition-action*</code> is documented in the <code>lispworks</code> package in LispWorks 4.3 and earlier. It is still currently still available there but this may change in future releases and you should now reference it via the <code>dspec</code> package. |
| See also            | <code>*handle-warn-on-redefinition*</code><br><code>record-definition</code>                                                                                                                                                                                                |

## **replacement-source-form** *Macro*

|                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                      |              |                 |              |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|--------------|-----------------|--------------|
| Summary              | Allows source location to work when a form is copied by a macro.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                      |              |                 |              |
| Package              | <code>dspec</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                      |              |                 |              |
| Signature            | <code>replacement-source-form original-form new-form =&gt; new-form-value</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                      |              |                 |              |
| Arguments            | <table> <tr> <td><i>original-form</i></td> <td>A Lisp form.</td> </tr> <tr> <td><i>new-form</i></td> <td>A Lisp form.</td> </tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <i>original-form</i> | A Lisp form. | <i>new-form</i> | A Lisp form. |
| <i>original-form</i> | A Lisp form.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                      |              |                 |              |
| <i>new-form</i>      | A Lisp form.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                      |              |                 |              |
| Values               | <i>new-form-value</i> A Lisp object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                      |              |                 |              |
| Description          | <p>A call to <code>replacement-source-form</code> can be used to allow the debugger and stepper to identify that <i>original-form</i> has been replaced by <i>new-form</i> in a macro expansion. Forms in a macro expansion that are <code>eq</code> to forms in the arguments to the macro will be identified automatically, but some macros (such as <code>iterate</code>) need to generate new forms that are equivalent to the original forms and wrapping them with <code>replacement-source-form</code> allows them to be identified too.</p> <p><i>original-form</i> should be a form that occurred in the arguments to the macro and does not otherwise occur in the expansion of the macro. <i>new-form</i> should be a form that was created by the macro.</p> |                      |              |                 |              |

The value of *new-form*, *new-form-value*, is returned when the **replacement-source-form** form is evaluated.

Examples Without the **dspec:replacement-source-form**, the calls to **pprint** would be unknown to the debugger and stepper because the forms do not occur in the original source code:

```
(defmacro pprint-for-print (&body forms)
  `(#(progn
      ,(loop for form in forms
             collect
             (if (and (consp form)
                       (eq (car form) 'print))
                 `(dspec:replacement-source-form
                   ,form
                   (pprint ,(cdr form)))
                 form))))
```

## save-tags-database

## *Function*

Summary Saves the current internal dspec database to a given file.

Package **dspec**

Signature **save-tags-database pathname => pathname**

Arguments *pathname* A filename.

Values *pathname* The filename that was supplied.

Description The function **save-tags-database** saves the current internal dspec database into the file given by *pathname*. The file can then be used in the variable **\*active-finders\***.

See also **\*active-finders\***  
**discard-source-info**

|                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <i>Function</i>              |
|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <b>single-form-form-parser</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                              |
| Summary                        | A pre-defined form parser.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                              |
| Package                        | <code>dspec</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                              |
| Signature                      | <code>single-form-form-parser top-level-form getter =&gt; dspec</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                              |
| Arguments                      | <code>top-level-form</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | A top level defining form.   |
|                                | <code>getter</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | The subform getter function. |
| Values                         | <code>dspec</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | A dspec.                     |
| Description                    | <p>The function <code>single-form-form-parser</code> is a predefined form parser for use with <code>define-form-parser</code>. The parser consumes one subform and returns a dspec made from the defining form and the subform. This can be used in the common case where a defining form has a name that follows the defining macro and the dspec class is the same as the defining macro, for example <code>defclass</code>.</p> <p><code>single-form-form-parser</code> is the predefined parser for <code>defvar</code>, <code>defparameter</code>, <code>defconstant</code>, <code>define-symbol-macro</code>, <code>define-compiler-macro</code>, <code>deftype</code>, <code>defsetf</code>, <code>define-setf-expander</code>, <code>defpackage</code>, <code>defclass</code>, <code>define-condition</code> and <code>define-method-combination</code> top level forms. It is also the parser for various LispWorks extensions such as <code>defsystem</code>.</p> <p>You can define it to be the parser for your defining forms. using <code>define-form-parser</code>.</p> |                              |
| See also                       | <code>define-form-parser</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                              |

|                                             |                            | <i>Function</i> |
|---------------------------------------------|----------------------------|-----------------|
| <b>single-form-with-options-form-parser</b> |                            |                 |
| Summary                                     | A pre-defined form parser. |                 |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>dspec</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Signature   | <code>single-form-with-options-form-parser top-level-form getter</code><br><code>=&gt; dspec</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Arguments   | <p><code>top-level-form</code> A top level defining form.</p> <p><code>getter</code> The subform getter function.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Values      | <code>dspec</code> A dspec.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Description | <p>The function <code>single-form-with-options-form-parser</code> is a predefined form parser for use with <code>define-form-parser</code>. The parser consumes one subform and returns a dspec made from the defining form and either the first element of the subform if it is a cons or the subform itself otherwise. This can be used in the common case where a defining form has a name with options that follows the defining macro and the dspec class is the same as the defining macro, for example <code>defstruct</code>.</p> <p><code>single-form-with-options-form-parser</code> is the pre-defined parser for <code>defstruct</code>, <code>fli:define-foreign-function</code>, <code>fli:define-foreign-variable</code>, <code>fli:define-c-struct</code>, <code>fli:define-c-union</code>, <code>fli:define-c-enum</code> and <code>fli:define-c-typedef</code> forms.</p> <p>You can define it to be the parser for your defining forms. using <code>define-form-parser</code>.</p> |
| See also    | <code>define-form-parser</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

| <b>traceable-dspec-p</b> |                                         | <i>Function</i> |
|--------------------------|-----------------------------------------|-----------------|
| Summary                  | Tests whether definition can be traced. |                 |
| Package                  | <code>dspec</code>                      |                 |

|             |                                                                                                                                                                                                                                                                                                                                                                             |                        |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Signature   | <code>traceable-dspec-p <i>dspec</i> =&gt; <i>result</i></code>                                                                                                                                                                                                                                                                                                             |                        |
| Arguments   | <code><i>dspec</i></code>                                                                                                                                                                                                                                                                                                                                                   | A dspec.               |
| Values      | <code><i>result</i></code>                                                                                                                                                                                                                                                                                                                                                  | A generalized boolean. |
| Description | <p>The function <code>traceable-dspec-p</code> determines whether the dspec <i>dspec</i> denotes a definition that can be traced using the Common Lisp macro <code>trace</code>.</p> <p><i>dspec</i> must not be a local dspec, and must be defined, according to <code>dspec-defined-p</code>. The result does not depend on whether <i>dspec</i> is currently traced.</p> |                        |
| Example     | <pre>CL-USER 67 &gt; (dspec:traceable-dspec-p '(subfunction                                          foo bar)) NIL</pre><br><pre>CL-USER 68 &gt; (dspec:traceable-dspec-p '(defun open)) OPEN</pre>                                                                                                                                                                         |                        |

|             | <i>Function</i>                                                                                                                                                                                           |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Gets and sets the global tracing state..                                                                                                                                                                  |
| Package     | <code>dspec</code>                                                                                                                                                                                        |
| Signature   | <code>tracing-enabled-p =&gt; enabledp</code><br><code>(setf tracing-enabled-p) enabledp =&gt; enabledp</code>                                                                                            |
| Values      | <code>enabledp</code> A generalized boolean.                                                                                                                                                              |
| Description | The function <code>tracing-enabled-p</code> determines whether tracing (by the Common Lisp macro <code>trace</code> ) is currently on. This is independent of whether any functions are currently traced. |

The function (`(setf tracing-enabled-p)`) switches tracing on or off according to the value of *enabledp*. This does not affect the list of functions that are currently traced.

See also      **trace**  
                 **tracing-state**

## tracing-state *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |          |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Summary     | Gets the current trace details.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |          |
| Package     | <b>dspec</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |          |
| Signature   | <b>tracing-state &amp;optional dspec =&gt; state</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |          |
| Signature   | <b>(setf tracing-state) state &amp;optional dspec =&gt; state</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |          |
| Arguments   | <b>dspec</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | A dspec. |
| Values      | <b>state</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | A list.  |
| Description | The function <b>tracing-state</b> returns a listing describing the current state of the tracing system. It shows the current tracing state for the dspec <i>dspec</i> , or for all traced definitions if <i>dspec</i> is not supplied.<br><br>The result <i>state</i> is a list each element of which is a list whose car is a dspec naming the traced definition and whose cdr is the additional trace options. Note that <b>tracing-state</b> returns more information than is returned by <b>trace</b> . It is useful for preserving a complex set of traces. |          |
|             | The function ( <b>(setf tracing-state)</b> ) sets the state of the tracing system. It changes the current tracing state for the dspec <i>dspec</i> , or for all traced definitions if <i>dspec</i> is not supplied.                                                                                                                                                                                                                                                                                                                                              |          |

(**setf tracing-state**) can be used to switch between different sets of traces. Note however that turning tracing on or off is better done using **tracing-enabled-p**.

See also

**trace**  
**tracing-enabled-p**

# 37

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## The EXTERNAL-FORMAT Package

This chapter describes symbols available in the `EXTERNAL-FORMAT` package, along with some of the actual external formats (typically with keyword names)

Use of these symbols are discussed in Chapter 26, “Internationalization: characters, strings and encodings”.

`:bmp`  
`:bmp-native`  
`:bmp-reversed`

*External Formats*

Summary      Implement reading and writing of 16-bit characters only (excluding supplementary characters).

Signature      `:bmp &key use-replacement little-endian`  
                 `:bmp-native &key use-replacement`  
                 `:bmp-reversed &key use-replacement`

|                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description         | <p>The external format <code>:bmp</code> and its variants implement reading and writing of 16-bit characters only (excluding supplementary characters).</p> <p><code>:bmp-native</code> and <code>:bmp-reversed</code> are the actual implementation formats. They implement reading and writing 16-bit characters with the native byte order (<code>:bmp-native</code>) or the reversed byte order (<code>:bmp-reversed</code>).</p> <p><code>:bmp</code> implements reading and writing 16-bit characters with control over the byte order. This format maps to either <code>:bmp-native</code> or <code>:bmp-reversed</code> as appropriate.</p> <p>If <i>little-endian</i> is supplied, it determines the byte order. Otherwise, if it is used for opening a file, the system checks whether the file starts with the BOM (Byte Order Mark), and if so it uses it. Otherwise the native byte order is used. The system uses the required byte order and the native byte order of the computer it executes on to decide whether to use <code>:bmp-native</code> or <code>:bmp-reversed</code>.</p> <p>When writing, these <code>:bmp</code> external formats signal an error when trying to write supplementary characters (code greater than <code>#xffff</code>).</p> <p><code>:bmp</code> cannot read surrogate code points. When encountering a surrogate code point it either signals an error (the default), or if <i>use-replacement</i> is non-nil, replaces it with the replacement character. When <i>use-replacement</i> is non-nil, these external formats never signal an error when reading.</p> |
| Compatibility note: | These formats were new in LispWorks 7.0. In LispWorks 6.1 and earlier versions <code>:unicode</code> is the external format to read 16-bit characters. Other than the treatment of surrogate code points, <code>:bmp</code> now does what <code>:unicode</code> used to do.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| See also            | “16-bit External formats guide” on page 445                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

| <b>:unicode</b>    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <i>External Format</i> |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Summary            | Implements UTF-16 translation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                        |
| Signature          | <code>:unicode &amp;key <i>little-endian</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                        |
| Description        | <p>The external format <code>:unicode</code> implements UTF-16 translation, with default byte order the native one. <code>:unicode</code> is equivalent to <code>(:utf-16 :little-endian <i>little-endian</i>)</code> where the value of <i>little-endian</i> depends on the byte order of the native machine.</p> <p>When opening a file with <code>:external-format :unicode</code> (without passing <i>little-endian</i>), the system checks for the existence of the BOM (Byte Order Mark) in the beginning of the file, and if there is a BOM uses it to determine the correct byte order. Otherwise, it uses the native byte order. There are no checks for a BOM in other situations.</p> |                        |
| Notes              | <code>:unicode</code> differs from <code>:utf-16</code> when <i>little-endian</i> is not supplied and there is no BOM, because <code>:unicode</code> uses the native endianness and <code>:utf-16</code> uses big-endian. In all other circumstances <code>:unicode</code> is equivalent to <code>:utf-16</code> .                                                                                                                                                                                                                                                                                                                                                                               |                        |
| Compatibility note | In LispWorks 6.1 and earlier versions, <code>:unicode</code> reads only 16-bit characters, including character objects corresponding to surrogate code points. There is no exact match to that in LispWorks 7.0 and later, because there is no external format that reads surrogates. <code>:bmp</code> can be used to read 16-bit characters, either giving an error or using the replacement character for surrogate code points.                                                                                                                                                                                                                                                              |                        |
| See also           | “16-bit External formats guide” on page 445                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                        |

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>:utf-16</b>          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>:utf-16be</b>        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>:utf-16le</b>        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>:utf-16-native</b>   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>:utf-16-reversed</b> | <i>External Formats</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Summary                 | Implement translations according to the UTF-16 standard of Unicode.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Signature               | <pre>:utf-16 &amp;key <b>use-replacement</b> <b>little-endian</b> :utf-16be &amp;key <b>use-replacement</b> :utf-16le &amp;key <b>use-replacement</b> :utf-16-native &amp;key <b>use-replacement</b> :utf-16-reversed &amp;key <b>use-replacement</b></pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Description             | <p>The external format <b>:utf-16</b> and variants implement translations according to the UTF-16 standard of Unicode. The variants differ only in their treatment of byte order. The parameter <i>use-replacement</i> is a boolean which defaults to <b>nil</b>. It controls what happens when reading encounters an illegal combination. Illegal combinations are either a leading surrogate (#xd800 to #xdbff) not followed by a trailing surrogate (#xdc00 to #xffff), or a trailing surrogate not following a leading surrogate. By default, the input code signals an error of type <b>external-format-error</b>. If <i>use-replacement</i> is non-nil, the input code replaces the error byte or pair of bytes by the replacement character (#xffffd).</p> <p><b>:utf-16-native</b> and <b>:utf-16-reversed</b> implement UTF-16 in the native or the reverse of the byte order of the computer that they are executing on.</p> <p><b>:utf-16be</b> and <b>:utf-16le</b> implement the UTF-16BE and UTF-16LE standard format, that is UTF-16 big-endian and</p> |

UTF-16 little-endian. The system maps these to either of `:utf-16-native` or `:utf-16-reversed`.

`:utf-16` implements the UTF-16 standard. The byte order defaults to big-endian byte order.

When opening a file with `:external-format :utf-16` (without passing *little-endian*), the system checks for the existence of the BOM (Byte Order Mark) in the beginning of the file, and if there is a BOM uses it to determine the right byte order. Otherwise, it uses big-endian (`:utf-16be`). There are no checks for a BOM in other situations.

|                     |                                                                                                                                                                      |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Compatibility notes | These formats were new in LispWorks 7.0.<br>In LispWorks 6.1 and earlier versions the <code>:unicode</code> external format is the format to read 16-bit characters. |
| See also            | “16-bit External formats guide” on page 445                                                                                                                          |

`:utf-32`

`:utf-32le`

`:utf-32be`

`:utf-32-native`

`:utf-32-reversed`

*External Formats*

Summary      Implement UTF-32 format, which means reading and writing 32-bit chunks as characters.

Signature      `:utf-32 &key use-replacement little-endian`  
`:utf-32le &key use-replacement`  
`:utf-32be &key use-replacement`  
`:utf-32-native &key use-replacement`  
`:utf-32-reversed &key use-replacement`

|                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description         | <p>The external format <code>:utf-32</code> and its variants implement UTF-32 format, which means reading and writing 32-bit chunks as characters.</p> <p><code>:utf-32-native</code> and <code>:utf-32-reversed</code> are the actual implementation formats. They implement UTF-32 with the native byte order (<code>:utf-32-native</code>) or the reversed byte order (<code>:utf-32-reversed</code>).</p> <p><code>:utf-32le</code> and <code>:utf-32be</code> implement UTF-32 with little-endian (<code>:utf-32le</code>) and big-endian (<code>:utf-32be</code>) byte order. The system maps them to one of <code>:utf-32-native</code> or <code>:utf-32-reversed</code> as appropriate.</p> <p><code>:utf-32</code> implements UTF-32 with control over the byte order. This format maps to one of <code>:utf-32-native</code> or <code>:utf-32-reversed</code> as appropriate. If <i>little-endian</i> is supplied, it determines the byte order. Otherwise, if it is used for opening a file, the system checks whether the file starts with the BOM (Byte Order Mark), and uses it if found. Otherwise the big-endian order is used. The system uses the required byte order and the native byte order of the computer it executes on to decide whether to use <code>:utf-32-native</code> or <code>:utf-32-reversed</code>.</p> <p>If the <code>:utf-32</code> formats encounter a surrogate code point or a character code which is too large, they by default signal an error of type <code>external-format-error</code>. If <i>use-replacement</i> is non-nil, they replace the illegal input by the replacement character. When <i>use-replacement</i> is non-nil these formats never signal an error.</p> <p>When writing, the <code>:utf-32</code> formats never signal an error.</p> |
| Compatibility notes | These formats were new in LispWorks 7.0. In LispWorks 6.1 and earlier versions there is an undocumented external format <code>character</code> that works similarly to <code>:utf-32-native</code> in LispWorks 7.0 and later. This is now mapped to <code>:utf-32-native</code> to avoid errors in existing code, and should not be used in new code.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

See also “16-bit External formats guide” on page 445

| char-external-code | Function                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                   |                                              |                  |                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|----------------------------------------------|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary            | Returns the code of a character in the specified character set.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                   |                                              |                  |                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Package            | <code>external-format</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                   |                                              |                  |                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Signature          | <code>char-external-code char set =&gt; code</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                   |                                              |                  |                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Arguments          | <table><tr><td><code>char</code></td><td>The character whose code you wish to return.</td></tr><tr><td><code>set</code></td><td>A character set. Legal values for <code>set</code> are <code>:unicode</code>, <code>:latin-1</code>, <code>:ascii</code>, <code>:macos-roman</code>, <code>:jis-x-208</code>, <code>:jis-x-212</code>, <code>:euc-jp</code>, <code>:sjis</code>, <code>:koi8-r</code>, <code>:windows-cp936</code> and <code>:gbk</code>. Additionally, on Windows, <code>set</code> can be a valid Windows code page identifier.</td></tr></table>                                                                                                                                      | <code>char</code> | The character whose code you wish to return. | <code>set</code> | A character set. Legal values for <code>set</code> are <code>:unicode</code> , <code>:latin-1</code> , <code>:ascii</code> , <code>:macos-roman</code> , <code>:jis-x-208</code> , <code>:jis-x-212</code> , <code>:euc-jp</code> , <code>:sjis</code> , <code>:koi8-r</code> , <code>:windows-cp936</code> and <code>:gbk</code> . Additionally, on Windows, <code>set</code> can be a valid Windows code page identifier. |
| <code>char</code>  | The character whose code you wish to return.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                   |                                              |                  |                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <code>set</code>   | A character set. Legal values for <code>set</code> are <code>:unicode</code> , <code>:latin-1</code> , <code>:ascii</code> , <code>:macos-roman</code> , <code>:jis-x-208</code> , <code>:jis-x-212</code> , <code>:euc-jp</code> , <code>:sjis</code> , <code>:koi8-r</code> , <code>:windows-cp936</code> and <code>:gbk</code> . Additionally, on Windows, <code>set</code> can be a valid Windows code page identifier.                                                                                                                                                                                                                                                                              |                   |                                              |                  |                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Values             | <code>code</code> The code of <code>char</code> in the character set <code>set</code> . An integer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                   |                                              |                  |                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Description        | <p>Returns the code of the character <code>char</code> in the coded character set specified by <code>set</code>, or <code>nil</code>, if there is no encoding. Note that a coded character set is not the same thing as an external format.</p> <p>For the <code>set</code> parameter, the <code>:jis-*</code> codes are KUTEN indexes (from the 1990 version of these standards) encoded as</p> <pre>(+ (* 100 row) column)</pre> <p><code>:euc-jp</code> is the complete two-byte format encoded as</p> <pre>(+ (* 256 first-byte) second-byte)</pre> <p><code>:sjis</code> is Shift-JIS encoded in the same way. Strictly speaking, EUC and Shift-JIS are not coded character sets, but encodings</p> |                   |                                              |                  |                                                                                                                                                                                                                                                                                                                                                                                                                             |

of the JIS sets, but the encoding is easily expressed as an integer, so the same interface to it is used.

See also      **`find-external-char`**

## **`decode-external-string`** *Function*

|                     |                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                     |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|
| Summary             | Decodes a binary vector to make a string.                                                                                                                                                                                                                                                                                                                                                                               |                                                     |
| Package             | <b><code>external-format</code></b>                                                                                                                                                                                                                                                                                                                                                                                     |                                                     |
| Signature           | <b><code>decode-external-string vector external-format &amp;key start end =&gt; string</code></b>                                                                                                                                                                                                                                                                                                                       |                                                     |
| Arguments           | <b><code>vector</code></b>                                                                                                                                                                                                                                                                                                                                                                                              | A binary vector.                                    |
|                     | <b><code>external-format</code></b>                                                                                                                                                                                                                                                                                                                                                                                     | An external format spec.                            |
|                     | <b><code>start, end</code></b>                                                                                                                                                                                                                                                                                                                                                                                          | Bounding index designators of <code>vector</code> . |
| Values              | <b><code>string</code></b>                                                                                                                                                                                                                                                                                                                                                                                              | A string.                                           |
| Description         | <p>The function <b><code>decode-lisp-string</code></b> decodes the integers in the part of the vector <code>vector</code> bounded by <code>start</code> and <code>end</code> using encoding <code>external-format</code> to make a string <code>string</code>.</p> <p>The element type of <code>vector</code> does not need to match the <code>external-format-foreign-type</code> of <code>external-format</code>.</p> |                                                     |
| Compatibility notes | This function exists in LispWorks 5.0 but is not documented and does not take the <code>:start</code> and <code>:end</code> arguments. Also, it was inefficient prior to LispWorks 5.0.1.                                                                                                                                                                                                                               |                                                     |
| See also            | <b><code>encode-lisp-string</code></b>                                                                                                                                                                                                                                                                                                                                                                                  |                                                     |

|                     |                        | <i>Function</i>                                                                                                                                                                                                                                                                                                                 |
|---------------------|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary             |                        | Converts a string to an encoded binary vector.                                                                                                                                                                                                                                                                                  |
| Package             |                        | <code>external-format</code>                                                                                                                                                                                                                                                                                                    |
| Signature           |                        | <code>encode-lisp-string string external-format &amp;key start end =&gt; vector</code>                                                                                                                                                                                                                                          |
| Arguments           | <i>string</i>          | A string.                                                                                                                                                                                                                                                                                                                       |
|                     | <i>external-format</i> | An external format spec.                                                                                                                                                                                                                                                                                                        |
|                     | <i>start, end</i>      | Bounding index designators of <i>string</i> .                                                                                                                                                                                                                                                                                   |
| Values              | <i>vector</i>          | A binary vector.                                                                                                                                                                                                                                                                                                                |
| Description         |                        | The function <code>encode-lisp-string</code> converts the part of <i>string</i> bounded by <i>start</i> and <i>end</i> to a binary vector <i>vector</i> encoded in encoding <i>external-format</i> .<br><br>The element type of <i>vector</i> matches the <code>external-format-foreign-type</code> of <i>external-format</i> . |
| Compatibility notes |                        | This function exists in LispWorks 5.0 but is not documented and does not take the <code>:start</code> and <code>:end</code> arguments. Also, it was inefficient prior to LispWorks 5.0.1.                                                                                                                                       |
| See also            |                        | <code>decode-external-string</code>                                                                                                                                                                                                                                                                                             |

|              |  | <i>Condition</i>                                                                                                      |
|--------------|--|-----------------------------------------------------------------------------------------------------------------------|
| Summary      |  | The condition class <code>external-format-error</code> is the super-class of all errors relating to external formats. |
| Package      |  | <code>external-format</code>                                                                                          |
| Superclasses |  | <code>error</code>                                                                                                    |

|             |                    |                                                                                                                                                                                                                                                                              |
|-------------|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Initargs    | <code>:name</code> | The name of the external format involved.                                                                                                                                                                                                                                    |
| Description |                    | The class <code>external-format-error</code> provides a slot for the name of external format involved: this is the fully expanded form of the specification with all the parameters filled in. It is also useful for users who want to set up a handler for encoding errors. |

**external-format-foreign-type** *Function*

|             |                                                                                                                                                        |                                                                                         |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| Summary     | Returns a type specifier for the integers handled by a specified external format.                                                                      |                                                                                         |
| Package     | <code>external-format</code>                                                                                                                           |                                                                                         |
| Signature   | <code>external-format-foreign-type external-format =&gt; type-specifier</code>                                                                         |                                                                                         |
| Arguments   | <code>external-format</code>                                                                                                                           | An external character format.                                                           |
| Values      | <code>type-specifier</code>                                                                                                                            | A type specifier describing the integer types handled by <code>external-format</code> . |
| Description | Takes the name of an external format, and returns a Lisp type specifier for the type of integers that the external format handles on the foreign side. |                                                                                         |
| See also    | <code>external-format-type</code>                                                                                                                      |                                                                                         |

**external-format-type** *Function*

|         |                                                                                     |  |
|---------|-------------------------------------------------------------------------------------|--|
| Summary | Returns a type specifier for the characters handled by a specified external format. |  |
| Package | <code>external-format</code>                                                        |  |

|             |                                                                                                                                                  |                                                                                           |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| Signature   | <code>external-format-type external-format =&gt; type-specifier</code>                                                                           |                                                                                           |
| Arguments   | <code>external-format</code> An external character format.                                                                                       |                                                                                           |
| Values      | <code>type-specifier</code>                                                                                                                      | A type specifier describing the character types handled by <code>external-format</code> . |
| Description | Takes the name of an external format, and returns a type specifier for the type of characters that the external format handles on the Lisp side. |                                                                                           |
| See also    | <code>external-format-foreign-type</code>                                                                                                        |                                                                                           |

## find-external-char *Function*

|             |                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Returns the character of a given code in a specified character set.                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Package     | <code>external-format</code>                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Signature   | <code>find-external-char code set =&gt; char</code>                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Arguments   | <code>code</code>                                                                                                                                                            | A character code. This is an integer.                                                                                                                                                                                                                                                                                                                                                                                          |
|             | <code>set</code>                                                                                                                                                             | A character set. Legal values for <code>set</code> are<br><code>:unicode</code> , <code>:latin-1</code> , <code>:ascii</code> , <code>:macos-roman</code> , <code>:jis-x-208</code> , <code>:jis-x-212</code> , <code>:euc-jp</code> , <code>:sjis</code> , <code>:koi8-r</code> , <code>:windows-cp936</code> and <code>:gbk</code> . Additionally, on Windows, <code>set</code> can be a valid Windows code page identifier. |
| Values      | <code>char</code>                                                                                                                                                            | The character represented by <code>code</code> . If <code>code</code> is not a legal code in the specified set, the return value is undefined.                                                                                                                                                                                                                                                                                 |
| Description | Returns the character that has the code <code>code</code> (an integer) in the coded character set specified by <code>set</code> , or <code>nil</code> , if that character is |                                                                                                                                                                                                                                                                                                                                                                                                                                |

not represented in the Lisp character set. Note that a coded character set is not the same thing as an external format.

For the `set` parameter, the `:jis-*` codes are KUTEN indexes (from the 1990 version of these standards) encoded as

```
(+ (* 100 row) column)
```

`:euc-jp` is the complete two-byte format encoded as

```
(+ (* 256 first-byte) second-byte)
```

`:sjis` is Shift-JIS encoded in the same way. Strictly speaking, EUC and Shift-JIS are not coded character sets, but encodings of the JIS sets, but the encoding is easily expressed as an integer, so the same interface to it is used.

See also      `char-external-code`

## **valid-external-format-p** *Function*

Summary      Tests whether an external format spec is valid.

Package      `external-format`

Signature      `valid-external-format-p ef-spec &optional env => result`

Arguments      `ef-spec`      An external format spec.

`env`      An environment across which the spec should apply.

Values      `result`      A boolean.

Description      This predicate tests whether the external format spec given in `ef-spec` is valid (in the environment `env`).

`result` is `t` if `ef-spec` is a valid spec, and `nil` otherwise.

Example      `(valid-external-format-p '(:Unicode :eol-style :lf))`

# 38

---

## The HCL Package

This chapter describes symbols available in the `HCL` package. This package is used by default. Its symbols are visible in the `CL-USER` package.

Various uses of the symbols documented here are discussed throughout this manual.

|                                                              |                  |
|--------------------------------------------------------------|------------------|
| <code>add-code-coverage-data</code>                          |                  |
| <code>reverse-subtract-code-coverage-data</code>             |                  |
| <code>subtract-code-coverage-data</code>                     |                  |
| <code>destructive-add-code-coverage-data</code>              |                  |
| <code>destructive-subtract-code-coverage-data</code>         |                  |
| <code>destructive-reverse-subtract-code-coverage-data</code> | <i>Functions</i> |

Summary      Add or subtract two `code-coverage-data` objects.

Package      `hcl`

Signature      `add-code-coverage-data ccd1 ccd2 name => new-ccd`  
`subtract-code-coverage-data ccd1 ccd2 name => new-ccd`

```

reverse-subtract-code-coverage-data ccd1 ccd2 name =>
new-ccd

destructive-add-code-coverage-data ccd1 ccd2 => ccd1

destructive-subtract-code-coverage-data ccd1 ccd2 => ccd1

destructive-reverse-subtract-code-coverage-data ccd1
ccd2 => ccd1

```

|             |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arguments   | <i>ccd1</i>    | A <code>code-coverage-data</code> object or (for the non-destructive functions only) <code>t</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|             | <i>ccd2</i>    | A <code>code-coverage-data</code> object or <code>t</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|             | <i>name</i>    | A Lisp object, normally a symbol or a string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Values      | <i>new-ccd</i> | A <code>code-coverage-data</code> object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Description |                | <p>Adding (subtracting) code coverage datas means adding (subtracting) all pairs of counters for the same piece of code from the two datas. When the data contains actual counters, adding (subtracting) really means adding (subtracting) the counter values, and reverse subtract means subtracting the first argument from the second. When the data contains only binary flags (that is, the code was compiled with <code>counters = nil</code>, see <code>generate-code-coverage</code>), addition is performed by doing logical OR, and subtraction by doing logical AND-NOT. Note that having counters is a property of each individual file, and a <code>code-coverage-data</code> object may have files that are compiled with either of these options.</p> <p>If <i>ccd1</i> or <i>ccd2</i> has value <code>t</code>, this is interpreted as the internal <code>code-coverage-data</code> object.</p> <p>These functions operate on each file in <i>ccd1</i> (first argument), and for each of these file for which there is a match in <i>ccd2</i>, perform the operation on all the counters of this file. That is, they add (subtract) the counter from <i>ccd2</i> to (from) the matching counter in <i>ccd1</i>. If there is no matching file in <i>ccd2</i>, the operation is done with 0 so the information from <i>ccd1</i> is used unchanged.</p> |

For files which have matches in *ccd2*, the information must be based on the same binary file, otherwise these functions signal an error.

The functions `add-code-coverage-data`, `subtract-code-coverage-data` and `reverse-subtract-code-coverage-data` all produce a new `code-coverage-data` object (with name *name*) which is the result of the operation. The functions `destructive-add-code-coverage-data`, `destructive-subtract-code-coverage-data` and `destructive-reverse-subtract-code-coverage-data` all overwrite *ccd1* with the result and return it.

For all these functions the result is a `code-coverage-data` object with information for each file for which there is information in *ccd1*, combined with the counters from *ccd2* for files with a match. Files in *ccd2* for which there is no match in *ccd1* are ignored.

|          |                                                                                                                                                                                                                                                  |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | For <code>reverse-subtract-code-coverage-data</code> and <code>destructive-reverse-subtract-code-coverage-data</code> the result for files with no match may be considered inconsistent, because negation their counters may be more consistent. |
| See also | Chapter 10, “Code Coverage”                                                                                                                                                                                                                      |

| <b>add-special-free-action</b> |                 | <i>Function</i>                                                                 |
|--------------------------------|-----------------|---------------------------------------------------------------------------------|
| Summary                        |                 | Adds a function to perform a special action during garbage collection.          |
| Package                        |                 | <code>hcl</code>                                                                |
| Signature                      |                 | <code>add-special-free-action <i>function</i> =&gt; <i>function-list</i></code> |
| Arguments                      | <i>function</i> | A function designator for a function of one argument.                           |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                    |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| Values      | <i>function-list</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | A list of the functions currently called to perform special actions, including the one just added. |
| Description | <p>When some objects are garbage collected, you may require a “special action” to be performed as well. <code>add-special-free-action</code> adds the function <i>function</i> to perform the special action. Note that the function is applied to all objects flagged for special-free-action, so the function <i>function</i> should check for the object’s type, so that it only affects relevant objects. Also, it should be fast when called with other objects.</p> <p>The functions <code>flag-special-free-action</code> and <code>flag-not-special-free-action</code> flag and unflag objects for action.</p> <p>When <i>function</i> is called, the object is still alive but is no longer flagged for special free action. Normally, the object will be collected on the next garbage collection cycle, but you can also store it somewhere which will prevent this. It may even be passed to <code>flag-special-free-action</code> again.</p> |                                                                                                    |
| Example     | <pre>(defun free-my-app (object)   (when (my-app-p object)     (free-some-external-resources object)))  (add-special-free-action 'free-my-app)</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                    |
| See also    | <a href="#">remove-special-free-action</a><br><a href="#">flag-special-free-action</a><br><a href="#">flag-not-special-free-action</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                    |

## **add-symbol-profiler** *Function*

|           |                                                            |
|-----------|------------------------------------------------------------|
| Summary   | Deprecated. Adds a symbol to the list of profiled symbols. |
| Package   | <code>hcl</code>                                           |
| Signature | <code>add-symbol-profiler symbol =&gt; nil</code>          |

|             |                                                                                                                |                                                                  |
|-------------|----------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|
| Arguments   | <i>symbol</i>                                                                                                  | A symbol to be added to the <code>*profile-symbol-list*</code> . |
| Values      | Returns <code>nil</code> .                                                                                     |                                                                  |
| Description | The function <code>add-symbol-profiler</code> is deprecated. It adds a symbol to the list of profiled symbols. |                                                                  |
| See also    | <code>remove-symbol-profiler</code>                                                                            |                                                                  |

## **allocation-in-gen-num** *Macro*

|             |                                                                                                                     |                                                                                                                                                                                                                                                                                                                    |
|-------------|---------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Allocates objects from a specified generation within the scope of evaluating a number of forms in 32-bit LispWorks. |                                                                                                                                                                                                                                                                                                                    |
| Package     | <code>hcl</code>                                                                                                    |                                                                                                                                                                                                                                                                                                                    |
| Signature   | <code>allocation-in-gen-num <i>gen-num</i> &amp;body <i>body</i> =&gt; <i>result</i></code>                         |                                                                                                                                                                                                                                                                                                                    |
| Arguments   | <i>gen-num</i>                                                                                                      | An integer, which if out of range for a valid generation number is rounded either to the youngest or oldest generation.<br><br>If <i>gen-num</i> is negative, the specified generation is: the highest generation number + 1 - <i>gen-num</i> , so that an argument of -1 specifies the highest generation number. |
|             | <i>body</i>                                                                                                         | The forms to be evaluated while the allocation generation has been temporarily set to <i>gen-num</i> .                                                                                                                                                                                                             |
| Values      | <i>result</i>                                                                                                       | The result of evaluating body.                                                                                                                                                                                                                                                                                     |
| Description | Allocates objects from a specified generation during the extent of the evaluation of the body forms.                |                                                                                                                                                                                                                                                                                                                    |

Normally objects are allocated from the first (youngest) generation, which assumes that they are short-lived. The memory allocator and garbage collector perform better if allocation of large numbers of non-ephemeral objects is done explicitly into a generation other than the youngest.

**Notes** `allocation-in-gen-num` is implemented only in 32-bit LispWorks. In 64-bit implementations, use `apply-with-allocation-in-gen-num` or the `:allocation` argument to `make-array` instead.

**Examples**

```
(allocation-in-gen-num
  1
  (setq tab (make-hash-table :size 1200
                             :test 'eq)
        arr (make-array 20)))
```

**See also** `apply-with-allocation-in-gen-num`  
`make-array`  
`set-default-generation`  
`get-default-generation`  
`*symbol-alloc-gen-num*`  
“Memory Management in 32-bit LispWorks” on page 135

## analysing-special-variables-usage *Function*

**Summary** Prints an analysis of proclaimed symbols seen during compilation, as an aid to improving declarations.

**Package** `hcl`

**Signature** `analyzing-special-variables-usage (&key all default maybe-globals maybe-dynamics unused only-bound wrong-global inconsistent stream) &body body => results`

**Arguments** `all` A boolean.

`default` A boolean.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                      |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
|             | <i>maybe-globals</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | A boolean.                           |
|             | <i>maybe-dynamics</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | A boolean.                           |
|             | <i>unused</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | A boolean.                           |
|             | <i>only-bound</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A boolean.                           |
|             | <i>wrong-global</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | A boolean.                           |
|             | <i>inconsistent</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | A boolean.                           |
|             | <i>stream</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | t or an output stream.               |
|             | <i>body</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Lisp code that calls the compiler.   |
| Values      | <i>results</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | The results of running <i>body</i> . |
| Description | <p>The macro <code>analyzing-special-variables-usage</code> executes the code in <i>body</i>, which needs to call the compiler, typically many times (compiling a whole system, for example). When <i>body</i> exits, it prints a simple analysis of symbols that were proclaimed and how they were proclaimed, in a way that is intended to be helpful in improving declarations. For a full explanation of how you might add or alter declarations, see “Usage of special variables” on page 113.</p> <p>The analysis is based solely on what the compiler sees, ignoring what is already in the image. It also ignores inline declarations.</p> <p>Only symbols for which the compiler sees a special proclamation are reported (including <code>cl:defvar</code>, <code>cl:defparameter</code>, <code>defglobal-parameter</code> and <code>defglobal-variable</code>, but not <code>cl:defconstant</code>).</p> <p><i>all</i> and <i>default</i> are convenience arguments to control groups of the other keyword arguments, which are all boolean flags. The default value of <i>all</i> is <code>nil</code>. <i>all</i> provides the default value of <i>maybe-globals</i> and <i>maybe-dynamics</i>. The default value of <i>default</i> is <code>t</code>. <i>default</i> provides the default value of <i>unused</i>, <i>only-bound</i>, <i>wrong-global</i> and <i>inconsistent</i>.</p> |                                      |

*stream* determines where the analysis goes, and is interpreted as if by `cl:format`. It does not affect any of the I/O in *body*. The default value of *stream* is `t`, meaning standard output.

*inconsistent* controls whether to print symbols where the declaration and usage is inconsistent. Inconsistencies include:

1. Accessing or binding the symbol before the proclamation.
2. Multiple declarations which are different (for example, change from `hcl:special-dynamic` to `cl:special`)

The *inconsistent* messages are the most useful. A well written program should not produce any such message.

*unused* controls whether to report symbols that are proclaimed special but are otherwise not used. For this option to be really useful, *body* needs to force compile many source files.

Since such unused variables do not affect the code, *unused* is normally useful only for finding and eliminating dead declarations, but it can also flag situations when the wrong variable is used (if the variable that is supposed to be used is not used elsewhere)

*only-bound* controls whether to report symbols that have been seen bound, but whose value has not been read. The comments about *unused* also apply to *only-bound*.

*wrong-global* controls whether to print symbols that are bound but are also proclaimed `hcl:special-global`. If the proclamation preceded the binding, the compiler will signal a `compiler-error`.

*maybe Globals* controls whether to report symbols that were not seen bound. If these symbols are really never bound, they can be proclaimed global by defining them with `defglobal-parameter` and `defglobal-variable`, or proclaimed `hcl:special-global`, both for speed and also to prevent them getting bound by mistake.

It is quite useful to force compile a program each now and then with *maybe-globals* true, then check through the report and proclaim global all those symbols that can be proclaimed global.

*maybe-dynamics* controls whether to report symbols that have been seen bound, and are proclaimed special, but not `hcl:special-dynamic` or `hcl:special-global`. Some of these may be proclaimed `hcl:special-dynamic`.

The report that is generated is grouped according to the file in which a proclamation was found. If a variable was proclaimed in multiple files, it will appear multiple times in the output. Within each file the output is grouped according to what is reported.

For the keyword arguments except *inconsistent*, the symbols are simply listed. For the *inconsistent* report, it outputs several lines for each symbol. Each line starts with one of the symbols `c1:special`, `hcl:special-global`, `hcl:special-dynamic`, `hcl:special-fast-access` (these four signify a proclamation), `:bound` or `:accessed` (these two indicate the usage). It is followed by the pathname of the file in which this one found. Only occurrences which give rise to inconsistency are listed.

|       |                                                                                                                                                                                                                                                                                                                                                                                     |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes | The report about <i>inconsistent</i> usage is almost always useful. <i>unused</i> and <i>only-bound</i> are mostly useful when <i>body</i> force compiles many files, though they have limited utility in partial compilation too. <i>maybe-globals</i> and <i>maybe-dynamics</i> need full compilation to be really useful. Of the latter <i>maybe-globals</i> is the more useful. |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|          |                                                                                             |
|----------|---------------------------------------------------------------------------------------------|
| See also | <code>declare</code><br><code>defglobal-parameter</code><br><code>defglobal-variable</code> |
|----------|---------------------------------------------------------------------------------------------|

|             |                     | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     |                     | Android only: Returns the value of a field in the <code>android.os.Build</code> Java class.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Package     |                     | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Signature   |                     | <code>android-build-value &amp;optional name =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Arguments   | <code>name</code>   | <code>nil</code> or a string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Values      | <code>result</code> | A string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Description |                     | <p>The function <code>android-build-value</code> is defined only in Lisp-Works for Android Runtime images, and can be used only when running on Android. It returns values of fields from the <code>android.os.Build</code> Java class.</p> <p>If <code>name</code> is non-<code>nil</code>, it must a string naming a field in the <code>android.os.Build</code> Java class. <code>result</code> in this case is the value of this field.</p> <p>If <code>name</code> is <code>nil</code> (the default), then <code>android-build-value</code> returns a string containing the names and values of most of the fields in the <code>android.os.Build</code> class. For each field, <code>result</code> contains a substring of the form:</p> <pre>"&lt;field-name&gt; : &lt;field-value&gt;&lt;newline&gt;"</pre> <p><code>result</code> is the concatenation of all of these substrings. The fields that are looked up are:</p> |

```
BOARD
BOOTLOADER
BRAND
CPU_ABI
CPU_ABI2
DEVICE
DISPLAY
FINGERPRINT
HARDWARE
HOST
MANUFACTURER
MODEL
PRODUCT
RADIO
SERIAL
TAGS
TIME
TYPE
USER
```

See also      Chapter 16, “Android interface”

## android-funcall-in-main-thread

## android-funcall-in-main-thread-list

*Functions*

Summary      Call a function on the Android main (GUI) thread.

Package      `hcl`

Signature      `android-funcall-in-main-thread func &rest args`

Signature      `android-funcall-in-main-thread-list func-and-args`

Arguments      `func`      A function designator.

`args`      Arguments for `func`.

`func-and-args`      A cons (`func . args`).

Description      The functions `android-funcall-in-main-thread` and  
`android-funcall-in-main-thread-list` arrange for the

function `func` to be applied to the `args` on the Android main thread (which is the GUI thread too). `android-funcall-in-main-thread` actually does it by consing `func` and `args` and calling `android-funcall-in-main-thread-list` with the result. `android-funcall-in-main-thread-list` is the "primitive" interface.

The invocation of the function is done by the event loop of the GUI thread, so it is synchronous with respect to processing events, in other words it will not happen in the middle of processing an event.

These functions should be used when `func` does something that needs to run on the main thread, most commonly operations that interact with GUI elements.

To allow for testing, these functions can be called on any architecture. On non-Android architectures, there is no "Android main process". In this case, `android-funcall-in-main-thread-list` first tests whether the variable `*android-main-process-for-testing*` is non-nil (which value must be a process), and if it is sends `func-and-args` to this process by `process-send`. This is based the assumption that this process processes cons events by applying the `c1:car` to the `c1:cdr`, which is the "normal" behavior of the system event processing (that is, what `general-handle-event` does). If you set this variable, make sure that this process processes events in this way. If `*android-main-process-for-testing*` is nil, `android-funcall-in-main-thread-list` arranges for the idle process to apply the `c1:car` to the `c1:cdr`.

#### Notes

`android-funcall-in-main-thread-list` always queues the function, even if it runs on the main thread. If you need to execute immediately when running on the main thread, check first using `android-main-thread-p`.

See also      **\*android-main-process-for-testing\***  
**android-main-thread-p**  
Chapter 16, “Android interface”

## **android-get-current-activity**                          *Function*

Summary      Return the current activity that was set by the Java method  
**com.lispworks.Manager.setCurrentActivity**.

Package      **hcl**

Signature      **android-get-current-activity** => **result**

Arguments      None.

Values      **result**      An object of class **android.app.Activity**,  
or **nil**.

Description      The function **android-get-current-activity** returns the current activity that was set by the Java method **com.lispworks.Manager.setCurrentActivity**, if the current thread is the Android main thread.

**android-get-current-activity** first checks whether the current thread is the main thread, and if it is not returns **nil**. Otherwise, it returns the activity that was last set by **com.lispworks.Manager.setCurrentActivity** (an object of class **android.app.Activity**). This is the object that is needed to create dialogs.

Notes      The main purpose of **android-get-current-activity** is to decide whether the current code can raise dialogs, and if so to get the activity to use as a context.

Examples      (**example-edit-file "android/dialog"**)

See also [android-main-thread-p](#)  
[com.lispworks.Manager.setCurrentActivity](#)

\*android-main-process-for-testing\* Variable

|               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary       | Variable defining the "Android main process" when not running on Android.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Package       | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Initial value | <code>nil</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Description   | <p>The variable <code>*android-main-process-for-testing*</code> defines the "Android main process" when not running on Android.</p> <p><code>*android-main-process-for-testing*</code> defaults to <code>nil</code>. If it is set, it must be a <code>mp:process</code> object, which processes events which are a cons by applying the <code>c1:car</code> to the <code>c1:cdr</code>.</p> <p><code>*android-main-process-for-testing*</code> is used by <code>android-funcall-in-main-thread-list</code> and <code>android-funcall-in-main-thread</code> when they are called on non-Android platforms.</p> |
| Notes         | <p><code>general-handle-event</code> processes conses by applying the <code>c1:car</code> to the <code>c1:cdr</code>, and therefore any process that uses it to process events will do the right thing. That includes the CAPI events loop, and users of <code>wait-processing-events</code> and <code>process-all-events</code>.</p>                                                                                                                                                                                                                                                                         |

## android-main-thread-p Function

**Summary** Tests whether the current thread is the Android main (GUI) thread.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                    |            |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Package     | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                                                                   |            |
| Signature   | <code>android-main-thread-p =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                    |            |
| Arguments   | None.                                                                                                                                                                                                                                                                                                                                                                                                                              |            |
| Values      | <code>result</code>                                                                                                                                                                                                                                                                                                                                                                                                                | A boolean. |
| Description | <p>The function <code>android-main-thread-p</code> is the predicate for whether the current thread is the Android main (GUI) thread.</p> <p>For testing, on non-Android platforms <code>android-main-thread-p</code> checks whether the current Lisp process is <code>*android-main-process-for-testing*</code> (if this variable is non-nil) or the Idle process (if <code>*android-main-process-for-testing*</code> is nil).</p> |            |
| See also    | <code>android-funcall-in-main-thread</code><br><code>*android-main-process-for-testing*</code>                                                                                                                                                                                                                                                                                                                                     |            |

|             |                                                                                                                                                      | <i>Function</i> |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Summary     | A predicate for whether any CAPI window is currently displayed.                                                                                      |                 |
| Package     | <code>hcl</code>                                                                                                                                     |                 |
| Signature   | <code>any-capi-window-displayed-p =&gt; result</code>                                                                                                |                 |
| Values      | <code>result</code>                                                                                                                                  | A boolean.      |
| Description | <p>The function <code>any-capi-window-displayed-p</code> is a predicate for whether any CAPI window (other than dialogs) is currently displayed.</p> |                 |

- Notes
1. See the *CAPI User Guide and Reference Manual* for a description of the CAPI toolkit which allows you to write graphical user interfaces in Lisp.
  2. Tools in the LispWorks IDE are all CAPI windows.

## **array-single-thread-p** *Function*

Summary      The predicate for single-thread arrays.

Package      **hcl**

Signature      **array-single-thread-p array => result**

Arguments      **array**                  An array.

Values      **result**                  A boolean.

Description      The function **array-single-thread-p** is the predicate for whether an array is one known to be only accessed in a single thread context, as created by

(make-array ... :single-thread t)

or set by **set-array-single-thread-p**.

See also      **make-array**  
**set-array-single-thread-p**

## **array-weak-p** *Function*

Summary      The predicate for whether an object is a weak array.

Package      **hcl**

Signature      **array-weak-p object => result**

|             |               |                                                                                                                                     |
|-------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------|
| Arguments   | <i>object</i> | A Lisp object.                                                                                                                      |
| Values      | <i>result</i> | A boolean.                                                                                                                          |
| Description |               | The function <b>array-weak-p</b> returns <b>t</b> if its argument <i>object</i> is a weak array, and otherwise returns <b>nil</b> . |
| See also    |               | <b>make-array</b><br><b>set-array-weak</b>                                                                                          |

## **augment-environment** *Function*

**Summary** Returns a new environment based on an existing one with different bindings.

**Package** **hcl**

**Signature** **augment-environment** *env* &**key** *variable symbol-macro function macro declare reset => newenv*

|           |                     |                                  |
|-----------|---------------------|----------------------------------|
| Arguments | <i>env</i>          | An environment or nil            |
|           | <i>variable</i>     | A list of symbols                |
|           | <i>symbol-macro</i> | A list of lists                  |
|           | <i>function</i>     | A list of function names         |
|           | <i>macro</i>        | A list of lists                  |
|           | <i>declare</i>      | A list of declaration-specifiers |
|           | <i>reset</i>        | A generalized boolean            |

**Values** *newenv* An environment

**Description** The function **augment-environment** returns a new environment *newenv*, based on *env* but modified according to the keyword arguments *variable*, *symbol-macro*, *function*, *macro*, *declare* and *reset*.

If *env* is `nil`, then *newenv* will be based on the null environment. Otherwise, if *reset* is false (the default) then all of the bindings in *env* will be present in *newenv* unless overridden by the other keyword arguments. Otherwise, if *reset* is true then all of the non-local bindings in *env* will be present in *newenv* but none of the local bindings will be present. Passing *reset* as true allows you to create an environment object for calls to `variable-information` and so on which can access the file compilation environment without seeing local bindings in the lexical environment.

*variable* should be a list of symbols and *newenv* will contain these symbols as local variable bindings. A binding will be a special binding if the symbol is declared special non-lexically in *env* or a special declaration is present in `declare`.

*symbol-macro* should be a list of lists of the form (*symbol expansion*) and *newenv* will contain local symbol-macro bindings for each *symbol* with *expansion* as its macroexpansion.

*function* should be a list of function names and *newenv* will contain these symbols as local function bindings.

*macro* should be a list of lists of the form (*symbol macrofunction*) and *newenv* will contain local macro bindings for each *symbol* with *macrofunction* as its macroexpansion function. Each *macrofunction* is a function of two arguments, a form and an environment, which should return the expanded form.

*declare* should be a list of declaration-specifiers, which will be added to *newenv* as if by `declare`.

It is an error to use a symbol in *symbol-macro* that is also in *variable* or is declared special.

It is an error to use a symbol in *macro* that is also in *function*.

*newenv* has the same extent as *env*, that is it might have dynamic extent within the function that created *env*.

The lists passed to `augment-environment` should be not destructively modified afterwards.

Notes      `augment-environment` is part of the environment access API which is based on that specified in *Common Lisp: the Language (2nd Edition)*.

See also    `declaration-information`  
              `define-declaration`  
              `function-information`  
              `map-environment`  
              `variable-information`

## **avoid-gc** *Function*

|             |                                                                                                                                                                                                                                                                                                               |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Avoids garbage collection if possible in 32-bit LispWorks.                                                                                                                                                                                                                                                    |
| Package     | <code>hcl</code>                                                                                                                                                                                                                                                                                              |
| Signature   | <code>avoid-gc =&gt; previous-results</code>                                                                                                                                                                                                                                                                  |
| Arguments   | None.                                                                                                                                                                                                                                                                                                         |
| Values      | The function returns the previous settings of <code>minimum-for-sweep</code> , <code>maximum-overflow</code> and <code>minimum-overflow</code> . (see <code>set-gc-parameters</code> for details of these.)                                                                                                   |
| Description | <p><code>avoid-gc</code> sets various internal parameters so that garbage collection is avoided as far as possible.</p> <p>This can be useful with non-interactive programs.</p> <p>If you use <code>avoid-gc</code>, use <code>normal-gc</code> later to reset the parameters to their default settings.</p> |
| Notes       | <code>avoid-gc</code> is implemented only in 32-bit LispWorks. It is not relevant to the Memory Management API in 64-bit imple-                                                                                                                                                                               |

mentations. In 64-bit implementations, you can use `set-default-segment-size` to increase the default size of segments in the lower generations (typically generations 0 and 1). This will lead to less frequent garbage collections.

## See also

`gc-if-needed`  
`normal-gc`  
`set-gc-parameters`  
`set-default-segment-size`  
`without-interrupts`

“Memory Management in 32-bit LispWorks” on page 135

**\*background-input\*****\*background-output\*****\*background-query-io\*****Variables**

Summary Default streams for the standard streams.

Package `hcl`

Initial value The value of `cl:*terminal-io*`.

Description The variables `*background-input*`, `*background-output*` and `*background-query-io*` are default streams for the standard Common Lisp streams.

These variables are all set to the value of `cl:*terminal-io*` when the image starts, but when the LispWorks IDE starts it sets:

- `*background-output*` to `mp:*background-standard-output*`.
- `*background-input*` to a stream that always returns EOF.
- `*background-query-io*` to a stream that interacts with the user using CAPI prompters.

The default value of each of the standard streams is a synonym stream to a `*background-*` stream:

- `*standard-input*` is a synonym to `*background-input*`.
- `*standard-output*`, `*trace-output*` and `*error-output*` are synonyms to `*background-output*`.
- `*query-io*` and `*debug-io*` are synonyms to `*background-query-io*`.

Thus when the LispWorks IDE is running, output to the standard output streams goes to the `mp:*background-standard-output*`, and can be viewed in the **Output** tab of the Listener and Editor windows, and the Output Browser tool. Trying to read from `*standard-input*` once the environment is running returns EOF. Using `*query-io*` causes on-screen prompting.

The main purpose of these variables is to redirect the standard input and output streams once the LispWorks IDE is running, because writing to `cl:*terminal-io*` is not useful in most cases.

You can set or rebind these variables if required, and this changes the default destination of the standard streams.

#### Notes

Processes that are created by CAPI for an interface while the IDE is running rebinding the standard input, output and query I/O streams to themselves (so setting them in these processes does not change the global value). This does not happen on processes that are not created by CAPI, and does not happen when the LispWorks IDE is not running, in particular in delivered applications. When the LispWorks IDE is running, the output to standard output stream on other processes will still go by default to the `mp:*background-standard-output*`, because `*background-output*` is set to it.

|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Compatibility note | These variables were new in LispWorks 7.0.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|                    | In LispWorks 6.1 and earlier versions, CAPI processes in the LispWorks IDE bound the output streams to <code>mp:*background-standard-output*</code> , the standard input to a stream that returns EOF and <code>*QUERY-IO*</code> to a stream that interacts with the user using CAPI prompters. Hence, for these processes, the default behavior has not changed. However input and output on other processes was going to/from the <code>c1:*terminal-io*</code> by default, which caused various problems. The main purpose of these variables is to fix these problems. |
| See also           | <b>*standard-input*</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

|             | <i>Function</i>                                                                                                                              |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Lists special variables bound by a definition.                                                                                               |
| Package     | <code>hcl</code>                                                                                                                             |
| Signature   | <code>binds-who function =&gt; result</code>                                                                                                 |
| Arguments   | <code>function</code> A symbol or a function dspec.                                                                                          |
| Values      | <code>result</code> A list.                                                                                                                  |
| Description | The function <code>binds-who</code> returns a list of the special variables bound by the definition named by <code>function</code> .         |
| Notes       | The cross-referencing information used by <code>binds-who</code> is generated when code is compiled with source-level debugging switched on. |
| See also    | <b>references-who</b><br><b>sets-who</b>                                                                                                     |

```
toggle-source-debugging
who-binds
```

## block-promotion *Macro*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                          |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|
| Summary     | Prevents promotion of objects into generation 2 during the execution of <i>body</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                          |
| Package     | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                          |
| Signature   | <code>block-promotion &amp;body body =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                          |
| Arguments   | <i>body</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Forms executed as an implicit <code>progn</code> .       |
| Values      | <i>result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | The result of evaluating the final form in <i>body</i> . |
| Description | <p>The macro <code>block-promotion</code> executes <i>body</i> and prevents promotion of objects into generation 2 during this execution. After <i>body</i> is executed, generations 0 and 1 are collected.</p> <p>This is useful when a significant number of transient objects actually survive all the garbage collections on generation 1. These would normally then be promoted and, by default, never get collected. In such a situation, <code>(gc-generation t)</code> will free a large amount of space in generation 2.</p> <p><code>block-promotion</code> can be thought of as doing <code>set-promotion-count</code> on generation 1 with an infinite <i>count</i>, for the duration of <i>body</i>.</p> <p><code>block-promotion</code> is suitable only for use in particular operations that are known to create such relatively long-lived, but transient, objects. In typical uses these are objects that live for a few seconds to several hours. An example usage is Lisp-Works <code>compile-file</code>, to ensure the transient compile-time data gets collected.</p> |                                                          |

**block-promotion** has global scope and hence may not be useful in an application such as a multithreaded server. During the execution of *body*, generation 1 grows to accommodate all the allocated data, which may have some negative effects on the behavior of the system, in particular on its interactive response.

- Notes
1. Symbols and process stacks are allocated in generation 2 or 3 (see `*symbol-alloc-gen-num*`) hence **block-promotion** cannot prevent these getting into that generation. `allocation-in-gen-num` can also cause allocation in higher generations.
  2. In 64-bit LispWorks, **block-promotion** is implemented using `set-blocking-gen-num`.

See also

- `allocation-in-gen-num`
- `mark-and-sweep`
- `set-promotion-count`

## **building-universal-intermediate-p** *Function*

- Summary      Deprecated. Simply returns `nil`.
- Package      `hcl`
- Signature      `building-universal-intermediate-p => intermediatep`
- Arguments      None
- Values      *intermediatep*      A boolean.
- Description      The function **building-universal-intermediate-p** is deprecated. The return value *intermediatep* is `nil`.
- Compatibility note      In LispWorks 6.1 for Macintosh and earlier versions, **building-universal-intermediate-p** is used in a build script to

determine whether LispWorks is building an intermediate image when making a universal binary.

In LispWorks 7.0 and later versions universal binaries are not supported, and this function always returns `nil`, on all platforms.

See also      `save-universal-from-script`  
                 `save-argument-real-p`

## **`calls-who`** *Function*

|             |                                                                                                                                                         |                        |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Summary     | Lists functions called by a function.                                                                                                                   |                        |
| Package     | <code>hcl</code>                                                                                                                                        |                        |
| Signature   | <code>calls-who dspec =&gt; callees</code>                                                                                                              |                        |
| Arguments   | <code>dspec</code>                                                                                                                                      | A <code>dspec</code> . |
| Values      | <code>callees</code>                                                                                                                                    | A list.                |
| Description | The function <code>calls-who</code> returns a list of the <code>dspecs</code> naming the functions called by the function named by <code>dspec</code> . |                        |
|             | See also the editor commands <code>List Callees</code> , and <code>Show Paths From</code> .                                                             |                        |
| Notes       | The cross-referencing information used by <code>calls-who</code> is generated when code is compiled with source-level debugging switched on.            |                        |
| Example     | <code>(calls-who '(method foo (string)))</code>                                                                                                         |                        |
| See also    | <code>toggle-source-debugging</code><br><code>who-calls</code>                                                                                          |                        |

| <b>cd</b>   | <i>Macro</i>                                                                                                                                                                                                          |                                                     |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|
| Summary     | Changes the current directory.                                                                                                                                                                                        |                                                     |
| Package     | <code>hcl</code>                                                                                                                                                                                                      |                                                     |
| Signature   | <code>cd &amp;optional directory =&gt; current-dir</code>                                                                                                                                                             |                                                     |
| Arguments   | <code>directory</code>                                                                                                                                                                                                | A pathname designator specifying the new directory. |
| Values      | <code>current-dir</code>                                                                                                                                                                                              | A physical pathname.                                |
| Description | The macro <code>cd</code> changes the current directory to that specified by <code>directory</code> . <code>directory</code> may be an absolute or relative pathname, and defaults to the string " <code>~/</code> ". |                                                     |
| Notes       | <code>cd</code> should not be used in multithreaded applications. In general we discourage you from using it.                                                                                                         |                                                     |
| See also    | <code>change-directory</code><br><code>get-working-directory</code>                                                                                                                                                   |                                                     |

| <b>change-directory</b> | <i>Function</i>                                           |                                                     |
|-------------------------|-----------------------------------------------------------|-----------------------------------------------------|
| Summary                 | Changes the current directory.                            |                                                     |
| Package                 | <code>hcl</code>                                          |                                                     |
| Signature               | <code>change-directory directory =&gt; current-dir</code> |                                                     |
| Arguments               | <code>directory</code>                                    | A pathname designator specifying the new directory. |
| Values                  | <code>current-dir</code>                                  | A physical pathname.                                |

|             |                                                                                                                                                               |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <code>change-directory</code> changes the current directory to that specified by <i>directory</i> . <i>directory</i> may be an absolute or relative pathname. |
|             | Use <code>get-working-directory</code> to find the current directory.                                                                                         |
| Notes       | <code>change-directory</code> should not be used in multithreaded applications. In general we discourage you from using it.                                   |
| See also    | <code>cd</code><br><code>get-working-directory</code>                                                                                                         |

|           | <i>Function</i>                                                                                                                                                                                                                                                                                                              |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary   | Provides information about the fragmentation in a generation in 32-bit LispWorks.                                                                                                                                                                                                                                            |
| Package   | <code>hcl</code>                                                                                                                                                                                                                                                                                                             |
| Signature | <code>check-fragmentation gen-num =&gt; total-free, total-small-blocks, total-large-blocks</code>                                                                                                                                                                                                                            |
| Arguments | <p><i>gen-num</i>      0 for the most recent generation, 1 for the most recent two generations, and so on up to a maximum (usually 3). Numbers outside this range signal an error.</p>                                                                                                                                       |
| Values    | <p><i>total-free</i>      Total free space in the generation.</p> <p><i>total-small-blocks</i> Amount of free space in the generation which is available in blocks of 512 bytes or larger.</p> <p><i>total-large-blocks</i> Amount of free space in the generation which is available in blocks of 4096 bytes or larger.</p> |

|             |                                                                                                                                                                                                                                     |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | The latter two values give indication of the level of fragmentation in the generation. This information can be used, for example, to decide whether to call <code>try-move-in-generation</code> .                                   |
| Notes       | <code>check-fragmentation</code> is implemented only in 32-bit Lisp-Works. It is not relevant to the Memory Management API in 64-bit implementations, where <code>gen-num-segments-fragmentation-state</code> is available instead. |
| See also    | <code>try-compact-in-generation</code><br><code>try-move-in-generation</code><br>“Guidance for control of the memory management system” on page 130                                                                                 |

|             | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Frees memory and reduces the size of the image, if possible.                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Package     | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Signature   | <code>clean-down &amp;optional full =&gt; new-size</code>                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Arguments   | <code>full</code> A generalized boolean.<br><code>new-size</code> A positive integer.                                                                                                                                                                                                                                                                                                                                                                                                    |
| Description | <p>Tries to free as much memory as possible and then reduce the size of the image as much as possible, and also move all the allocated objects to an old generation.</p> <p><code>full</code> controls whether to operate on the highest generation. The default value of <code>full</code> is <code>t</code>.</p> <p>If <code>full</code> is <code>t</code>, <code>clean-down</code> does a mark and sweep on generation 3, promotes all the objects into generation 3, deletes the</p> |

empty segments and tries to reduce the image size. This is called by default before saving an image.

If *full* is `nil`, `clean-down` does a mark and sweep on generation 2, promotes all the objects to generation 2 and tries to reduce the size of all generations up to 2, but does not touch generation 3.

`clean-down` returns the new size of the Lisp image after reduction, in bytes.

`clean-down` may fail to delete empty segments if there are static segments in high address space.

#### Notes

1. `try-move-in-generation` (which is implemented only in 32-bit LispWorks) uses less CPU than `clean-down`, though it does not do the mark and sweep.
2. In 64-bit LispWorks, `clean-down` is implemented as if by `(gc-generation 7 :coalesce t)` though you can use `gc-generation` directly for better control.
3. In the Mobile GC, `clean-down` performs the same GC as `(gc-generation t)`.
4. `clean-down` may temporarily increase memory usage, and when called with *full* `nil` may result in a larger Lisp image (though better organized, and therefore behaving better). In 32-bit LispWorks in situations where it is important not to increase memory usage, such as when the operating system signals that memory is low, use `reduce-memory` instead.

#### See also

`gc-generation`

`reduce-memory`

`save-image`

`try-move-in-generation`

“Guidance for control of the memory management system”  
on page 130

|             | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Attempts to promote all objects from generation zero into generation one, thereby clearing generation zero, in 32-bit LispWorks.                                                                                                                                                                                                                                                                                                                                                                                                       |
| Package     | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Signature   | <code>clean-generation-0 =&gt; 1</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Arguments   | None                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Values      | Returns the value 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Description | This is useful when passing from a phase of creating long-lived data to a phase of mostly ephemeral data, for example, the end of loading an application and the start of its use.                                                                                                                                                                                                                                                                                                                                                     |
| Notes       | <ol style="list-style-type: none"> <li>1. The function may not be very useful, as it may be more efficient to directly allocate the objects in a particular generation in the first place, using <code>allocation-in-gen-num</code> or <code>set-default-generation</code>.</li> <li>2. <code>clean-generation-0</code> is implemented only in 32-bit LispWorks. It is not relevant to the Memory Management API in 64-bit implementations, where the same effect can be obtained by a call <code>(gc-generation 0)</code>.</li> </ol> |
| Example     | <pre>;   allocate lots of non-ephemeral objects ;   ..... (clean-generation-0)</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| See also    | <code>allocation-in-gen-num</code><br><code>collect-generation-2</code><br><code>collect-highest-generation</code><br><code>expand-generation-1</code><br><code>gc-generation</code>                                                                                                                                                                                                                                                                                                                                                   |

**set-promotion-count**

“Memory Management in 32-bit LispWorks” on page 135

**clear-code-coverage**

**reset-code-coverage**

**restore-code-coverage-data**

*Functions*

Summary      Modify the internal **code-coverage-data** object.

Package      **hcl**

Signature      **clear-code-coverage => result**  
**reset-code-coverage => result**  
**restore-code-coverage-data code-coverage-data &key error => result**

Arguments      **code-coverage-data**

                  A **code-coverage-data** object.

**error**            :warn, nil or t.

Value            **result**        A boolean.

Description      The function **clear-code-coverage** clears the internal **code-coverage-data** object, which means removing all the files from it, so that their counters are not accessible anymore. Note that it does not actually remove the counters from the code.

The function **reset-code-coverage** resets all the counters in the internal **code-coverage-data** object to 0.

The function **restore-code-coverage-data** sets the counters of all files that appear in both the internal code coverage data and the argument **code-coverage-data** to the counters in the **code-coverage-data** argument. All these files

need to have the same code coverage code, that is they must be based on the same binary file.

`error` controls what happens for files that do not have the same code coverage code. Value `:warn` means warn and continue, `:nil` means quietly skip it, and `t` means signal an error. `restore-code-coverage-data` never restores a file with no matching code coverage code. The default value of `error` is `:warn`.

The value of `result` indicates whether there was an internal `code-coverage-data` object when the function was called.

#### Notes

1. If `error` is `t`, some of the files would be restored and some not, leaving the internal `code-coverage-data` object in an inconsistent state.
2. All these functions also reset any snapshot by calling `reset-code-coverage-snapshot`.

#### See also

Chapter 10, “Code Coverage”

|             |                                                                                                                                                                                                                                                                                                                                                                                            | Type |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| Summary     | A structure containing information about code coverage.                                                                                                                                                                                                                                                                                                                                    |      |
| Package     | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                           |      |
| Readers     | <code>code-coverage-data-name</code><br><code>code-coverage-data-create-time</code>                                                                                                                                                                                                                                                                                                        |      |
| Description | <p>The type <code>code-coverage-data</code> is a structure containing information about code coverage.</p> <p><code>code-coverage-data</code> contains information about some set of files. With the exception of the internal code coverage data, <code>code-coverage-data</code> does not change after it is created. The internal code coverage data contains information about all</p> |      |

files that have been loaded with code coverage (since the last call to `clear-code-coverage`). A file is "with code coverage" when it is a binary file compiled with code coverage on (see `generate-code-coverage`).

The counters in the internal code coverage data are the counters that the actual code is referencing, and therefore they are modified whenever any of this code is executing. For each file the counters are either actual counters or binary flags (see *counters* argument in `generate-code-coverage`), but inside the structure there may be files of either counter type.

All other `code-coverage-data` structures start their life as copies of the internal code coverage data, and then they can be further manipulated. They are displayed by `code-coverage-data-generate-coloring-html` or the LispWorks IDE.

The *name* is supplied to the data when it is created by functions like `copy-current-code-coverage`, and the *create-time* is the universal time when the data was created. These values are provided so that you can track your data: they are not used by the system. *name* can be any Lisp object, but normally should be a symbol or a string (because if you save the data name will be written too, so it is best if does not point to a large structure).

See also      Chapter 10, “Code Coverage”

|         |                                                  | <i>Function</i> |
|---------|--------------------------------------------------|-----------------|
|         | <b>code-coverage-data-generate-coloring-html</b> |                 |
| Summary | Generates HTML showing the code coverage.        |                 |
| Package | <code>hcl</code>                                 |                 |

|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signature | <code>code-coverage-data-generate-coloring-html target &amp;key<br/>code-coverage-data shared-source-directory filter target-type color-<br/>uncovered color-covered show-counters counter-space index-filename<br/>index-name index-sort index-mark-not-entered index-mark-partial<br/>index-show-non-runtime open</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Arguments | <p><i>target</i>                    A pathname designator.</p> <p><i>code-coverage-data</i>            A <code>code-coverage-data</code> object.</p> <p><i>shared-source-directory</i>        A pathname designator.</p> <p><i>filter</i>                    A string, a function or a symbol naming a function.</p> <p><i>target-type</i>                A string or <code>nil</code>.</p> <p><i>color-uncovered</i>            A boolean.</p> <p><i>color-covered</i>              A boolean.</p> <p><i>show-counters</i>             A boolean.</p> <p><i>counter-space</i>             <code>nil</code>, <code>:before</code>, <code>:after</code>, <code>:both</code> or <code>t</code>.</p> <p><i>index-filename</i>            A pathname designator or <code>nil</code>.</p> <p><i>index-name</i>                A string.</p> <p><i>index-sort</i>                One of the keywords <code>:relative-name</code>, <code>:name</code> and <code>:uncovered</code>.</p> <p><i>index-mark-not-entered</i>    A boolean.</p> <p><i>index-mark-partial</i>          A boolean.</p> <p><i>index-show-non-runtime</i>    A boolean.</p> <p><i>open</i>                    A boolean.</p> |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The function <code>code-coverage-data-generate-coloring-html</code> generates HTML showing the code coverage.</p> <p><i>target</i> specifies the directory for the HTML files, and optionally the name of the index file, if <i>target</i> has a name component and <i>index-filename</i> is not supplied.</p> <p><i>code-coverage-data</i> must be a <code>code-coverage-data</code> object to use. Otherwise <code>code-coverage-data-generate-coloring-html</code> uses the internal data.</p> <p><i>shared-source-directory</i> must specify a directory path. It has two effects:</p> <ul style="list-style-type: none"> <li>• HTML is produced only for source files in the <i>shared-source-directory</i> (the <i>filter</i> may exclude some of these), and</li> <li>• The path of each HTML file is constructed from the relative path of the source file with respect to the <i>shared-source-directory</i> (as produced by <code>c1:enough-namestring</code>) merged with the <i>target</i> directory. The result is a tree of HTML files which is parallel to the tree of the source files.</li> </ul> <p>If <i>shared-source-directory</i> is not supplied, all files that passed the <i>filter</i> are produced, and the target HTML file has the filename of the source file inside the <i>target</i> directory. Note that this may cause clashes if there are files with the same name in the data.</p> <p><i>filter</i> can be used to restrict which files HTML is produced for. If <i>filter</i> is a string it is interpreted as a regexp. If the <code>c1:namestring</code> of the truename of a source file matches <i>filter</i> (as by <code>find-regexp-in-string</code>) then HTML is produced for this source file. If <i>filter</i> is a function (or fbound symbol) it must take two arguments, the truename and the <code>code-coverage-file-stats</code> for this source file, and return a boolean specifying whether to produce HTML for this source file. The <code>stats</code> object can be accessed by the <code>code-coverage-file-stats</code> accessor functions (for example <code>code-coverage-file-stats-lambdas-count</code>). If <i>filter</i> is not supplied, all</p> |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

files (or, if *shared-source-directory* is supplied, all those files inside it) are produced.

*target-type* specifies the type of the output files. The default value of *target-type* is "htm".

*color-uncovered*, *color-covered*, *show-counters* and *counter-space* control the HTML output. See "Source files HTML coloring" below for details. Note that the colors to actually use are specified by `code-coverage-set-html-background-colors`.

*color-uncovered* controls whether uncovered forms are colored. These include forms that did not execute at all, eliminated forms and forms which were partially executed but the unexecuted part is hidden (in a macroexpansion). The default value of *color-uncovered* is t.

*color-covered* controls whether covered forms are colored. These include forms that were fully executed, and those parts of partially executed forms that were executed. The default value of *color-covered* is nil.

*show-counters* controls whether to insert counters in the HTML. The default value of *show-counters* is t.

*counter-space* specifies whether to insert a space before and/or after each counter. The value t has the same meaning as :both. The default value of *counter-space* is :after.

*index-filename*, *index-name*, *index-sort*, *index-mark-not-entered*, *index-mark-partial* and *index-show-non-runtime* control the generation of the index file. See "Index file" below for the description of the index file's contents.

*index-filename*, when supplied, specifies the name of the index file. It is merged with the *target* path to generate the full path. Note that the file type should be included in either *index-filename* or the *target* path. If *index-filename* is not supplied, it defaults to "`code-coverage-index.htm`". If *index-filename* is nil, no index file is produced.

*index-name* is printed (with format directive `~A`) as part of the title of the index file, and not used otherwise. The default value of *index-name* is "Index".

*index-sort* controls the order files are listed in the table in the index. `:relative-name` means sort by the relative name of the source file with respect to *shared-source-directory*. If *shared-source-directory* is not supplied, `:relative-name` has the same effect as `:name`. `:name` means sort by the name of the source file. `:uncovered` means sort by the number of not fully covered run time lambdas in the file (the sum of `code-coverage-file-stats-not-called` and `code-coverage-file-stats-partially-covered` called with `:runtime`). The default value of *index-sort* is `:relative-name`.

*index-mark-not-entered* controls whether to mark cells in the run time part for uncovered lambdas. The default value of *index-mark-not-entered* is `t`.

*index-mark-partial* controls whether to mark cells in the run time part for lambdas that are partially covered. The default value of *index-mark-partial* is `t`.

*index-show-non-runtime* controls whether to show the non-run time part of the table. The default value of *index-show-non-runtime* is `t`.

*open* specifies whether the index file should be opened (by `open-url`) once it is generated. The default value of *open* is `nil`.

## The HTML output

`code-coverage-data-generate-coloring-html` generates a HTML file for each source file in *code-coverage-data* that is inside the *shared-source-directory* (or all source files if *shared-source-directory* is `nil`) and pass the *filter* (or all if *filter* is `nil`), as described above, and one index file with statistics. It uses background colors to mark various things (see below), and these colors can be set by `code-coverage-set-html-back-`

`ground-colors`. The colors that are described below are the default colors.

## Index file

The index file contains a table with a single row per file.

The first column shows the file "relative name", which is relative to the optional `shared-source-directory`, or just the filename. The rest of the columns contain statistics, which are divided into 2 parts: run time lambdas and optional non-run time lambdas. "Lambda" here means a separate piece of code (for example code that is called inline does not count as a separate lambda). Run time lambdas refer to code that is expected to run at run time, which includes things like functions and methods. Non-run time lambdas are other lambdas, like macros and top-level forms (as known as one-shot forms). More accurately, run time and non-run time refer to the counts which are returned by the `code-coverage-file-stats` accessor functions (for example `code-coverage-file-stats-lambdas-count`) when they are called with `:runtime` or `:non-runtime`. See `code-coverage-file-stats` for details.

The run time and the non-run time parts each contain 4 columns:

|         |                                                                                                                             |
|---------|-----------------------------------------------------------------------------------------------------------------------------|
| Total   | The total number of lambdas, as returned by <code>code-coverage-file-stats-lambdas-count</code> .                           |
| Full    | The number of lambdas that were fully covered, as returned by <code>code-coverage-file-stats-fully-covered</code> .         |
| Partial | The number of lambdas that were partially covered, as returned by <code>code-coverage-file-stats-partially-covered</code> . |

None            The number of lambdas that were not covered, as returned by `code-coverage-file-stats-not-called`.

In the run time columns, Partial and None cells which are non-zero are optionally marked with a colored background. This helps you to see which files contain run time forms that were not executed. The default color is DarkSalmon, and this can be set by `code-coverage-set-html-background-colors` with keyword argument *marked-cell*.

## Source files HTML coloring

The HTML file corresponding to a source file contains the full text of the source file (including comments), with parts optionally highlighted by background colors, and optional counters and some text added. At the time of writing, the default behavior is to highlight uncovered forms and add counters. The background colors can be changed by `code-coverage-set-html-background-colors`. The general issues associated with coloring are covered in “Understanding the code coverage output” on page 124.

Notes        If no file containing code coverage code was loaded, there is no internal data, so if `code-coverage-data` is not supplied then `code-coverage-data-generate-coloring-html` signals an error.

See also     `code-coverage-data`  
`code-coverage-set-html-background-colors`  
Chapter 10, “Code Coverage”  
“Understanding the code coverage output” on page 124

## `code-coverage-data-generate-statistics`

## *Function*

Summary     Generates statistics about code coverage.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Signature   | <code>code-coverage-data-generate-statistics &amp;key code-coverage-data sort =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Arguments   | <p><code>code-coverage-data</code><br/> A <code>code-coverage-data</code> object.</p> <p><code>sort</code><br/> A generalized boolean.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Values      | <p><code>result</code><br/> A vector of <code>code-coverage-file-stats</code> objects.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Description | <p>The function <code>code-coverage-data-generate-statistics</code> generates statistics about code coverage.</p> <p><code>code-coverage-data</code>, if supplied, must be a <code>code-coverage-data</code> object, otherwise the internal <code>code-coverage-data</code> object is used. For each file in the data, <code>code-coverage-data-generate-statistics</code> generates a <code>code-coverage-file-stats</code> object. It returns a vector of these <code>code-coverage-file-stats</code> objects.</p> <p>If the argument <code>sort</code> is non-nil (the default), the vector is sorted by the <code>cl:file-namestring</code> of the source file.</p> |
| Notes       | <ol style="list-style-type: none"> <li>1. The stats objects do not change after <code>code-coverage-data-generate-statistics</code> returns, even if the data that was used is the internal one.</li> <li>2. The statistics are only coverage, that is they treat the counters as binary zero/non-zero values. That includes negative counters (which may occur if the supplied data is a result of subtraction), which counted as "Covered".</li> <li>3. The stats objects can be accessed by the <code>code-coverage-file-stats</code> readers.</li> </ol>                                                                                                            |
| See also    | <code>code-coverage-data</code><br><code>code-coverage-file-stats</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

## `code-coverage-file-stats` *Type*

|                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary        | A structure containing code coverage statistics.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Package        | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Readers        | <code>code-coverage-file-stats-source-file</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Pseudo-readers | <code>code-coverage-file-stats-lambdas-count</code><br><code>code-coverage-file-stats-called</code><br><code>code-coverage-file-stats-fully-covered</code><br><code>code-coverage-file-stats-hidden-covered</code><br><code>code-coverage-file-stats-not-called</code><br><code>code-coverage-file-stats-partially-covered</code><br><code>code-coverage-file-stats-counters-count</code><br><code>code-coverage-file-stats-counters-executed</code><br><code>code-coverage-file-stats-counters-hidden</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Description    | Objects of type <code>code-coverage-file-stats</code> are created by <code>code-coverage-data-generate-statistics</code> , and are then accessed by the readers.<br><br><code>code-coverage-file-stats-source-file</code> returns the true-name of the source file. The pseudo-readers return integers counting "lambdas" in this file, where "lambda" here means a separate function object that was produced by the compiler. In most cases these correspond to pieces of code that you can see, like a function that results from <code>cl:defun</code> or <code>cl: defmethod</code> , or a lambda that appears in your code, but in some cases the compiler generates functions in a non-obvious way.<br><br>The pseudo-readers each have signature<br><br><code>pseudo-reader ccfs keyword =&gt; count</code><br><br>where <code>ccfs</code> is a <code>code-coverage-file-stats</code> object, and <code>keyword</code> specifies the kind of lambda. All lambdas belong to one of these four kinds:<br><br><code>:functions</code> Functions that are defined by <code>cl:defun</code> . |

|                        |                                                               |
|------------------------|---------------------------------------------------------------|
| <code>:macros</code>   | Macros and macro-like (for example <code>cl:defsetf</code> ). |
| <code>:one-shot</code> | Load time lambdas that the compiler generates.                |
| <code>:lambdas</code>  | Other lambdas (including <code>cl:defmethod</code> ).         |

In addition, the following three values of *keyword* can be used:

|                           |                                                     |
|---------------------------|-----------------------------------------------------|
| <code>:all</code>         | All lambdas.                                        |
| <code>:runtime</code>     | <code>:functions</code> and <code>:lambdas</code> . |
| <code>:non-runtime</code> | <code>:one-shot</code> and <code>:macros</code> .   |

Each pseudo-reader returns the number of lambdas or counters in the file of the kind specified by the *keyword*. These are:

|                                                         |                                                                                                                       |
|---------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| <code>code-coverage-file-stats-lambdas-count</code>     | All lambdas.                                                                                                          |
| <code>code-coverage-file-stats-called</code>            | Lambdas that have been called.                                                                                        |
| <code>code-coverage-file-stats-fully-covered</code>     | Lambdas which were fully covered, that is all of their counters are non-zero.                                         |
| <code>code-coverage-file-stats-hidden-covered</code>    | Lambdas where there are counters which are 0, but do not correspond to actual source code (result of macroexpansion). |
| <code>code-coverage-file-stats-not-called</code>        | Lambdas that were not called at all.                                                                                  |
| <code>code-coverage-file-stats-partially-covered</code> | Lambdas that were partially covered, but part of the source did not execute.                                          |
| <code>code-coverage-file-stats-counters-count</code>    |                                                                                                                       |

All counters.

**code-coverage-file-stats-counters-executed**

Counters that executed (that is, they are not zero).

**code-coverage-file-stats-counters-hidden**

Counters which have not been executed and are hidden, that is not in the source (in a result of macroexpansion).

Notes

1. The statistics are based on interpreting the counters as a binary switch of zero/non-zero. Negative counter values (which may occur if the code coverage data is a result of a subtraction operation such as `subtract-code-coverage-data`) are interpreted as "executed".
2. The run time/non-run time distinction is intended to correspond to code that would run in the actual application (run time) and code that is used only at compile-time or load-time.

Examples

```
code-coverage-file-stats-called code-coverage-file-stats
:runtime
=>
lambda-count
```

where *lambda-count* is the number of lambdas in the file which are "run time" and have been called.

See also

Chapter 10, "Code Coverage"

**code-coverage-data-generate-statistics**

## **code-coverage-set-editor-colors**

*Function*

Summary

Specifies the colors that the editor uses to color code coverage.

Package

**hcl**

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |                                 |                          |                                 |                  |                                 |                          |                                 |                      |                                 |                       |                                 |              |                                 |             |                                 |                   |                                 |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|---------------------------------|--------------------------|---------------------------------|------------------|---------------------------------|--------------------------|---------------------------------|----------------------|---------------------------------|-----------------------|---------------------------------|--------------|---------------------------------|-------------|---------------------------------|-------------------|---------------------------------|
| Signature                | <code>code-coverage-set-editor-colors &amp;key counters counters-negative uncovered partially-covered fully-covered hidden-partial error warn eliminated</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |                                 |                          |                                 |                  |                                 |                          |                                 |                      |                                 |                       |                                 |              |                                 |             |                                 |                   |                                 |
| Arguments                | <table border="0"> <tr> <td><i>counters</i></td><td>A CAPI color or an editor face.</td></tr> <tr> <td><i>counters-negative</i></td><td>A CAPI color or an editor face.</td></tr> <tr> <td><i>uncovered</i></td><td>A CAPI color or an editor face.</td></tr> <tr> <td><i>partially-covered</i></td><td>A CAPI color or an editor face.</td></tr> <tr> <td><i>fully-covered</i></td><td>A CAPI color or an editor face.</td></tr> <tr> <td><i>hidden-partial</i></td><td>A CAPI color or an editor face.</td></tr> <tr> <td><i>error</i></td><td>A CAPI color or an editor face.</td></tr> <tr> <td><i>warn</i></td><td>A CAPI color or an editor face.</td></tr> <tr> <td><i>eliminated</i></td><td>A CAPI color or an editor face.</td></tr> </table>                                                                                                                       | <i>counters</i> | A CAPI color or an editor face. | <i>counters-negative</i> | A CAPI color or an editor face. | <i>uncovered</i> | A CAPI color or an editor face. | <i>partially-covered</i> | A CAPI color or an editor face. | <i>fully-covered</i> | A CAPI color or an editor face. | <i>hidden-partial</i> | A CAPI color or an editor face. | <i>error</i> | A CAPI color or an editor face. | <i>warn</i> | A CAPI color or an editor face. | <i>eliminated</i> | A CAPI color or an editor face. |
| <i>counters</i>          | A CAPI color or an editor face.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |                                 |                          |                                 |                  |                                 |                          |                                 |                      |                                 |                       |                                 |              |                                 |             |                                 |                   |                                 |
| <i>counters-negative</i> | A CAPI color or an editor face.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |                                 |                          |                                 |                  |                                 |                          |                                 |                      |                                 |                       |                                 |              |                                 |             |                                 |                   |                                 |
| <i>uncovered</i>         | A CAPI color or an editor face.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |                                 |                          |                                 |                  |                                 |                          |                                 |                      |                                 |                       |                                 |              |                                 |             |                                 |                   |                                 |
| <i>partially-covered</i> | A CAPI color or an editor face.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |                                 |                          |                                 |                  |                                 |                          |                                 |                      |                                 |                       |                                 |              |                                 |             |                                 |                   |                                 |
| <i>fully-covered</i>     | A CAPI color or an editor face.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |                                 |                          |                                 |                  |                                 |                          |                                 |                      |                                 |                       |                                 |              |                                 |             |                                 |                   |                                 |
| <i>hidden-partial</i>    | A CAPI color or an editor face.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |                                 |                          |                                 |                  |                                 |                          |                                 |                      |                                 |                       |                                 |              |                                 |             |                                 |                   |                                 |
| <i>error</i>             | A CAPI color or an editor face.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |                                 |                          |                                 |                  |                                 |                          |                                 |                      |                                 |                       |                                 |              |                                 |             |                                 |                   |                                 |
| <i>warn</i>              | A CAPI color or an editor face.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |                                 |                          |                                 |                  |                                 |                          |                                 |                      |                                 |                       |                                 |              |                                 |             |                                 |                   |                                 |
| <i>eliminated</i>        | A CAPI color or an editor face.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |                                 |                          |                                 |                  |                                 |                          |                                 |                      |                                 |                       |                                 |              |                                 |             |                                 |                   |                                 |
| Description              | <p>The function <code>code-coverage-set-editor-colors</code> changes the colors or faces that the editor uses to color code coverage. Each argument is a CAPI color name, color alias or color specification, or an <code>editor:face</code> object (the result of <code>editor:make-face</code>). See "The Color System" in the <i>CAPI User Guide and Reference Manual</i> for details about CAPI colors.</p> <p>When an argument value is an <code>editor:face</code>, it specifies the face to use. Otherwise, it specifies the background color to use.</p> <p>The faces and colors are used to color parts of the code as in <code>code-coverage-set-html-background-colors</code>. Note that <code>code-coverage-set-editor-colors</code> does not accept a <code>:marked</code> keyword argument like <code>code-coverage-set-html-background-colors</code> does.</p> |                 |                                 |                          |                                 |                  |                                 |                          |                                 |                      |                                 |                       |                                 |              |                                 |             |                                 |                   |                                 |
| See also                 | <p><code>code-coverage-set-html-background-colors</code><br/>     "The Color System" in the <i>CAPI User Guide and Reference Manual</i></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                 |                                 |                          |                                 |                  |                                 |                          |                                 |                      |                                 |                       |                                 |              |                                 |             |                                 |                   |                                 |

|             |                                                                         | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------|-------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Sets the default code coverage data that the editor uses when coloring. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Package     | <code>hcl</code>                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Signature   |                                                                         | <code>code-coverage-set-editor-default-data <i>object</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Arguments   | <i>object</i>                                                           | A <code>code-coverage-data</code> object, a string, a pathname or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Description |                                                                         | <p>The function <code>code-coverage-set-editor-default-data</code> sets the default code coverage data that the editor uses when it colors a file.</p> <p>If <i>object</i> is a <code>code-coverage-data</code> object, this is used as-is.</p> <p>If <i>object</i> is a string or pathname then it should name a file that was created by <code>save-current-code-coverage</code> or <code>save-code-coverage-data</code>. The data is loaded from this file using <code>load-code-coverage-data</code> and used.</p> <p>If <i>object</i> is <code>nil</code> then <code>code-coverage-set-editor-default-data</code> uses the internal code coverage data. The default value of <i>object</i> is <code>nil</code>.</p> |
| Notes       |                                                                         | The editor commands <code>Code Coverage File</code> and <code>Code Coverage Current Buffer</code> use this data.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| See also    |                                                                         | <code>code-coverage-data</code><br><code>save-current-code-coverage</code><br><code>save-code-coverage-data</code><br><code>load-code-coverage-data</code><br><code>Code Coverage File</code> in the Editor User Guide<br><code>Code Coverage Current Buffer</code> in the Editor User Guide<br><code>Code Coverage Set Default Data</code> in the Editor User Guide                                                                                                                                                                                                                                                                                                                                                     |

**Code Coverage Load Default Data in the Editor User Guide**

|                                                 | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                        |
|-------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>code-coverage-set-html-background-colors</b> |                                                                                                                                                                                                                                                                                                                                                                                        |
| Summary                                         | Sets the background colors used in the HTML code coverage output.                                                                                                                                                                                                                                                                                                                      |
| Package                                         | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                       |
| Signature                                       | <code>code-coverage-set-html-background-colors &amp;key counters counters-negative uncovered partially-covered fully-covered hidden-partial error warn eliminated marked-cell</code>                                                                                                                                                                                                   |
| Arguments                                       | <code>counters</code> A string.<br><code>counters-negative</code> A string.<br><code>uncovered</code> A string.<br><code>partially-covered</code> A string.<br><code>fully-covered</code> A string.<br><code>hidden-partial</code> A string.<br><code>error</code> A string.<br><code>warn</code> A string.<br><code>eliminated</code> A string.<br><code>marked-cell</code> A string. |
| Description                                     | <p>The function <code>code-coverage-set-html-background-colors</code> sets the background colors that <code>code-coverage-data-generate-coloring-html</code> uses to color the output.</p> <p>Each of the keyword arguments, when supplied, must specify a color that is valid HTML. This can be either:</p>                                                                           |

- A hexadecimal value "#RRGGBB" where RR, GG and BB are hexadecimal numbers specifying the Red, Green and Blue values, or
- A name that web browsers recognize.

LispWorks does not actually check that the name is a known name.

Only those colors for which a keyword argument is supplied are affected.

See “Understanding the code coverage output” on page 124 for details of how the colors are used.

See also

`code-coverage-data-generate-coloring-html`

`code-coverage-set-editor-colors`

“Understanding the code coverage output” on page 124

## collect-generation-2

### *Function*

|             |                                                                                                                           |                                                                                                                                                             |
|-------------|---------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Controls whether generation 2 is garbage collected in 32-bit LispWorks.                                                   |                                                                                                                                                             |
| Package     | <code>hcl</code>                                                                                                          |                                                                                                                                                             |
| Signature   | <code>collect-generation-2 on =&gt; size</code>                                                                           |                                                                                                                                                             |
| Arguments   | <code>on</code>                                                                                                           | If <code>on</code> is <code>nil</code> , generation 2 is not garbage collected. If <code>on</code> is <code>t</code> , the generation is garbage collected. |
| Values      | <code>size</code>                                                                                                         | The current size of the image.                                                                                                                              |
| Description | Controls whether generation 2 is garbage collected. (Generation 2 normally holds long-lived objects created dynamically.) |                                                                                                                                                             |

|          |                                                                                                                                                                                                                                                                                                                      |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | <code>collect-generation-2</code> is implemented only in 32-bit LispWorks. It is not relevant to the Memory Management API in 64-bit implementations, where you can use <code>set-blocking-gen-num</code> instead.                                                                                                   |
| See also | <code>clean-generation-0</code><br><code>collect-highest-generation</code><br><code>expand-generation-1</code><br><code>set-blocking-gen-num</code><br><code>set-promotion-count</code><br>“Guidance for control of the memory management system” on page 130<br>“Memory Management in 32-bit LispWorks” on page 135 |

## **collect-highest-generation** *Function*

|             |                                                                                                                                                             |                                                                                                                                                                       |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Controls whether the top generation is garbage-collected in 32-bit LispWorks.                                                                               |                                                                                                                                                                       |
| Package     | <code>hcl</code>                                                                                                                                            |                                                                                                                                                                       |
| Signature   | <code>collect-highest-generation <i>flag</i></code>                                                                                                         |                                                                                                                                                                       |
| Arguments   | <code>flag</code>                                                                                                                                           | If <i>flag</i> is non-nil, the top generation is collected; if <i>flag</i> is any other value, the top generation is not collected. The default is <code>nil</code> . |
| Values      | <code>collect-highest-generation</code> returns no values.                                                                                                  |                                                                                                                                                                       |
| Description | The function <code>collect-highest-generation</code> controls whether the top generation is garbage-collected in 32-bit LispWorks.                          |                                                                                                                                                                       |
| Notes       | <code>collect-highest-generation</code> is implemented only in 32-bit LispWorks. It is not relevant to the Memory Management API in 64-bit implementations. |                                                                                                                                                                       |

See also `avoid-gc`  
`clean-generation-0`  
`collect-generation-2`  
`expand-generation-1`  
`normal-gc`  
“Memory Management in 32-bit LispWorks” on page 135

**\*compiler-break-on-error\*** *Variable*

Summary Controls whether `compile-file` handles compilation errors.

Package `hcl`

Initial value `nil`

Description If an error occurs during compilation of a form by `compile-file`, an error handler normally causes the compilation of that form to be skipped, and the error is reported later.  
When `*compiler-break-on-error*` is non-nil, an error during compilation by `compile-file` is signaled and the debugger is entered.

See also `compile-file`

**compile-file-if-needed** *Function*

Summary Compiles a Lisp source file if it is newer than the corresponding fasl file.

Package `hcl`

Signature `compile-file-if-needed input-pathname &key output-file load &allow-other-keys => output-truename, warnings-p, failure-p`

Arguments `input-pathname` A pathname designator.

|             |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <i>output-file</i>     | A pathname designator.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|             | <i>load</i>            | A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Values      | <i>output-truename</i> | A pathname or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|             | <i>warnings-p</i>      | A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|             | <i>failure-p</i>       | A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Description |                        | <p>The function <code>compile-file-if-needed</code> compares the <code>file-write-date</code> of the source file named by <i>input-pathname</i> with the <code>file-write-date</code> of the appropriate fasl file (as computed by <code>compile-file-pathname</code> from <i>input-pathname</i> and <i>output-file</i>).</p> <p>If the fasl file does not exist or is older than <i>input-pathname</i>, then <code>compile-file</code> is called with <i>input-pathname</i>, <i>output-file</i>, <i>load</i> and any other arguments passed., and the values returned are those returned from <code>compile-file</code>.</p> <p>Otherwise, if <i>load</i> is true <code>compile-file-if-needed</code> loads the fasl file and returns <code>nil</code>, and if <i>load</i> is <code>nil</code> it simply returns <code>nil</code>.</p> |

Example

```
CL-USER 19 > (compile-file-if-needed "H:/tmp/foo.lisp"
   :output-file
   "C:/temp/")
;;; Compiling file H:/tmp/foo.lisp ...
;;; Safety = 3, Speed = 1, Space = 1, Float = 1,
Interruptible = 0
;;; Compilation speed = 1, Debug = 2, Fixnum safety = 3
;;; Source level debugging is off
;;; Source file recording is on
;;; Cross referencing is off
; (TOP-LEVEL-FORM 1)
; (TOP-LEVEL-FORM 2)
; (TOP-LEVEL-FORM 3)
; FOO
; BAR
#P"C:/temp/foo.ofasl"
NIL
NIL

CL-USER 20 > (compile-file-if-needed "H:/tmp/foo.lisp"
   :output-file
   "C:/temp/"
   :load t)
; Loading fasl file C:\temp\foo.ofasl
NIL
```

See also

`compile-file`

`copy-code-coverage-data`

`copy-current-code-coverage`

`load-code-coverage-data`

`save-code-coverage-data`

`save-current-code-coverage`

*Functions*

Summary

Copy, save and load `code-coverage-data` objects.

Package

`hcl`

Signature

`copy-code-coverage-data ccd name => new-ccd`

`copy-current-code-coverage &optional name => new-ccd`

```

load-code-coverage-data pathname &key errorp => ccd
save-code-coverage-data pathname ccd => t
save-current-code-coverage pathname &optional name => t

```

|             |                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arguments   | <i>ccd</i>      | A <code>code-coverage-data</code> object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|             | <i>name</i>     | A Lisp object, normally a symbol or a string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|             | <i>pathname</i> | A pathname designator.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Values      | <i>new-ccd</i>  | A <code>code-coverage-data</code> object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Description |                 | <p>The function <code>copy-code-coverage-data</code> copies its <i>ccd</i> argument. The copy is deep, such that <i>ccd</i> and <i>new-ccd</i> do not share data, except read-only objects like pathnames. <i>name</i> is the name supplied to the new copy.</p> <p>The function <code>copy-current-code-coverage</code> copies the internal code coverage data. The default value of <i>name</i> is "Copy".</p> <p>The function <code>save-code-coverage-data</code> saves the code coverage data in <i>pathname</i>. The saving is done in the same binary form that the compiler and <code>dump-forms-to-file</code> use. The data can be loaded by <code>load-code-coverage-data</code>. <code>save-code-coverage-data</code> always saves to a file with type "ccd". If <i>pathname</i> does not have a type, <code>save-code-coverage-data</code> adds the type "ccd". If <i>pathname</i> has another type, <code>save-code-coverage-data</code> signals an error</p> <p>The function <code>save-current-code-coverage</code> saves the internal code coverage data. <i>name</i> is the name supplied to the saved data. The default value of <i>name</i> is (<i>pathname-name pathname</i>). Like <code>save-code-coverage-data</code>, <code>save-current-code-coverage</code> always saves to a file with type "ccd".</p> <p>The function <code>load-code-coverage-data</code> loads code coverage data from <i>pathname</i> and returns it. <i>pathname</i> must name a file that was created by <code>save-code-coverage-data</code> or <code>save-current-code-coverage</code> (with or without the "ccd" type).</p> |

*errorp* determines what to do when `load-code-coverage-data` fails to load. Value `nil` means return `nil`, otherwise it calls `error`. If *errorp* is true but not `t`, when `load-code-coverage-data` calls `error` it passes *errorp* as if it is the name of the function that fails. This can be used to give a better indication which function failed. The default value of *errorp* is `t`.

|          |                                                                                                                                                                                                                                                                                                                                      |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | A <code>code-coverage-data</code> object can be also written "by hand" into fasl files using <code>dump-form</code> or <code>dump-forms-to-file</code> . In this case you will need to arrange to recover it when the fasl is loaded. <code>load-code-coverage-data</code> uses <code>load-data-file</code> with a <i>callback</i> . |
| See also | <code>code-coverage-data</code><br>Chapter 10, "Code Coverage"                                                                                                                                                                                                                                                                       |

|             | <b>copy-to-weak-simple-vector</b> | <i>Function</i>                                                                                                                                                                                                           |
|-------------|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     |                                   | Creates a weak vector with the same contents as the supplied vector.                                                                                                                                                      |
| Package     |                                   | <code>hcl</code>                                                                                                                                                                                                          |
| Signature   |                                   | <code>copy-to-weak-simple-vector vector-t =&gt; weak-vector</code>                                                                                                                                                        |
| Arguments   | <code>vector-t</code>             | An array of type ( <code>vector t</code> ).                                                                                                                                                                               |
| Values      | <code>weak-vector</code>          | A weak array of type ( <code>vector t</code> ).                                                                                                                                                                           |
| Description |                                   | The function <code>copy-to-weak-simple-vector</code> creates and returns a weak vector with the same contents as the argument <code>vector-t</code> .<br><br>Apart from the checking of arguments, this is equivalent to: |

```
(replace (make-array (length vector-t)
                      :weak t)
        vector-t)
```

See **set-array-weak** for a description of weak vectors.

See also

**make-array**

**set-array-weak**

“Freeing of objects by the GC” on page 165

|                                        |                 |
|----------------------------------------|-----------------|
| <b>create-macos-application-bundle</b> | <i>Function</i> |
|----------------------------------------|-----------------|

|         |                                                                         |
|---------|-------------------------------------------------------------------------|
| Summary | Creates a Mac OS X application bundle for the running Lisp-Works image. |
|---------|-------------------------------------------------------------------------|

|         |            |
|---------|------------|
| Package | <b>hcl</b> |
|---------|------------|

|           |                                                                                                                                                                                                                                                             |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signature | <b>create-macos-application-bundle target-path &amp;key template-bundle bundle-name signature package-type extension application-icns identifier version build version-string help-book-folder help-book-name document-types executable-name =&gt; path</b> |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|           |                                           |
|-----------|-------------------------------------------|
| Arguments | <b>target-path</b> A pathname designator. |
|-----------|-------------------------------------------|

|  |                                               |
|--|-----------------------------------------------|
|  | <b>template-bundle</b> A pathname designator. |
|--|-----------------------------------------------|

|  |                              |
|--|------------------------------|
|  | <b>bundle-name</b> A string. |
|--|------------------------------|

|  |                            |
|--|----------------------------|
|  | <b>signature</b> A string. |
|--|----------------------------|

|  |                               |
|--|-------------------------------|
|  | <b>package-type</b> A string. |
|--|-------------------------------|

|  |                            |
|--|----------------------------|
|  | <b>extension</b> A string. |
|--|----------------------------|

|  |                                                |
|--|------------------------------------------------|
|  | <b>application-icns</b> A pathname designator. |
|--|------------------------------------------------|

|  |                             |
|--|-----------------------------|
|  | <b>identifier</b> A string. |
|--|-----------------------------|

|  |                          |
|--|--------------------------|
|  | <b>version</b> A string. |
|--|--------------------------|

|  |                        |
|--|------------------------|
|  | <b>build</b> A string. |
|--|------------------------|

|  |                                 |
|--|---------------------------------|
|  | <b>version-string</b> A string. |
|--|---------------------------------|

|  |                                   |
|--|-----------------------------------|
|  | <b>help-book-folder</b> A string. |
|--|-----------------------------------|

|  |                                 |
|--|---------------------------------|
|  | <b>help-book-name</b> A string. |
|--|---------------------------------|

|             |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <i>document-types</i>  | A list or <code>t</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|             | <i>executable-name</i> | <code>t</code> or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Values      | <i>path</i>            | A pathname.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Description |                        | <p>The function <code>create-macos-application-bundle</code> creates a Mac OS X application bundle for the running LispWorks image, and returns the pathname <i>path</i> in which an image is expected to be saved. If you are saving an image, it is convenient to use <code>save-image-with-bundle</code>.</p> <p><i>target-path</i> is where the new bundle is created.</p> <p>By default <code>create-macos-application-bundle</code> uses the application bundle of the current image as a template, and modifies it according to its arguments. If you do not supply any of the keyword arguments, the only modification is to the actual path.</p> <p><i>template-bundle</i> can be supplied to provide a path for an application bundle which will be used as a template. If <i>template-bundle</i> is not supplied, <code>create-macos-application-bundle</code> uses the path of the bundle of the current image. Except when specified, all the other parameters default to their values in the <i>template-bundle</i>.</p> <p><i>bundle-name</i> provides <code>CFBundleName</code>. The default value is the name of the last directory component in <i>target-path</i>.</p> <p><i>signature</i> is the signature in the <code>PkgInfo</code> file.</p> <p><i>package-type</i> is the package type, <code>CFBundlePackageType</code>. The default value of <i>package-type</i> is "APPL".</p> <p><i>extension</i> is the extension to add to the last component of <i>target-path</i>. The default value of extension is "app", as in "Lisp-Works.app".</p> <p><i>application-icns</i> provides <code>CFBundleIconFile</code>.</p> <p><i>package-type</i> is the package type, <code>CFBundlePackageType</code>. The default value of <i>package-type</i> is "APPL".</p> |

*extension* is the extension to add to the last component of *target-path*. The default value of *extension* is "app", as in "Lisp-Works.app".

*application-icns* provides CFBundleIconFile.

*identifier* provides CFBundleIdentifier. You must change this if you are creating a bundle for your own application.

*version* is the version value, CFBundleVersion. If *template-bundle* is nil, *version* defaults to the value returned by `c1:lisp-implementation-version`.

*version-string* provides CFBundleShortVersionString. If *version-string* is `nil` (the default), then *version* and *build* (if non nil) are used to make a default string.

*help-book-folder* provides CFBundleHelpBookFolder.

*help-book-name* provides CFBundleHelpBookName.

*document-types* provides the CFBundleDocumentTypes dict array. Each item of the list *document-types* should be a list of the form (*name extensions icns-file os-types role*) which provide the dict values as follows: the string *name* provides CFBundleTypeName; the list of strings *extensions* provides the contents of the array CFBundleTypeExtensions; the pathname designator *icns-file* provides the string CFBundleTypeIconFile; the list of strings *os-types* provides the contents of the array CFBundleTypeOSTypes and the string *role* provides CFBundleTypeRole. *role* can be omitted and defaults to "Editor". *os-types* can be omitted and defaults to ("\*\*\*\*"). The default value of *document-types* is `t`, which means copy them from the application bundle *template-bundle*.

*executable-name* is the filename of the LispWorks image executable, not including the directory. The default value of *executable-name* is the pathname name of the last component of *target-path*.

#### Notes

`create-macos-application-bundle` is implemented only in LispWorks for Macintosh.

See also `save-image-with-bundle`

## **create-temp-file**

## **open-temp-file**

## *Functions*

Summary      Creates a "temp file" and returns a pathname or a stream to it.

Package      `hcl`

Signature      `create-temp-file &key file-type directory prefix => pathname`

Signature      `open-temp-file &key file-type element-type directory prefix  
delete-when-close external-format => stream`

Arguments      `file-type`      A string or `nil`.

`element-type`      A type specifier.

`directory`      A pathname designator.

`prefix`      A string or `nil`.

`delete-when-close`      A generalized boolean.

`external-format`      An external file format designator.

Values      `pathname`      A pathname.

`stream`      An I/O stream.

Description      The function `open-temp-file` opens a "temp file". This is a new file in the "temp directory" which is guaranteed to be new. Its name contains a random element. The permissions of the file are read-write for the user only.

`file-type` is the file type of the name. The default value of `file-type` is "tmp".

`directory`, if supplied, is the directory to create the file in. It defaults to the default temp directory, which is what `get-`

`temp-directory` returns, which defaults to what the Operating System uses as the temp directory.

`prefix` is used as the first part of the file name. The default prefix is "`lwtemp_machinename_pid`". More characters are appended to make the name unique and random.

If `delete-when-close` is non-nil, when the stream `stream` that is returned is closed, the system tries to delete the file quietly. That is, it tries to avoid giving an error if it fails.

`element-type` and `external-format` are interpreted the same way as in `open`.

The stream that is returned is an I/O stream.

The function `create-temp-file` creates a new temp file and returns the `pathname` for it. `create-temp-file` behaves exactly like `open-temp-file`, as described above, except that it returns a pathname rather than a stream to the new file.

Notes

1. `pathname` can be called to find the pathname that was used in `open-temp-file`. The file can be guaranteed to be new only if the temp directory is configured correctly.
2. The default "temp directory" can be found by using `get-temp-directory`.
3. When `delete-when-close` is non-nil, it tries to delete the file when the stream is closed, but that does not necessarily succeed. On Microsoft Windows it certainly fails when the file is still opened (for example, by another stream in the same process or another process)

See also

`get-temp-directory`  
`open`  
`set-temp-directory`

|                    |                               | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                         |
|--------------------|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary            | Deprecated. Signals an error. |                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Package            | <code>hcl</code>              |                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Signature          |                               | <code>create-universal-binary <i>target-image</i> <i>src-image1</i> <i>src-image2</i> =&gt; <i>target-image</i></code>                                                                                                                                                                                                                                                                                                  |
| Arguments          | <i>target-image</i>           | A pathname designator.                                                                                                                                                                                                                                                                                                                                                                                                  |
|                    | <i>src-image1</i>             | A pathname designator.                                                                                                                                                                                                                                                                                                                                                                                                  |
|                    | <i>src-image2</i>             | A pathname designator.                                                                                                                                                                                                                                                                                                                                                                                                  |
| Values             | <i>target-image</i>           | A pathname designator.                                                                                                                                                                                                                                                                                                                                                                                                  |
| Description        |                               | The function <code>create-universal-binary</code> is deprecated and signals an error.                                                                                                                                                                                                                                                                                                                                   |
| Compatibility note |                               | In LispWorks 6.1 for Macintosh and earlier versions, <code>create-universal-binary</code> creates a universal binary from two mono-architecture LispWorks images. It must be called only in a LispWorks for Macintosh image that is itself a universal binary.<br><br>In LispWorks 7.0 and later versions, universal binaries are not supported and hence <code>create-universal-binary</code> simply signals an error. |
| See also           |                               | <code>save-image</code><br><code>save-universal-from-script</code>                                                                                                                                                                                                                                                                                                                                                      |

|         |  | <i>Function</i>                                                  |
|---------|--|------------------------------------------------------------------|
| Summary |  | Return the name of the currently executing function as a string. |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                                               |
| Signature   | <code>current-function-name =&gt; name</code>                                                                                                                                                                                                                                                                                                                                                                  |
| Arguments   | None                                                                                                                                                                                                                                                                                                                                                                                                           |
| Values      | <code>name</code> A string or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                               |
| Description | <p>The function <code>current-function-name</code> returns the name of the currently executing function as a string.</p> <p><code>name</code> is a string representing the name of the function from which <code>current-function-name</code> is called. The result is generated by <code>print-to-string</code> with the variable <code>*package*</code> bound to the <code>KEYWORD</code> package.</p>       |
| Notes       | <p><code>current-function-name</code> is for use in debugging, for example to give more context in a run time error message that is produced by a macroexpansion.</p> <p>The result when <code>current-function-name</code> is called outside a function (in a Listener or at the top level of a file) is not well defined. It is either <code>nil</code> or a name of some internally generated function.</p> |

| <b>current-stack-length</b> |                                                    | <i>Function</i> |
|-----------------------------|----------------------------------------------------|-----------------|
| Summary                     | Returns the size of the current stack.             |                 |
| Package                     | <code>hcl</code>                                   |                 |
| Signature                   | <code>current-stack-length =&gt; stack-size</code> |                 |
| Arguments                   | None                                               |                 |

|                     |                         |                                                                                                                                                                |
|---------------------|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Values              | <code>stack-size</code> | The current size of the stack, in 32 bit words (in 32-bit implementations) or 64-bit words (in 64-bit implementations).                                        |
| Compatibility notes |                         | In LispWorks 4.4 and previous on Windows and Linux platforms, <code>current-stack-length</code> was not implemented. This is fixed in LispWorks 5.0 and later. |
| Example             |                         | <code>(current-stack-length) =&gt; 16000</code>                                                                                                                |
| See also            |                         | <code>extend-current-stack</code><br><code>*sg-default-size*</code>                                                                                            |

|             |                           | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     |                           | Return a string representing the date and time.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Package     |                           | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Signature   |                           | <code>date-string &amp;optional seconds expand-month =&gt; string</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Arguments   | <code>seconds</code>      | <code>nil</code> (default) or an integer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|             | <code>expand-month</code> | A generalized boolean, default false.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Values      | <code>string</code>       | A string                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Description |                           | <p>The function <code>date-string</code> returns a string representing the date and time (including seconds).</p> <p>If <code>seconds</code> is <code>nil</code> (the default), <code>string</code> represents the current time. Otherwise, <code>seconds</code> is interpreted as a universal time and <code>string</code> represents that time.</p> <p>If <code>expand-month</code> is true then the date is written as DD MMM YYYY, with the month in characters. Otherwise, the date is written as YYYY/MM/DD, with the month in digits.</p> |

The time follows the date, separated by a space, and is always written as HH:MM:SS.

`date-string` is intended as a quick way of marking some text as related to some time. For example, the function `log-bug-form` starts by doing something like:

```
(format stream "==== Log at ~a ===~2%" (date-string))
```

| <b>declaration-information</b>                           | <i>Function</i>                                                                                                                                                                                                                                                                                                |                  |                    |            |                                    |
|----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--------------------|------------|------------------------------------|
| Summary                                                  | Return information about the function bindings of a symbol in an environment.                                                                                                                                                                                                                                  |                  |                    |            |                                    |
| Package                                                  | <code>hcl</code>                                                                                                                                                                                                                                                                                               |                  |                    |            |                                    |
| Signature                                                | <code>declaration-information decl-name &amp;optional env =&gt; info</code>                                                                                                                                                                                                                                    |                  |                    |            |                                    |
| Arguments                                                | <table border="0"> <tr> <td style="padding-right: 20px;"><i>decl-name</i></td><td>A declaration name</td></tr> <tr> <td style="padding-right: 20px;"><i>env</i></td><td>An environment or <code>nil</code></td></tr> </table>                                                                                  | <i>decl-name</i> | A declaration name | <i>env</i> | An environment or <code>nil</code> |
| <i>decl-name</i>                                         | A declaration name                                                                                                                                                                                                                                                                                             |                  |                    |            |                                    |
| <i>env</i>                                               | An environment or <code>nil</code>                                                                                                                                                                                                                                                                             |                  |                    |            |                                    |
| Values                                                   | <i>info</i> Information about <i>decl-name</i>                                                                                                                                                                                                                                                                 |                  |                    |            |                                    |
| Description                                              | The function <code>declaration-information</code> returns information about the declarations for <i>decl-name</i> in the environment <i>env</i> .                                                                                                                                                              |                  |                    |            |                                    |
| The following values for <i>decl-name</i> are supported: |                                                                                                                                                                                                                                                                                                                |                  |                    |            |                                    |
| <code>optimize</code>                                    | The value of <i>info</i> is a list of lists of the form ( <i>quality value</i> ), where <i>quality</i> is one of the optimization qualities specified by the Common Lisp standard and LispWorks extensions ( <code>float</code> , for example). Each <i>value</i> is the corresponding value for that quality. |                  |                    |            |                                    |
| <code>declaration</code>                                 |                                                                                                                                                                                                                                                                                                                |                  |                    |            |                                    |

The value of *info* is a list of symbols that have been declared as declaration names, for example by use of  
`(declare (declaration ...))`

There are currently no other supported values for *decl-name*.

|          |                                                                                                                                                                               |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | <code>declaration-information</code> is part of the environment access API which is based on that specified in <i>Common Lisp: the Language (2nd Edition)</i> .               |
| See also | <code>augment-environment</code><br><code>define-declaration</code><br><code>function-information</code><br><code>map-environment</code><br><code>variable-information</code> |

## **\*default-package-use-list\*** *Variable*

|               |                                                                                                                                                                                   |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary       | List of packages that newly created packages use by default.                                                                                                                      |
| Package       | <code>hcl</code>                                                                                                                                                                  |
| Initial value | <code>("CL" "LW" "HCL")</code>                                                                                                                                                    |
| Description   | This variable is the default value of the <code>:use</code> keyword to <code>defpackage</code> , which specifies which existing packages the package being defined inherits from. |

## **\*default-profiler-collapse\*** *Variable*

|         |                                          |
|---------|------------------------------------------|
| Summary | Controls collapsing of the profile tree. |
| Package | <code>hcl</code>                         |

|               |                                                                                                                                                                                                        |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Initial value | <code>nil</code>                                                                                                                                                                                       |
| Description   | The variable <code>*default-profiler-collapse*</code> is a boolean indicating whether the profile tree should collapse functions with only one child function. The default value is <code>nil</code> . |
| See also      | <code>print-profile-list</code><br><code>set-up-profiler</code>                                                                                                                                        |

### **\*default-profiler-cutoff\*** *Variable*

|               |                                                                                                                                                                                                                                                        |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary       | The minimum percentage that the profiler will display in the output tree.                                                                                                                                                                              |
| Package       | <code>hcl</code>                                                                                                                                                                                                                                       |
| Initial value | <code>0</code>                                                                                                                                                                                                                                         |
| Description   | The variable <code>*default-profiler-cutoff*</code> is the minimum percentage (0 to 100) that the profiler will display in its output tree. Functions below this percentage will not be displayed. The initial value is 0, meaning display everything. |
| See also      | <code>print-profile-list</code><br><code>set-up-profiler</code>                                                                                                                                                                                        |

### **\*default-profiler-limit\*** *Variable*

|               |                                                                          |
|---------------|--------------------------------------------------------------------------|
| Summary       | The maximum number of lines of output that are printed during profiling. |
| Package       | <code>hcl</code>                                                         |
| Initial value | <code>100,000,000</code>                                                 |

|             |                                                                                                                                                                                                                                                                                                                                      |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>*<code>default-profiler-limit</code>*</p> is the maximum number of lines of output in profile results. The default value is large to ensure that you receive all possible output requested.                                                                                                                                       |
|             | <p>*<code>default-profiler-limit</code>*</p> only counts output lines for functions that are actually called during profiling. Therefore, if * <code>default-profiler-limit</code> * is 19, and 20 functions were profiled, you would receive full output if one or more of the functions were not actually called during profiling. |
| See also    | <code>print-profile-list</code><br><code>set-up-profiler</code>                                                                                                                                                                                                                                                                      |

## **\*default-profiler-sort\*** *Variable*

|               |                                                                                                                                                                                                                                |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary       | The default sorting style for the profiler.                                                                                                                                                                                    |
| Package       | <code>hcl</code>                                                                                                                                                                                                               |
| Initial value | <code>:profile</code>                                                                                                                                                                                                          |
| Description   | The variable * <code>default-profiler-limit</code> * controls which column of the profiler's columnar report is used for sorting.<br>The value can be one of <code>:profile</code> , <code>:call</code> or <code>:top</code> . |
| See also      | <code>print-profile-list</code><br><code>set-up-profiler</code>                                                                                                                                                                |

## **defglobal-parameter** *Function*

|           |                                                                                  |
|-----------|----------------------------------------------------------------------------------|
| Summary   | Defines a <code>hcl:special-global</code> parameter.                             |
| Package   | <code>hcl</code>                                                                 |
| Signature | <code>defglobal-parameter name initial-value &amp;optional doc =&gt; name</code> |

|             |                                                                                                                                                                                    |                |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| Arguments   | <i>name</i>                                                                                                                                                                        | A symbol.      |
|             | <i>initial-value</i>                                                                                                                                                               | A Lisp object. |
|             | <i>doc</i>                                                                                                                                                                         | A string.      |
| Values      | <i>name</i>                                                                                                                                                                        | A symbol.      |
| Description | The macro <code>defglobal-parameter</code> has the same semantics as <code>cl:defparameter</code> , but also declares the name <i>name</i> to be <code>hcl:special-global</code> . |                |
| See also    | <code>defglobal-variable</code>                                                                                                                                                    |                |

| <b>defglobal-variable</b> |                                                                                                                                                                             | <i>Function</i> |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Summary                   | Defines a <code>hcl:special-global</code> variable.                                                                                                                         |                 |
| Package                   | <code>hcl</code>                                                                                                                                                            |                 |
| Signature                 | <code>defglobal-variable name &amp;optional initial-value doc =&gt; name</code>                                                                                             |                 |
| Arguments                 | <i>name</i>                                                                                                                                                                 | A symbol.       |
|                           | <i>initial-value</i>                                                                                                                                                        | A Lisp object.  |
|                           | <i>doc</i>                                                                                                                                                                  | A string.       |
| Values                    | <i>name</i>                                                                                                                                                                 | A symbol.       |
| Description               | The macro <code>defglobal-variable</code> has the same semantics as <code>cl:defvar</code> , but also declares the name <i>name</i> to be <code>hcl:special-global</code> . |                 |
| See also                  | <code>defglobal-parameter</code>                                                                                                                                            |                 |

## define-declaration Macro

|             |                                                                                                                                                                                                                                                                                                                                                 |                        |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Summary     | Define a user declaration handler for code walkers.                                                                                                                                                                                                                                                                                             |                        |
| Package     | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                |                        |
| Signature   | <code>define-declaration decl-name lambda-list &amp;rest body =&gt; decl-name</code>                                                                                                                                                                                                                                                            |                        |
| Arguments   | <code>decl-name</code>                                                                                                                                                                                                                                                                                                                          | A symbol.              |
|             | <code>lambda-list</code>                                                                                                                                                                                                                                                                                                                        | A list of two symbols. |
|             | <code>body</code>                                                                                                                                                                                                                                                                                                                               | One or more forms.     |
| Values      | <code>decl-name</code>                                                                                                                                                                                                                                                                                                                          | A symbol.              |
| Description | The macro <code>define-declaration</code> defines a handler for <code>decl-name</code> , which tells the compiler and <code>augment-environment</code> how to deal with this declaration. The handler is a function with lambda list <code>lambda-list</code> , and body <code>body</code> , that is the same function as would be produced by: |                        |

```
#'(lambda lambda-list . body)
```

When the compiler and `augment-environment` processes a declaration with `decl-name` as the first element, the handler is called with two arguments:

- The declaration itself.
- The environment, which is the compilation environment in the compiler and the new environment in `augment-environment`.

The handler must return two values. The first value specifies what kind of declaration it is, and must be one of:

`:variable`      The declaration applies to variable bindings, and hence affects the result of `variable-information`.

|                        |                                                                                                                   |
|------------------------|-------------------------------------------------------------------------------------------------------------------|
| <code>:function</code> | The declaration applies to function bindings, and hence affects the result of <code>function-information</code> . |
| <code>:declare</code>  | The declaration does not apply to bindings, and affects the result of <code>declaration-information</code> .      |

If the first value is `:variable` or `:function` then the second value must be a list, the elements of which are lists of the form (*binding-name key value*). If the corresponding information function (either `variable-information` or `function-information`) is called with *binding-name* and the environment, then the a-list returned by the information function as its third value will have *value* associated with *key*.

If the first value is `:declare`, then the second value must be a cons of the form (*key . value*). The function `declaration-information` will return *value* when called with *key* and the environment.

`define-declaration` causes *decl-name* to be proclaimed as a declaration, as if by:

```
(proclaim '(declaration decl-name))
```

*decl-name* must not be a standard declaration identifier; `define-declaration` signals an error if it is.

The consequences are undefined if a *key* returned by a declaration handler defined with `define-declaration` is a symbol that is used by the corresponding information function to return information about any standard declaration specifier. For example, if the first return value from the handler is `:variable`, then the second return value should not use the symbols `dynamic-extent`, `ignore`, or `type` as *key*, because they are reserved by `variable-information` to return information about the corresponding standard declaration.

#### Notes

Using a declaration defined by `define-declaration` affects only the return values of `variable-information`, `func-`

`tion-information` OR `declaration-information` as described above. It does not affect the behavior of the compiler. `define-declaration` is intended for use by code walkers that require extra information in the environment.

The evaluator ignores declarations defined by `define-declaration`.

`define-declaration` does not have any compile-time effect so must have been evaluated before a declaration for `decl-name` is processed.

`augment-environment` processes declarations last, so the environment that is passed to the handler already contains any other information that was passed to `augment-environment`.

The implementation of `define-declaration` is based on the specification in Common Lisp the Language, 2nd Edition as on CMU website on 10 Feb 2016:  
<http://www.cs.cmu.edu/Groups/AI/html/cltl/clm/node102.html>.

#### See also

`declare`  
`declaration-information`  
`function-information`  
`variable-information`  
`augment-environment`  
`undefine-declaration`

## delete-advice

*Macro*

Summary      Removes a piece of advice.

Package      `hcl`

Signature      `delete-advice function-dspec name => nil`

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                    |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arguments   | <i>function-dspec</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | A function-dspec Specifies the function definition to which the piece of advice belongs. See “Function dspecs” on page 84 for description of function-dspec.                                       |
|             | <i>name</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | A symbol naming the piece of advice to be removed. Since several pieces of advice may be attached to a single functional definition, the name is necessary to indicate which one is to be removed. |
| Values      | <code>delete-advice</code> returns <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                    |
| Description | <p><code>delete-advice</code> is used to remove a piece of advice. Advice is a way of altering the behavior of functions. Pieces of advice are associated with a function using <code>defadvice</code>. They define additional actions to be performed when the function is invoked, or alternative code to be performed instead of the function, which may or may not access the original definition. As well as being attached to ordinary functions, advice may be attached to methods and to macros (in this case it is in fact associated with the macro’s expansion function).</p> <p><code>remove-advice</code> is a function, identical in effect to <code>delete-advice</code>, except that you need to quote the arguments.</p> |                                                                                                                                                                                                    |
| Notes       | <code>delete-advice</code> is an extension to Common Lisp.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                    |
| See also    | <code>defadvice</code><br><code>remove-advice</code><br>Chapter 6, “The Advice Facility”                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                    |

**delivered-image-p***Function*

|         |                                                                   |
|---------|-------------------------------------------------------------------|
| Summary | The predicate for whether the running image is a delivered image. |
|---------|-------------------------------------------------------------------|

|             |                                                                                                                                                                                                                                                                                                                                                                        |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                       |
| Signature   | <code>delivered-image-p =&gt; result</code>                                                                                                                                                                                                                                                                                                                            |
| Values      | <i>result</i> A boolean.                                                                                                                                                                                                                                                                                                                                               |
| Description | <p>The function <code>delivered-image-p</code> returns true if the running image is a delivered image, that is an executable or dynamic library created by <code>deliver</code>.</p> <p>Otherwise the running image is a LispWorks development image (potentially a Saved Session or saved explicitly by <code>save-image</code>) and then <i>result</i> is false.</p> |
| See also    | <code>deliver</code>                                                                                                                                                                                                                                                                                                                                                   |

## **deliver-to-android-project** *Function*

|           |                                                                                                                                               |                                                                                        |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| Summary   | Deliver LispWorks for Android. Implemented only in LispWorks for Android Runtime.                                                             |                                                                                        |
| Package   | <code>hcl</code>                                                                                                                              |                                                                                        |
| Signature | <code>deliver-to-android-project function project-path level &amp;key library-name using-ndk no-sub-dir studio-p &amp;allow-other-keys</code> |                                                                                        |
| Arguments | <i>function</i>                                                                                                                               | A symbol.                                                                              |
|           | <i>project-path</i>                                                                                                                           | A pathname designator.                                                                 |
|           | <i>level</i>                                                                                                                                  | An integer in the inclusive range [0, 5].                                              |
|           | <i>library-name</i>                                                                                                                           | A string.                                                                              |
|           | <i>using-ndk</i>                                                                                                                              | A boolean.                                                                             |
|           | <i>no-sub-dir</i>                                                                                                                             | A pathname or a string specifying a directory, or <code>t</code> or <code>nil</code> . |
|           | <i>studio-p</i>                                                                                                                               | A boolean.                                                                             |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The function <code>deliver-to-android-project</code> delivers a LispWorks runtime for the Android platform.</p> <p><code>deliver-to-android-project</code> creates two files, a Lisp heap and a dynamic library, that needs to be part of an Android project to be used on Android. It does some Android-specific processing, and then calls <code>deliver</code>.</p> <p>If <i>function</i> is non-nil it is the restart function which is called after the LispWorks runtime finishes initializing. It is called on another process (by <code>funcall-async</code>), and its return value is not used. By the time the function <i>function</i> is called, LispWorks is ready to receive calls from Java, and a call from <i>function</i> to Java may be used to inform Java that LispWorks is ready instead of the <i>reporter</i> argument to <code>com.lispworks.Manager.init</code> (or in parallel to it). The function <i>function</i> should return in short time, If you want it to linger, use <code>process-run-function</code> to start another with a function that lingers, and return from <i>function</i>.</p> <p><i>project-path</i> is the path of the Android project, except when <i>no-sub-dir</i> is supplied, when it defines a directory to put the files. When delivering into an Android Studio project, <i>project-path</i> can be either the root of the project or the "main" directory (the location of the file <code>AndroidManifest.xml</code>).</p> <p><i>level</i> is the delivery level. It is passed to <code>deliver</code>. See the documentation for <code>deliver</code> for details.</p> <p><i>library-name</i> when supplied must be a string, and defines the base name of the files. The call to <code>com.lispworks.Manager.init</code> which initializes LispWorks must match <i>library-name</i>. The default value of <i>library-name</i> is "LispWorks".</p> <p><b>Note:</b> Actually the call <code>com.lispworks.Manager.init</code> uses the name to find the files, so if you rename the files <code>com.lispworks.Manager.init</code> must match the names of the files, rather than <i>library-name</i>.</p> |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

*using-ndk* needs to be true if the Android project is built using Eclipse and uses NDK to build C code. The default value of *using-ndk* is `nil`.

*no-sub-dir*, when non-`nil`, tells `deliver-to-android-project` that the *project-path* argument is the directory where the files need to go, rather than a project path. In this case `deliver-to-android-project` does not look for sub-directories. If *no-sub-dir* is a pathname or string, it specifies a directory where the heap should go. If this directory is relative, it is relative to the *project-path* directory. If *no-sub-dir* is `t`, it specifies that the heap should go at top level in *project-path*. When *no-sub-dir* is passed, it is your responsibility to ensure that the files end up in the right place in the Android project. *no-sub-dir* is useful when the delivery cannot be done directly into the Android Project, for example when it is on a different machine or there are permissions issues. It may also be useful if you have a project with a directory structure that does not match the structure that `deliver-to-android-project` expects. The default value of *no-sub-dir* is `nil`.

*studio-p* tells `deliver-to-android-project` whether the target Android project is built with Android Studio or not, which is used to decide where the files go. When *studio-p* is not passed, `deliver-to-android-project` tries to determine whether it is Android Studio as described below.

`deliver-to-android-project` first decides the names of the files to generate and where they should go.

The two files that `deliver-to-android-project` generates are named `lib<library-name>.so.lwheap` for the heap file, and `lib<library-name>.so` for the dynamic library, so by default the names are `libLispWorks.so.lwheap` and `libLispWorks.so`.

The directory or directories where the files go are determined as follows:

1. When *no-sub-dir* is `nil` (the default), it first checks whether the *project-path* contains a file named `AndroidManifest.xml`.
  - a) If the file `AndroidManifest.xml` exists, then this is the "main" path. If *studio-p* was not supplied, it sets *studio-p* to `t` if there is a directory called "java" in the "main" directory, otherwise it sets *studio-p* to `nil`.
  - b) If there is no `AndroidManifest.xml` file, it checks whether inside the *project-path* there is a sub-sub-sub-directory `app/src/main`, and whether `AndroidManifest.xml` exists in it. If so, it takes the sub-sub-sub-directory as the "Main" directory, and sets *studio-p* to `t` (ignoring any supplied value).

Once it decided where the "Main" directory is, it puts the heap in its "assets" sub-directory, and the dynamic library in its "jni libs" sub-directory. The "jni libs" directory is:

- (i) If *studio-p* is `t` it is "`jniLibs/armeabi-v7a`".
  - (ii) Otherwise if *using-ndk* is `nil` it is "`libs/armeabi-v7a`".
  - (iii) Otherwise it is "`jni`".
2. If *no-sub-dir* is non-nil, then the dynamic library is put in the *project-path* directory. If *no-sub-dir* is `t`, the heap is put in the same place. Otherwise, the directory specified by *no-sub-dir* is merged with the *project-path* to create the path where the heap goes.

Note: If *no-sub-dir* is a pathname or string it must specify a directory, which can be an absolute path.

After `deliver-to-android-project` determines the names of the files and where they go, it calls `deliver`, passing *function*, the appropriate path, *level*, the Delivery keywords `:split`, `:exe-file`, `:dll-exports` and `:image-type` with the correct values for Android, and all the keyword arguments it was supplied except *library-name*, *using-ndk*, *studio-p* and *no-sub-dir*. The keywords that `deliver-to-android-`

`project` passes explicitly should not be used, but the rest of the Deliver keywords can be used and are interpreted in the standard way (see the *LispWorks Delivery User Guide* for details). However, since CAPI is not available on Android, all keywords related to CAPI are not useful.

## Notes

1. With Android Studio you do not need `using-ndk`. You need it when you use `ndk-build` to build dynamic libraries in your project. In Eclipse that is normally done by the CDT builder. You need `using-ndk` because the `ndk-build` removes all dynamic libraries from the `libs` sub-directory and its sub-directories, including the LispWorks dynamic library. The solution for this is to pass a true value for `using-ndk` to `deliver-to-android-project`, and add to the `Android.mk` file in the `jni` sub-directory the lines that are required to copy the LispWorks dynamic library to `libs/armeabi-v7a`. Assuming you do not pass `library-name`, these lines in `Android.mk` should be:

```
LOCAL_SRC_FILES := libLispWorks.so  
LOCAL_MODULE      := LispWorks  
include $(PREBUILT_SHARED_LIBRARY)
```

If you pass `library-name`, you need to change the lines above to match your change. There can be other solutions, for example you can deliver elsewhere, and add a build step that copies the LispWorks files into the project after the CDT builder (on Eclipse). If the build in Eclipse is changed not to delete files from the `libs` directory, then `using-ndk` is not needed.

2. Like `deliver`, `deliver-to-android-project` cannot be called with multiprocessing running, and is best called inside a script that is passed to LispWorks by the command line argument `-build`.

3. `deliver-to-android-project` is available only in the Android delivery image `lispworks-7-1-0-arm-linux-android`. This image is an ARM image, and must be run on ARM architecture. That can be either an ARM machine, or an ARM emulator.

To deliver a LispWorks for Android Runtime image with a delivery script that calls `deliver-to-android-project` using the QEMU emulator, use the shell script `examples/android/run-lw-android.sh`, which passes its arguments to `lispworks-7-1-0-arm-linux-android`:

```
run-lw-android.sh -build /path/to/delivery-script.lisp
```

4. The algorithm for finding the directories will work for Eclipse and for Android Studio with the default settings. Android Studio is very flexible and still in flux, so may change. It seems unlikely that the names of the sub-directories (`assets`, `jnilibs` and `java`) will change, but the main directory may move around. Supplying the actual main directory rather than the root should still work. If this does not work, you can supply `no-sub-dir` to either put the files in the right directories, or just put it in some directory and copy it to the right place.

See also

Chapter 16, “Android interface”  
*LispWorks Delivery User Guide*

### **\*disable-trace\***

### **Variable**

Summary      Controls tracing.

Package      `hcl`

Initial value      `nil`

|             |                                                                                                                                                                                                                                                                                                             |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <code>*disable-trace*</code> controls tracing without affecting the tracing state. If it is set to <code>t</code> then tracing is switched off, but this does not call <code>untrace</code> . When the value of <code>*disable-trace*</code> is restored to <code>nil</code> , tracing continues as before. |
| Notes       | <code>*disable-trace*</code> is an extension to Common Lisp.                                                                                                                                                                                                                                                |
| See also    | <code>trace</code>                                                                                                                                                                                                                                                                                          |

|                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <i>Function</i> |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>do-profiling</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <i>Function</i> |
| Summary             | A convenience function for profiling multiple threads, combining <code>start-profiling</code> and <code>stop-profiling</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                 |
| Package             | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                 |
| Signature           | <code>do-profiling &amp;key initialize processes profile-waiting ignore-in-foreign sleep function arguments func-and-args print stream</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |
| Arguments           | <p><i>initialize</i>      A boolean.</p> <p><i>processes</i>     One of <code>:current</code>, <code>:all</code>, a <code>mp:process</code> or a list of <code>mp:process</code> objects.</p> <p><i>profile-waiting</i>    A boolean.</p> <p><i>ignore-in-foreign</i>   A boolean.</p> <p><i>sleep</i>            A non-negative number, or <code>nil</code>.</p> <p><i>function</i>        A function designator.</p> <p><i>arguments</i>      Arguments passed to <i>function</i>.</p> <p><i>func-and-args</i>    A function designator or a list (<i>function-designator</i> . <i>args</i>).</p> <p><i>print</i>            A generalized boolean.</p> <p><i>stream</i>          An output stream.</p> |                 |

Description      The function **do-profiling** is a convenience function for profiling multiple threads, combining **start-profiling** and **stop-profiling**.

The behavior of **do-profiling** with no arguments is the same as:

```
(progn
  (start-profiling :processes :all)
  (sleep 6)
  (stop-profiling))
```

The arguments *initialize*, *processes*, *profile-waiting* and *ignore-in-foreign* are passed to **start-profiling**. They have the same default values as for **start-profiling**, except *processes* which defaults to **:all**.

The arguments *print* and *stream* are passed to **stop-profiling**. They have the same default values as in **stop-profiling**.

*sleep* is the time to sleep in seconds. If *sleep* is **nil** or 0 **do-profiling** does not sleep. Also, if *sleep* is supplied and either *function* or *func-and-args* are passed, it does not sleep.

*func-and-args*, and *function* together with *arguments*, can both be used for calling a function you supply. *func-and-args* is either a list of the form **(function-designator . args)**, in which case *function-designator* is applied to the *args*, or it is a function designator which is called without arguments. *function* is applied to *arguments*.

The order of execution is first *func-and-args* (if this is non-nil), then *function* together with *arguments* if *function* is non-nil, and then sleep if *sleep* was passed explicitly or both *function* and *func-and-args* are **nil**.

Example      To profile whatever happens in the next 6 seconds:

```
(hcl:do-profiling)
```

To profile whatever happens in the next 10 minutes:

```
(hcl:do-profiling :sleep 600)
```

To run 4 processes in parallel with the same function and profile until they all die:

```
(defun check-all-processes-died (processes)
  (dolist (p processes t)
    (when (mp:process-alive-p p)
      (return nil)))

  (let ((processes
         (loop for x below 4
               collect
               (mp:process-run-function
                 (format nil "my process ~a" x)
                 () 'my-function))))
    (hcl:do-profiling
      :func-and-args
      (list 'mp:process-wait
            "Waiting for processes to finish"
            'check-all-process-died
            processes)))
```

See also      [start-profiling](#)  
                [stop-profiling](#)

## editor-color-code-coverage

*Function*

Summary      Displays code coverage in an Editor tool for one file.

Package      `hcl`

Signature      `editor-color-code-coverage filename &key code-coverage-data  
for-editing show-counters color-covered color-uncovered => result`

Arguments      `filename`      A pathname designator.

`code-coverage-data`  
                A `code-coverage-data` object.

`for-editing`      A boolean.

|             |                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <i>show-counters</i>    | A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|             | <i>color-covered</i>    | A boolean, controlled by preferences.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|             | <i>color-uncovered</i>  | A boolean, controlled by preferences.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|             | <i>font-lock-p</i>      | <code>nil</code> , <code>t</code> or the keyword <code>:force</code> . The default value of <i>font-lock-p</i> is <code>t</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|             | <i>comment-counters</i> | A boolean, controlled by preferences.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Values      | <i>real-filename</i>    | A pathname.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|             | <i>runtime-only</i>     | A boolean, controlled by preferences.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Values      | <i>result</i>           | An editor buffer object, or a list.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Description |                         | <p>The function <code>editor-color-code-coverage</code> displays code coverage in an Editor tool in the LispWorks IDE for one file. <i>filename</i> must specify a source file, which has code coverage information in the <i>code-coverage-data</i>.</p> <p>If <i>code-coverage-data</i> is not supplied, it defaults to the internal code coverage data, that is its binary file with code coverage data was loaded in the current image or <code>restore-code-coverage-data</code> was called with data that contains this file. Otherwise, it must specify a <code>code-coverage-data</code> object with data for this file.</p> <p><i>for-editing</i> specifies whether is intended that the buffer with the coloring will be editable. When <i>for-editing</i> is <code>nil</code>, a buffer without a pathname is created with a different name from the source file, which prevents accidental overwriting of the source file. If <i>for-editing</i> is non-<code>nil</code>, the file is opened in the normal way, which may mean using an existing editor buffer if it is already opened. Unless you supply <i>show-counters</i>, a buffer that is opened with <i>for-editing</i> non-<code>nil</code> does not contain any modification of the source code. The default value of <i>editing</i> is <code>nil</code>.</p> <p>Depending on the value of <i>comment-counters</i>, the counters may be wrapped by <code>#     #</code>. When <i>show-counters</i> is non-<code>nil</code>,</p> |

counters are inserted inside the source code. The counters are wrapped in #| |#, so the code is still functional, but less readable. The default value of *show-counters* is (not *for-editing*).

*color-covered* and *color-uncovered* control whether to color covered and uncovered forms respectively. The default value of *color-covered* is `nil`. The default value of *color-uncovered* is `t`. The default for *color-covered* and *color-uncovered* can be set in the LispWorks IDE **Preferences...** dialog for Code Coverage Browser, tab **Coloring**.

*font-lock-p* controls whether font lock (that is, color according to Lisp syntax in the normal way) should be done. When it is `t`, if the buffer is not already "font locked", it is "font locked" before coloring for code coverage. If *font-lock-p* is `:force`, the buffer is always "font locked" first.

*comment-counters* controls whether to comment counters when they are added. It has no effect when *show-counters* is `nil`. When the counters are commented, the code is still valid, because the reader just skips the counters, so you can edit and compile it. When the counters are not commented, the code is not valid, but it is easier to read. The default for *comment-counters* can be set in the **Preferences...** dialog for Code Coverage Browser, tab **Coloring**. The initial default value of *comment-counters* is `t`.

*runtime-only* controls whether to display only run time forms, which means exclude forms that execute only at compile time or load time. The default for *runtime-only* can be set in the **Preferences...** dialog for Code Coverage Browser, tab **Coloring**. The initial default value of *runtime-only* is `nil`.

*real-filename* may be used to specify the actual file to load. When it is non-nil, *filename* should be a pathname which is the same as the truename that the compiler used when it compiled the file to generate the code coverage. The filename is used to lookup the data in the *code-coverage-data* object, while *real-filename* is used as the actual text to load. Note that while *filename* needs to be the same as the truename that the

compiler used, it is not necessarily a real truename on the current machine.

`editor-color-code-coverage` returns the editor buffer if it is successful. If it fails it returns a list containing a format string followed by format arguments, which can be used to present an error or message to the user.

If `editor-color-code-coverage` succeeds and *for-editing* is `nil`, it remembers that it generated the buffer for the *filename*, and if it is called again with the same *filename* and *for-editing* `nil` and succeeds, deletes the previous buffer.

See “Understanding the code coverage output” on page 124 for details of how to interpret the coloring.

|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | <i>real-filename</i> is used when the coloring is done on a machine which sees the file via a different pathname than the machine that compiled it, or when the code coverage data is generated from a copy of the source. The mapping in the Code Coverage browser uses it. Figuring out the truename on a different machine is not always easy. The best way is way is to use the one from the data, which you can find either by searching the data using <code>map-code-coverage-data</code> , or from a <code>code-coverage-file-stats</code> object if you already have it. |
| See also | <p>“Understanding the code coverage output” on page 124</p> <p>Chapter 10, “Code Coverage”</p> <p><code>code-coverage-data</code></p>                                                                                                                                                                                                                                                                                                                                                                                                                                             |

|           | <i>Function</i>                                           |
|-----------|-----------------------------------------------------------|
| Summary   | Enlarges a generation in 32-bit LispWorks.                |
| Package   | <code>hcl</code>                                          |
| Signature | <code>enlarge-generation gen-num size =&gt; result</code> |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                  |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|
| Arguments   | <i>gen-num</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | A generation number.                                             |
|             | <i>size</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | The amount (in bytes) by which the generation is to be enlarged. |
| Values      | <i>result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A boolean.                                                       |
| Description | <p>The function <code>enlarge-generation</code> enlarges generation <i>gen-num</i> by <i>size</i> bytes. If possible, an existing segment in generation <i>gen-num</i> is enlarged, otherwise a new segment of size <i>size</i> is added to the generation.</p> <p><i>result</i> is <code>t</code> on success and <code>nil</code> on failure.</p> <p>This function is useful when it is known that a generation will need to grow. After <code>enlarge-generation</code> is called, the garbage collector is saved the work of deducing that the generation must grow.</p> <p><code>enlarge-generation</code> is most useful in non-interactive applications, where relatively long GC delays are not a problem. In this case, enlarging generations 0 and 1 by several MB may improve the overall performance of the GC.</p> |                                                                  |
| Notes       | <p><code>enlarge-generation</code> is implemented only in 32-bit LispWorks. It is not relevant to the Memory Management API in 64-bit implementations. In 64-bit implementations you can use <code>set-default-segment-size</code>.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                  |
| See also    | <p><code>set-default-segment-size</code><br/> “Memory Management in 32-bit LispWorks” on page 135</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                  |

## enlarge-static *Function*

|         |                                                                    |
|---------|--------------------------------------------------------------------|
| Summary | Enlarges the size of the first static segment in 32-bit LispWorks. |
| Package | <code>hcl</code>                                                   |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                      |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| Signature   | <code>enlarge-static size =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                      |
| Arguments   | <code>size</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | A non-negative <code>fixnum</code> . |
| Values      | <code>result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | A boolean.                           |
| Description | <p>This function can be used when the system would otherwise allocate additional static segments. Such additional segments would cause the application to grow irreversibly.</p> <p><code>size</code> is the amount (in bytes) by which the static segment is to be enlarged. It is rounded up to a multiple of 64K.</p> <p><code>result</code> is <code>t</code> if the static segment was successfully enlarged, and <code>nil</code> otherwise.</p> <p>Use <code>room</code>, with argument <code>t</code>, to find the size of the static segments, and thus the size by which to enlarge the first static segment.</p> |                                      |
| Notes       | <p><code>enlarge-static</code> is implemented only in 32-bit LispWorks. It is not relevant to the Memory Management API in 64-bit implementations, where the irreversible growth problem described above does not exist.</p>                                                                                                                                                                                                                                                                                                                                                                                                |                                      |
| See also    | <code>in-static-area</code><br><code>room</code><br><code>set-default-segment-size</code><br><code>switch-static-allocation</code><br>“Memory Management in 32-bit LispWorks” on page 135                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                      |

|                          | <b>Function</b>                                                                                            |
|--------------------------|------------------------------------------------------------------------------------------------------------|
| <b>ensure-hash-entry</b> |                                                                                                            |
| Summary                  | Gets a value from a <code>hash-table</code> , adding a new value if this fails, all with the table locked. |
| Package                  | <code>hcl</code>                                                                                           |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                       |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| Signature   | <code>ensure-hash-entry key hash-table new-value &amp;optional in-lock-constructor =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                       |
| Arguments   | <code>key</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | A Lisp object.                                        |
|             | <code>hash-table</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | A <code>hash-table</code> .                           |
|             | <code>new-value</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A Lisp object.                                        |
|             | <code>in-lock-constructor</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | A function designator for a function of one argument. |
| Values      | <code>result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | A Lisp object.                                        |
| Description | <p>The function <code>ensure-hash-entry</code> gets the value for the key <code>key</code> in the hash table <code>hash-table</code>, and if this fails puts a new value <code>new-value</code> in <code>hash-table</code> and returns it. <code>ensure-hash-entry</code> does all this with <code>hash-table</code> locked.</p> <p>If the key <code>key</code> is not found, then if <code>in-lock-constructor</code> is non-nil then <code>in-lock-constructor</code> is called with <code>new-value</code> as its argument, and the result is put in the table and returned. If <code>key</code> is not found and <code>in-lock-constructor</code> is <code>nil</code>, <code>new-value</code> is put in the table and returned.</p> |                                                       |
| Notes       | <p><code>ensure-hash-entry</code> is quite inefficient because it always locks the hash table. Normally you should use <code>with-ensuring-gethash</code> or <code>gethash-ensuring</code> instead.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                       |
| See also    | <code>gethash-ensuring</code><br><code>with-ensuring-gethash</code><br>“Modifying a hash table with multiprocessing” on page 279                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                       |

## error-situation-forms

*Macro*

|         |                                                  |
|---------|--------------------------------------------------|
| Summary | Informs the compiler of "error situation" forms. |
|---------|--------------------------------------------------|

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Signature   | <code>error-situation-forms &amp;body body =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Arguments   | <code>body</code> Lisp forms.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Values      | <code>result</code> The result of evaluating <code>body</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Description | <p>The macro <code>error-situation-forms</code> tells the compiler that a body of code comprises "error situation" forms.</p> <p><code>body</code> is evaluated as an implicit progn, but its forms are treated as "error situation" forms. Currently that means that the compiler does not generate code coverage inside <code>body</code> or for the <code>(error-situation-forms ...)</code> form itself, unless <code>force</code> was supplied non-nil to <code>generate-code-coverage</code> or <code>with-code-coverage-generation</code>.</p> <p>In the future, it may also affect other parameters.</p> |
| Notes       | For code coverage, <code>error-situation-forms</code> differs from <code>without-code-coverage</code> in that it does not generate a counter for the <code>(error-situation-forms ...)</code> form itself, and therefore is more convenient to use.                                                                                                                                                                                                                                                                                                                                                              |
| Examples    | <pre>(if (check-something)     (ok-code)     (error-situation-forms (call-error)))</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| See also    | <code>without-code-coverage</code><br><code>generate-code-coverage</code><br><code>with-code-coverage-generation</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

## **expand-generation-1** *Function*

|         |                                                         |
|---------|---------------------------------------------------------|
| Summary | Controls expansion of generation 1 in 32-bit LispWorks. |
| Package | <code>hcl</code>                                        |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signature   | <code>expand-generation-1 <i>on</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Arguments   | <code><i>on</i></code> <code>t, nil</code> or <code>1</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Description | <p>The function <code>expand-generation-1</code> controls the subsequent behavior of the garbage collector when insufficient space is freed by a <code>mark-and-sweep</code>. When this occurs, either generation 1 is expanded, or the objects in it are promoted.</p> <p>If <code>on</code> is <code>nil</code>, generation 1 is never expanded.</p> <p>If <code>on</code> is <code>t</code>, generation 1 is always expanded (rather than promotion) when needed.</p> <p>If <code>on</code> is <code>1</code>, generation 1 is only expanded if its current size is less than 500000 bytes. This is the initial setting.</p> |
| Notes       | <code>expand-generation-1</code> is implemented only in 32-bit LispWorks. It is not relevant to the Memory Management API in 64-bit implementations, where you can use <code>set-default-segment-size</code> .                                                                                                                                                                                                                                                                                                                                                                                                                  |
| See also    | <code>clean-generation-0</code><br><code>collect-generation-2</code><br><code>collect-highest-generation</code><br><code>mark-and-sweep</code><br><code>set-default-segment-size</code><br><code>set-gc-parameters</code><br><a href="#">“Memory Management in 32-bit LispWorks” on page 135</a>                                                                                                                                                                                                                                                                                                                                |

|           | <i>Function</i>                                                                   |
|-----------|-----------------------------------------------------------------------------------|
| Summary   | Extends the current stack.                                                        |
| Package   | <code>hcl</code>                                                                  |
| Signature | <code>extend-current-stack &amp;optional <i>how-much</i> =&gt; <i>size</i></code> |

|                     |                                                                                                                                                               |                                                                     |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| Arguments           | <i>how-much</i>                                                                                                                                               | What percentage the stack should be extended by. The default is 50. |
| Values              | <i>size</i>                                                                                                                                                   | The new size of the stack, after extending.                         |
| Description         | Extend the current stack by the given percentage.                                                                                                             |                                                                     |
| Compatibility notes | In LispWorks 4.4 and previous on Windows and Linux platforms, <code>extend-current-stack</code> is not implemented. This is fixed in LispWorks 5.0 and later. |                                                                     |
| Example             | To double the size of the current stack:                                                                                                                      |                                                                     |
|                     |                                                                                                                                                               | <code>(hcl:extend-current-stack 100)</code>                         |
| See also            | <code>current-stack-length</code><br><code>*stack-overflow-behaviour*</code>                                                                                  |                                                                     |

## **extended-time** *Macro*

|             |                                                                                                                                                                                                                                                                                                                                                             |                        |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Summary     | Prints useful timing information, including information on garbage collection (GC) activity.                                                                                                                                                                                                                                                                |                        |
| Package     | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                            |                        |
| Signature   | <code>extended-time &amp;body body</code>                                                                                                                                                                                                                                                                                                                   |                        |
| Arguments   | <i>body</i>                                                                                                                                                                                                                                                                                                                                                 | The forms to be timed. |
| Description | <p>The macro <code>extended-time</code> runs the forms in <i>body</i>. It then prints a summary of the time taken followed by a breakdown of time spent in the GC.</p> <p>The three columns of the GC breakdown show, respectively, total time, user time, and system time, all in seconds. The rows of the GC breakdown indicate the type of activity.</p> |                        |
|             | In 32-bit LispWorks these rows begin:                                                                                                                                                                                                                                                                                                                       |                        |

**main promote**

indicates promotions from generation 0.

**internal promote**

indicates when an attempt to promote from one generation to the next causes promotion of the higher generation, to make room for the objects from the lower generation.

**fixup**

is a part of the compaction and promotion process.

In 64-bit LispWorks these rows begin:

**Standard *gen-num* (*n* calls)**

indicates *n* Standard GCs (includes automatic GCs and calls to `gc-generation`) in which the highest generation collected was *gen-num*.

**Marking *gen-num* (*n* calls)**

indicates *n* Marking GCs (includes calls to `marking-gc`) in which the highest generation collected was *gen-num*.

Thus in the example below

**Standard 1 ( 1 calls) ...**

indicates that there was 1 Standard GC in which the highest generation collected was 1.

Notes

`extended-time` does not print Garbage Collector times if it is used while GC timing is on (after `start-gc-timing` is called, and before `get-gc-timing` is called with `reset` non-nil).

Example

This example illustrates output in 32-bit LispWorks:

```
CL-USER 57 > (extended-time (foo))
Timing the evaluation of (PROGN (FOO))

User time      =      26.703
System time   =       0.109
Elapsed time  =      27.047
Allocation    = 40021902832 bytes
0 Page faults

   total / user
/ system
total gc activity                  = 3.312500 /
3.312500 / 0.000000
main promote ( 1 calls)          = 0.000000 /
0.000000 / 0.000000
mark and sweep ( 7305 calls)     = 3.312500 /
3.312500 / 0.000000
internal promote ( 0 calls)     = 0.000000 /
0.000000 / 0.000000
promote ( 0 calls)               = 0.000000 /
0.000000 / 0.000000
fixup ( 1 calls)                 = 0.000000 /
0.000000 / 0.000000
compact ( 0 calls)               = 0.000000 /
0.000000 / 0.000000
10006387712
0.0
```

This example illustrates output in 64-bit LispWorks:

```

CL-USER 3 > (extended-time (foo))
Timing the evaluation of (PROGN (FOO))

User time      =      11.433
System time    =       0.268
Elapsed time   =      11.197
Allocation     = 80040251696 bytes
5 Page faults

   total / user /
system
total gc activity                  =      2.168062 / 2.126444
/ 0.041618
Standard 0 (28545 calls) =      2.153886 / 2.119799
/ 0.034087
Standard 1 (    1 calls) =      0.014176 / 0.006645
/ 0.007531
10006387712
0.0

```

See also [start-gc-timing](#)  
[time](#)  
“Guidance for control of the memory management system”  
on page 130

|              | <i>Condition</i>                                                                                                                                                                                               |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary      | The class of error signaled when loading a file which is not a proper fasl file.                                                                                                                               |
| Package      | <code>hcl</code>                                                                                                                                                                                               |
| Superclasses | <code>simple-error</code><br><code>file-error</code><br><code>stream-error</code>                                                                                                                              |
| Description  | The condition class <code>fasl-error</code> is used by <code>load</code> and <code>load-data-file</code> to signal an error when the file is not a proper binary file ("fasl file"), or seems to be corrupted. |
| See also     | <a href="#">load-data-file</a>                                                                                                                                                                                 |

|                                    |                  |
|------------------------------------|------------------|
| <b>fast-directory-files</b>        |                  |
| <b>fdf-handle-directory-p</b>      |                  |
| <b>fdf-handle-directory-string</b> |                  |
| <b>fdf-handle-last-access</b>      |                  |
| <b>fdf-handle-last-modify</b>      |                  |
| <b>fdf-handle-link-p</b>           |                  |
| <b>fdf-handle-size</b>             |                  |
| <b>fdf-handle-writable-p</b>       | <i>Functions</i> |

**Summary**      Maps a callback on the names of files in a specified directory and returns a list of those for which the callback returned true. The callback can retrieve information about the files.

**Package**      `hcl`

**Signature**      `fast-directory-files dir-pathname callback => result`  
`fdf-handle-directory-p fdf-handle => directory-p`  
`fdf-handle-directory-string fdf-handle => directory-string`  
`fdf-handle-last-access fdf-handle => last-access`  
`fdf-handle-last-modify fdf-handle => last-modify`  
`fdf-handle-link-p fdf-handle => link-p`  
`fdf-handle-size fdf-handle => size`  
`fdf-handle-writable-p fdf-handle => writable-p`

**Arguments**      `dir-pathname`      A pathname designator without wild characters in its directory path.  
`callback`          A function designator.  
`fdf-handle`        An opaque object used to retrieve information about a file in `dir-pathname`.

**Values**      `result`          A list of strings.  
`directory-p, link-p, writable-p`

Booleans.

*directory-string* A string.

*last-access, last-modify, size*

Integers.

Description The function **fast-directory-files** maps the function *callback* on the names of the files in directory specified by *dir-pathname*, and returns a list of the names for which *callback* returned non-nil.

*dir-pathname* must be a pathname designator, which does not contain wild characters in its directory path. To be useful, it should either be a directory (with no name and type), or with wild name and/or type.

*callback* must be a function of two arguments, the name of the file and an opaque object which is referred to as the *fdf-handle*. The *fdf-handle* can be used to retrieve information about the file, by calling any of the **fdf-handle-\*** functions documented on this page.

**fast-directory-files** traverses the files that match *dir-pathname* in an undefined way, and for each file calls the *callback* with the file's name (not including the directory) and a *fdf-handle*. If *callback* returns non-nil it adds the name to a list. It returns the list of names for which the *callback* returned non-nil. Note that the names do not contain the directory name.

The *fdf-handle* can be accessed by the following readers. Functions named in parentheses would return the same value when called on the full path of the file:

**fdf-handle-size** returns the size of the file in bytes.

**fdf-handle-last-modify** returns the universal time of the last modification of the file (**cl:file-write-date**).

**fdf-handle-last-access** returns the universal time of the last access of the file.

**fdf-handle-directory-p** is a predicate for whether the file is a directory (**file-directory-p**)

**fdf-handle-link-p** is a predicate for whether the file is a soft link (always returns `nil` on Windows).

`fdf-handle-writable-p` is a predicate for whether the file is writable (`file-writable-p`).

**fdf-handle-directory-string** returns a string with the directory path followed by a separator. Therefore the full path of the file can be constructed by:

```
(string-append (fdf-handle-directory-string fdf-handle)  
               name)
```

|          |                                                                                                               |
|----------|---------------------------------------------------------------------------------------------------------------|
| Notes    | The <code>fdf-handle</code> can be used only within the dynamic scope of the callback to which it was passed. |
| See also | <code>directory</code><br>“Fast access to files in a directory” on page 465                                   |

| file-string            | Function                                                                                                                                                                                                                                                                                                                                                          |             |                                                        |               |                                                                                          |                        |                                                                         |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------------------------------------|---------------|------------------------------------------------------------------------------------------|------------------------|-------------------------------------------------------------------------|
| Summary                | Returns the contents of a file as a string.                                                                                                                                                                                                                                                                                                                       |             |                                                        |               |                                                                                          |                        |                                                                         |
| Package                | hcl                                                                                                                                                                                                                                                                                                                                                               |             |                                                        |               |                                                                                          |                        |                                                                         |
| Signature              | <code>file-string <i>file</i> &amp;key <i>length external-format</i> =&gt; <i>string</i></code>                                                                                                                                                                                                                                                                   |             |                                                        |               |                                                                                          |                        |                                                                         |
| Arguments              | <table><tr><td><i>file</i></td><td>A pathname, string or file-stream, designating a file.</td></tr><tr><td><i>length</i></td><td>The number of characters to return in <i>string</i>, or <code>nil</code> (the default).</td></tr><tr><td><i>external-format</i></td><td>An external format specification, default value <code>:default</code>.</td></tr></table> | <i>file</i> | A pathname, string or file-stream, designating a file. | <i>length</i> | The number of characters to return in <i>string</i> , or <code>nil</code> (the default). | <i>external-format</i> | An external format specification, default value <code>:default</code> . |
| <i>file</i>            | A pathname, string or file-stream, designating a file.                                                                                                                                                                                                                                                                                                            |             |                                                        |               |                                                                                          |                        |                                                                         |
| <i>length</i>          | The number of characters to return in <i>string</i> , or <code>nil</code> (the default).                                                                                                                                                                                                                                                                          |             |                                                        |               |                                                                                          |                        |                                                                         |
| <i>external-format</i> | An external format specification, default value <code>:default</code> .                                                                                                                                                                                                                                                                                           |             |                                                        |               |                                                                                          |                        |                                                                         |
| Values                 | <i>string</i><br>A string containing characters from <i>file</i> .                                                                                                                                                                                                                                                                                                |             |                                                        |               |                                                                                          |                        |                                                                         |

|             |                                                                                                                                         |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| Description | Returns the entire contents of <i>file</i> (if <i>length</i> is <code>nil</code> ), or the first <i>length</i> characters, as a string. |
| Example     | <pre>CL-USER 26 &gt; file-string "configure.lisp" :length 18 ";; -*- Mode: Lisp;"</pre>                                                 |
| See also    | <code>guess-external-format</code>                                                                                                      |

## file-writable-p *Function*

|             |                                                                                                                                                                                                                                                                                              |                                                        |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|
| Summary     | Tests whether a file is writable.                                                                                                                                                                                                                                                            |                                                        |
| Package     | <code>hcl</code>                                                                                                                                                                                                                                                                             |                                                        |
| Signature   | <code>file-writable-p file =&gt; result</code>                                                                                                                                                                                                                                               |                                                        |
| Arguments   | <code>file</code>                                                                                                                                                                                                                                                                            | A pathname, string or file-stream, designating a file. |
| Values      | <code>result</code>                                                                                                                                                                                                                                                                          | <code>t</code> or <code>nil</code>                     |
| Description | The function <code>file-writable-p</code> checks whether <i>file</i> is writable. Note that this checks the properties of the file, so trying to write to the file may still fail if the file is non-writable for other reasons, for example if it is opened for writing by another program. |                                                        |
| Example     | <pre>CL-USER 44 &gt; file-writable-p (sys:lispworks-file "private-patches/load.lisp") T</pre>                                                                                                                                                                                                |                                                        |

## filter-code-coverage-data *Function*

|         |                                                                    |  |
|---------|--------------------------------------------------------------------|--|
| Summary | Filters information from a <code>code-coverage-data</code> object. |  |
| Package | <code>hcl</code>                                                   |  |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                              |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
| Signature   | <code>filter-code-coverage-data ccd filter &amp;key without-stats name<br/>=&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                              |
| Arguments   | <code>ccd</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | A <code>code-coverage-data</code> object or <code>t</code> . |
|             | <code>filter</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | A string, a function or a fbound symbol.                     |
|             | <code>without-stats</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | A boolean.                                                   |
|             | <code>name</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | A Lisp object, normally a symbol or a string.                |
| Values      | <code>result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | A <code>code-coverage-data</code> object.                    |
| Description | <p>The function <code>filter-code-coverage-data</code> creates a new <code>code-coverage-data</code> object with information for some of the files in the argument <code>ccd</code>, as determined by the <code>filter</code>. If <code>ccd</code> is <code>t</code>, this is interpreted as the internal <code>code-coverage-data</code> object.</p> <p>If <code>filter</code> is a string, it is interpreted as a regexp (see <code>find-regexp-in-string</code>) which is applied to the namestring of each file. <code>without-stats</code> is ignored in this case.</p> <p>If <code>filter</code> is a function or a fbound symbol, it is applied to the truename of each file and stats object or only to the truename, depending on <code>without-stats</code>. If <code>without-stats</code> is <code>nil</code> the <code>filter</code> is applied to the truename and a <code>code-coverage-file-stats</code> object for the file. If <code>without-stats</code> is true, the <code>filter</code> is applied only to the truename. The default value of <code>without-stats</code> is <code>nil</code>.</p> <p><code>name</code> is the name supplied to the new <code>code-coverage-data</code> object. The default value of <code>name</code> is "Filter".</p> |                                                              |
| See also    | <code>code-coverage-data</code><br><code>code-coverage-file-stats</code><br><code>map-code-coverage-data</code><br>Chapter 10, "Code Coverage"                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                              |

|             | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Returns the size in bytes of the representation of any Lisp object.                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Package     | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Signature   | <code>find-object-size <i>object</i> =&gt; <i>size</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Arguments   | <i>object</i> Any Common Lisp form.                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Values      | <p>The result is an integer which is the number of bytes of heap memory currently used to represent the object. If the object takes up no heap memory (fixnum or character), then 0 is returned. Such objects are represented by an immediate value held in a single machine “word”.</p> <p>The size of a heap object includes hidden space required to hold type and other information; for instance, a base-string of 10 1-byte characters occupies more than 10 bytes of memory.</p> |
| Description | Certain Common Lisp objects are not represented by a single heap object; for instance, using <code>find-object-size</code> on a hash-table is misleading as the function returns the size of the hash-table descriptor, rather than the total of the descriptor and the hash-table-array. General vectors and arrays also have this property. All symbols are of the same size, since the print name is not part of a symbol object.                                                    |
| Example     | <pre>(hcl:find-object-size   (make-string 1000 :initial-element #\A                :element-type 'base-char)) =&gt; 1012</pre>                                                                                                                                                                                                                                                                                                                                                          |
| See also    | <code>room</code><br><code>total-allocation</code>                                                                                                                                                                                                                                                                                                                                                                                                                                      |

## **find-throw-tag** *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |              |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| Summary     | The predicate for whether there is a specific catch in the dynamic scope.                                                                                                                                                                                                                                                                                                                                                                                                                                                       |              |
| Package     | <b>hcl</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |              |
| Signature   | <b>find-throw-tag</b> <i>tag</i> => <i>result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |              |
| Arguments   | <i>tag</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | A catch tag. |
| Values      | <i>result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | A boolean.   |
| Description | The function <b>find-throw-tag</b> is the predicate for whether there is a catch in the dynamic scope with the supplied catch tag <i>tag</i> , so that <b>c1:throw</b> will succeed to throw to it.                                                                                                                                                                                                                                                                                                                             |              |
| Notes       | <b>find-throw-tag</b> needs to traverse all the catch frames on the stack until it finds the tag, and therefore would be slower than checking a dynamically bound variable. If the check needs to be called often, then it is normally better to bind a special variable when the catch is established, and then check that variable. In situations when the check is rare (for example, it is called only in cases of error), using <b>find-throw-tag</b> is better because it eliminates the overhead of binding the special. |              |
| See also    | <b>throw-if-tag-found</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |              |

## **finish-heavy-allocation** *Function*

|         |                                                                      |
|---------|----------------------------------------------------------------------|
| Summary | Tells the system that allocation of many long-lived objects is over. |
| Package | <b>hcl</b>                                                           |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signature   | <code>finish-heavy-allocation</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Description | <p>The function <code>finish-heavy-allocation</code> tells the system that the application finished doing 'heavy' allocation, and from that point onwards allocation is 'normal'. The main distinction between heavy and normal allocation is the typical lifetime of objects: normal allocation means most of new objects are ephemeral, while heavy allocation a large proportion of the new objects are long-lived.</p> <p>Heavy allocation normally happens when loading, either the application itself or large amount of data. Operations that do not involve loading will almost always be normal. Hence the time that is useful to call <code>finish-heavy-allocation</code> is after loading something.</p> |
| See also    | <code>with-heavy-allocation</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

## **flag-not-special-free-action** *Function*

|           |                                                                                                                                                      |                                                            |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|
| Summary   | Unflags an object for special action on garbage collection.                                                                                          |                                                            |
| Package   | <code>hcl</code>                                                                                                                                     |                                                            |
| Signature | <code>flag-not-special-free-action</code>                                                                                                            | <code>object =&gt; nil</code>                              |
| Arguments | <code>object</code>                                                                                                                                  | The object on which the special actions are to be removed. |
| Values    | Returns <code>nil</code> .                                                                                                                           |                                                            |
| Example   | <pre>CL-USER 1 &gt; (make-instance 'capi:title-pane) #&lt;CAPI:TITLE-PANE "" 20F9898C&gt;  CL-USER 2 &gt; (flag-not-special-free-action *) NIL</pre> |                                                            |

See also      **add-special-free-action**  
**flag-special-free-action**  
**remove-special-free-action**

## **flag-special-free-action** *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                       |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Summary     | Flags an object for special action on garbage collection.                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                       |
| Package     | <b>hcl</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                       |
| Signature   | <b>flag-special-free-action</b> <i>object</i> => t                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                       |
| Arguments   | <i>object</i>                                                                                                                                                                                                                                                                                                                                                                                                                                      | The object on which the special actions are to be performed. This cannot be a symbol. |
| Values      | Returns t.                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                       |
| Description | Note that all the current special-free-action functions are performed on the object. Use <b>flag-not-special-free-action</b> to unflag an object.                                                                                                                                                                                                                                                                                                  |                                                                                       |
| Notes       | Each object that is flagged for special free action adds some overhead to every garbage collection. This is not significant for a small number of objects, but calling <b>flag-special-free-action</b> with a large number of objects may slow the system significantly. Thus you should avoid using special free actions where possible. Normally, they should be used only for objects that keep some external resources which need to be freed. |                                                                                       |
| Example     | <pre>CL-USER 29 &gt; (make-instance 'capi:title-pane) #&lt;CAPI:TITLE-PANE "" 20F9898C&gt;  CL-USER 30 &gt; (flag-special-free-action *) T</pre>                                                                                                                                                                                                                                                                                                   |                                                                                       |

See also      **add-special-free-action**  
                **flag-not-special-free-action**  
                **remove-special-free-action**

## function-information *Function*

|             |                                                                                                                                                                                                                                                                                                                        |  |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Summary     | Return information about the function bindings of a symbol in an environment.                                                                                                                                                                                                                                          |  |
| Package     | <b>hcl</b>                                                                                                                                                                                                                                                                                                             |  |
| Signature   | <b>function-information</b> <i>function-name</i> &optional <i>env</i> => <i>kind</i> ,<br><i>localp</i> , <i>decls</i>                                                                                                                                                                                                 |  |
| Arguments   | <i>function-name</i> A function name<br><i>env</i> An environment or <b>nil</b>                                                                                                                                                                                                                                        |  |
| Values      | <i>kind</i> Either <b>nil</b> , or one of the keywords : <b>special</b> , : <b>lexical</b> , : <b>symbol-macro</b> and : <b>constant</b> .<br><i>localp</i> A boolean<br><i>decls</i> An a-list                                                                                                                        |  |
| Description | The function <b>function-information</b> returns information about how <i>function-name</i> is bound in the environment <i>env</i> . <i>function-name</i> can be a symbol or <b>setf</b> function name.<br><br>The value of <i>kind</i> will be as follows:                                                            |  |
|             | <b>nil</b> There is no information about <i>variable</i> in <i>env</i><br><b>:macro</b> <i>function-name</i> has a macro binding in <i>env</i><br><b>:function</b> <i>function-name</i> has a function binding in <i>env</i><br><b>:special-form</b> <i>function-name</i> has a special operator binding in <i>env</i> |  |

*localp* will be true if *function-name* is bound by a form that has indefinite scope (for example `flet`) or false if *function-name* has global scope (for example `defun`).

*decls* is an a-list of declarations that refer to *function-name*. The `cdr` of each pair is specified according to the `car` of the pair as follows:

**dynamic-extent**

The `cdr` is non-nil if *function-name* is declared `dynamic-extent` in *env*.

**inline**

The `cdr` is inline or `notinline` if *function-name* is explicitly declared `inline` or `notinline` in *env*. The `cdr` is `nil` (or the pair is omitted) if this information is not known.

**ftype**

The `cdr` is the type specifier that is declared for *function-name* in *env* if any.

Notes

1. Not all of these declarations are supported.
2. `function-information` is part of the environment access API which is based on that specified in *Common Lisp: the Language (2nd Edition)*.

See also

`augment-environment`  
`declaration-information`  
`define-declaration`  
`map-environment`  
`variable-information`

**get-code-coverage-delta**  
**reset-code-coverage-snapshot**  
**set-code-coverage-snapshot**

*Functions*

Summary

Generate "deltas", which are `code-coverage-data` objects with information for a period.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Signature   | <code>get-code-coverage-delta &amp;key snapshot name =&gt; ccd</code><br><code>reset-code-coverage-snapshot =&gt; nil</code><br><code>set-code-coverage-snapshot =&gt; t</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Arguments   | <code>snapshot</code> A boolean.<br><code>name</code> A Lisp object, normally a symbol or a string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Values      | <code>ccd</code> A <code>code-coverage-data</code> object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Description | <p>The function <code>get-code-coverage-delta</code> returns a <code>code-coverage-data</code> object with information covering the period since the previous snapshot, and with name <code>name</code>. Normally this would be set by <code>set-code-coverage-snapshot</code> or <code>get-code-coverage-delta</code> with <code>snapshot</code> non-nil. If there was no such previous call, then the "delta" period commences, for each file, from the time it was loaded.</p> <p>The function <code>reset-code-coverage-snapshot</code> eliminates any snapshot. This is useful because the snapshot uses memory.</p> <p>The function <code>set-code-coverage-snapshot</code> creates a snapshot of the internal code coverage data, to be used by <code>get-code-coverage-delta</code>.</p> <p>When <code>snapshot</code> is non-nil, <code>get-code-coverage-delta</code> sets up a new snapshot. This is more efficient than using <code>set-code-coverage-snapshot</code> again, but otherwise has the same effect. The default value of <code>snapshot</code> is <code>nil</code>.</p> |
| Notes       | <ol style="list-style-type: none"> <li>1. The functions <code>reset-code-coverage</code>, <code>clear-code-coverage</code> and <code>restore-code-coverage-data</code> also eliminate the snapshot.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

2. Code coverage manipulation functions like `subtract-code-coverage-data` can also be used to compute deltas, but `get-code-coverage-delta` will normally do it using less memory.

See also

`clear-code-coverage`  
`code-coverage-data`  
`reset-code-coverage`  
`restore-code-coverage-data`  
`subtract-code-coverage-data`

|             |                                                                                                                                                                                                                                                                                                                                                        | <i>Function</i> |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Summary     | Does a Copying GC.                                                                                                                                                                                                                                                                                                                                     |                 |
| Package     | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                       |                 |
| Signature   | <code>gc-generation gen-num &amp;key coalesce promote block =&gt; allocation</code>                                                                                                                                                                                                                                                                    |                 |
| Arguments   | <code>gen-num</code> An integer between 0 and 7 inclusive, or <code>t</code> .<br><code>coalesce</code> A generalized boolean.<br><code>promote</code> A generalized boolean.<br><code>block</code> An integer between 0 and 7, inclusive, or one of the keywords <code>:blocking-gen-num</code> and <code>:all</code> .                               |                 |
| Values      | <code>allocation</code> The total allocation in generation <code>gen-num</code> and younger generations.                                                                                                                                                                                                                                               |                 |
| Description | <p>The function <code>gc-generation</code> does a Garbage Collection of a specific generation. The actual operation is different between 64-bit LispWorks and 32-bit LispWorks.</p> <p><code>gen-num</code> should be a valid generation number, or <code>t</code>. The value <code>t</code> is mapped to the blocking generation number in 64-bit</p> |                 |

LispWorks, and to 2 in 32-bit LispWorks. For backwards compatibility the keyword :**blocking-gen-num** is also accepted, with the same meaning as t.

It is especially helpful to GC the blocking generation (or other higher generations) when large, long-lived data structures become garbage. This is because higher generations are rarely collected by default. For the higher generations, the GC takes longer but recovers more space.

Another situation which may require **gc-generation** is when objects are marked for special free action (by **flag-special-free-action** or **free-function** in a weak hash table). If such objects live long enough to be promoted to higher generation, they may not be garbage collected long after there are no pointers to them. If the free action is important, you may need to periodically GC higher generation (typically the blocking generation, by passing **gen-num** t).

## Operation in 64-bit LispWorks

By default **gc-generation** operates on the live objects in generation **gen-num** and all lower generations at or above the generation specified by **block** by copying them inside their current generation, and it operates on the live objects in generations lower than **block** by copying them to the next higher generation.

If **promote** is non-nil, the live objects in generation **gen-num** are also promoted to the next generation. That is the same operation that happens when the GC is invoked automatically. The default value of **promote** is nil.

If **coalesce** is non-nil, all non-static live objects in lower generations are promoted to generation **gen-num**. That is what **clean-down** does (with **gen-num** being the highest generation). It may be useful directly in some cases. The default value of **coalesce** is nil.

*block* specifies a generation number up to which to promote. An integer value specifies the generation number. If *block* is :**blocking-gen-num**, then **gc-generation** promotes up to the blocking generation. If *block* is :**all**, then **gc-generation** promotes nothing. The default value of *block* is :**blocking-gen-num**.

**gc-generation** is useful when you know points in your application where many objects tend to die, or when you know that that application is less heavily loaded at some time. Typically many objects die in the end (or beginning) of an iteration in a top level loop of the application, and that is normally a useful place to put a call to **gc-generation** of generation 2 or generation 3. If you know a time when the application can spend time garbage collecting, a call to **gc-generation** with a higher value of *gen-num* may be useful. It is probably never really useful to use **gc-generation** on generation 0 or 1.

To decide on which *gen-num* to call **gc-generation**, check which generation gets full by making periodic calls to **room**.

**gc-generation** with *promote* or *coalesce* may also be useful to move objects from the blocking generation to higher generations, which does not happen automatically (except when saving the image). For example, after loading a large amount of code, and before generating any data that may die shortly, assuming the blocking generation is 3, it may be useful to do:

```
(gc-generation 4 :coalesce t)
```

to move all (non-static) objects to generation 4, where they will not be touched by the GC any more (except following pointers to younger generations).

## Operation in 32-bit LispWorks

**gc-generation** marks and sweeps the generation *gen-num* and all generations below, and then does some additional cleanups. *coalesce*, *promote* and *block* are ignored.

## Operation in the Mobile GC

When the *gen-num* argument is a number, it must be 0, 1 or 2. The value **t** (and **:blocking-gen-num**) is interpreted as 2.

Generation 0 is always promoted, but the **:promote** keyword affects generation 1 and, if non-nil, promotes even if promotion was blocked by **set-promote-generation-1**.

The keyword **:block** is ignored.

Otherwise, the function acts as in 64-bit LispWorks above.

Compatibility notes In 32-bit LispWorks, **gc-generation** simply calls **mark-and-sweep**. This has a similar effect, but two significant differences must be noted:

1. by default, **gc-generation** promotes the young generations, so repeated calls to **gc-generation** will promote everything to generation *gen-num* or generation *block* (whichever is lower). In contrast **mark-and-sweep** never promotes.
2. In 32-bit LispWorks, generation 2 is the blocking generation. In 64-bit LispWorks, the default blocking generation is generation 3. That is because the 64-bit implementation promotes faster and so needs more generations before the block.

Also note that

`(gc-generation t)`

is intended as the replacement of

`(mark-and-sweep 2)`

See also **clean-down**  
**mark-and-sweep**  
**marking-gc**  
**set-blocking-gen-num**  
“Guidance for control of the memory management system”  
on page 130

| <b>gc-if-needed</b> | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary             | Garbage collects if the previous call requires more space than is actually available in 32-bit LispWorks.                                                                                                                                                                                                                                                                                                                                                                   |
| Package             | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Signature           | <code>gc-if-needed =&gt; nil</code>                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Arguments           | None.                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Values              | Returns <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Description         | This function checks to see if the amount of allocation from the previous call is more than <code>system:*allocation-inter-val*</code> , and if it is, performs a mark and sweep and promotion on generation 0. It also tries to reduce the big-chunk area. This is a fairly brief operation, and can be used whenever some operation is finished and may have left some garbage. The system itself uses it after compiling and loading files, when waiting for input, etc. |
| Notes               | <code>gc-if-needed</code> does nothing in 64-bit LispWorks.                                                                                                                                                                                                                                                                                                                                                                                                                 |
| See also            | <code>avoid-gc</code><br><code>get-gc-parameters</code><br><code>mark-and-sweep</code><br><code>normal-gc</code><br><code>set-gc-parameters</code><br><code>without-interrupts</code><br><code>with-heavy-allocation</code><br>“Memory Management in 32-bit LispWorks” on page 135                                                                                                                                                                                          |

| <b>generate-code-coverage</b> | <i>Function</i>                              |
|-------------------------------|----------------------------------------------|
| Summary                       | Switches code coverage generation on or off. |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |            |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Package     | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |            |
| Signature   | <code>generate-code-coverage &amp;key <i>on</i> <i>atomic-p</i> <i>counters</i> <i>force</i> <i>count-implicit-branch</i> =&gt; <i>on</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |            |
| Arguments   | <i>on</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | A boolean. |
|             | <i>atomic-p</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | A boolean. |
|             | <i>counters</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | A boolean. |
|             | <i>force</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | A boolean. |
|             | <i>count-implicit-branch</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | A boolean. |
| Values      | <i>on</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | A boolean. |
| Description | <p>The function <code>generate-code-coverage</code> switches code coverage generation on or off.</p> <p><i>on</i> determines whether code coverage is generated. If <i>on</i> is true, code coverage generation is switched on, which means that when <code>compile-file</code> is called in the conventional way, that is generate a binary file from a source file, it generates code coverage code. If <i>on</i> is <code>nil</code>, code coverage generation is switched off and in this case the other keyword arguments are ignored. The default value of <i>on</i> is <code>t</code>.</p> <p><code>generate-code-coverage</code> returns <code>t</code> or <code>nil</code>, depending on the value of <i>on</i>.</p> <p><i>atomic-p</i> controls whether counting is done atomically or not. It is ignored when <i>counters</i> is <code>nil</code>. Passing <i>atomic-p</i> true makes the counters atomic, which may be much slower than counting non-atomically, but guarantees that the code is not going to drop counts when running multiprocessing. The default value of <i>atomic-p</i> is <code>nil</code>.</p> <p><i>counters</i> controls whether the code coverage code actually counts executions, or simply sets a flag to indicate that the code has been executed. Passing <i>counters</i> <code>nil</code> generates code</p> |            |

which is a little smaller and faster, but does not count the number of times a piece of code has been executed. The default value of *counters* is `t`.

*force*, if true, forces generating counters in code that is marked not to generate counters by `without-code-coverage` or `error-situation-forms`. The default value of *force* is `nil`.

*count-implicit-branch* controls whether to generate counters for implicit branches. Implicit branches are generated by macros like `c1:when`, where the source only contains the "then" branch, and the "else" branch (which returns `nil`) is implicit. The other macros are `c1:unless` (when it is an implicit "then"), and the switch macros `c1:cond`, `c1:case` and `c1:typecase` when they do not have a `t` or `otherwise` clause. When *count-implicit-branch* is true, the compiler generates a counter for the implicit branch, which counts the number of times that the implicit branch was executed. In other words for `c1:when` this is the number of times that the condition returned `nil`; for `c1:unless` this is the number of times that the condition returned true, and for the switch macros it is the number of times that all the clauses returned `nil`.

When coloring with an implicit branch with counter 0 inside a form with a non-zero counter, there is nowhere to put the color for the uncovered code, so the form is colored as a *hidden-partial* form (see “Understanding the code coverage output” on page 124).

The default value of *count-implicit-branch* is `t`.

## Notes

If `generate-code-coverage` is called outside the body of `with-code-coverage-generation`, it switches the generation globally. Inside the body of `with-code-coverage-generation` it switches the generation within the scope of the surrounding `with-code-coverage-generation`, but has no effect once this `with-code-coverage-generation` exited.

See also `code-coverage-data-generate-coloring-html`  
`editor-color-code-coverage`  
`error-situation-forms`  
`with-code-coverage-generation`  
`without-code-coverage`  
Chapter 10, “Code Coverage”

## **get-default-generation** *Function*

|             |                                                                                                                                                                                                                                                                                                                                |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Returns the current default generation.                                                                                                                                                                                                                                                                                        |
| Package     | <code>hcl</code>                                                                                                                                                                                                                                                                                                               |
| Signature   | <code>get-default-generation =&gt; default-gen</code>                                                                                                                                                                                                                                                                          |
| Arguments   | None.                                                                                                                                                                                                                                                                                                                          |
| Values      | Returns the current default.                                                                                                                                                                                                                                                                                                   |
| Description | By default, all new objects are allocated to a specific generation. This function returns the current value of this default generation.                                                                                                                                                                                        |
| Notes       | In 64-bit LispWorks <code>get-default-generation</code> returns 0.                                                                                                                                                                                                                                                             |
| See also    | <code>allocation-in-gen-num</code><br><code>clean-generation-0</code><br><code>collect-generation-2</code><br><code>collect-highest-generation</code><br><code>expand-generation-1</code><br><code>set-default-generation</code><br><code>*symbol-alloc-gen-num*</code><br>“Memory Management in 32-bit LispWorks” on page 135 |

| <b>get-gc-parameters</b> |                                                                                                                                                                                    | <i>Function</i>                                                                                                                                                                                           |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary                  | Returns the current values of various garbage collector parameters in 32-bit LispWorks.                                                                                            |                                                                                                                                                                                                           |
| Package                  | <code>hcl</code>                                                                                                                                                                   |                                                                                                                                                                                                           |
| Signature                | <code>get-gc-parameters <i>parameters</i> =&gt; <i>values</i></code>                                                                                                               |                                                                                                                                                                                                           |
| Arguments                | <code>parameters</code>                                                                                                                                                            | A keyword representing a single GC parameter. Any other value means all parameters.                                                                                                                       |
| Values                   | <code>values</code>                                                                                                                                                                | If <i>parameters</i> specifies a single GC parameter, the value of that parameter is returned. Otherwise <i>values</i> is an <i>alist</i> containing every GC parameter, together with its current value. |
| Description              | <p>See <code>set-gc-parameters</code> for a full description of these parameters.</p> <p>With keyword argument, of one of the parameters, the corresponding value is returned.</p> |                                                                                                                                                                                                           |
| Notes                    | <p><code>get-gc-parameters</code> is implemented only in 32-bit LispWorks. It is not relevant to the Memory Management API in 64-bit implementations.</p>                          |                                                                                                                                                                                                           |

Example      CL-USER 1 > (get-gc-parameters :minimum-overflow)  
500000

```
CL-USER 2 > (pprint (get-gc-parameters t))

((:ENLARGE-BY-SEGMENTS . 10)
 (:MINIMUM-FOR-PROMOTE . 1000)
 (:MAXIMUM-OVERFLOW . 1000000)
 (:MINIMUM-OVERFLOW . 500000)
 (:MINIMUM-BUFFER-SIZE . 200)
 (:NEW-GENERATION-SIZE . 262144)
 (:PROMOTE-MAX-BUFFER . 100000)
 (:PROMOTE-MIN-BUFFER . 200)
 (:MAXIMUM-BUFFER-SIZE . 131072)
 (:MINIMUM-FOR-SWEEP . 8000)
 (:BIG-OBJECT . 131072))
```

See also     **set-gc-parameters**  
“Memory Management in 32-bit LispWorks” on page 135

## **get-temp-directory** *Function*

Summary     Returns a directory that can be used for temporary files.

Package     *hcl*

Signature    **get-temp-directory** => *directory*

Values       *directory*     A pathname

Description    The function **get-temp-directory** returns a directory which is likely to be writable and can be used for temporary files.

Notes        By default, the functions **create-temp-file** and **open-temp-file** use the result of **get-temp-directory** as the directory to create their temp file in.

See also      **`create-temp-file`**  
**`example-compile-file`**  
**`open-temp-file`**

## **get-working-directory** *Function*

Summary      Finds the current working directory.

Package      **`hcl`**

Signature      **`get-working-directory => cwd`**

Arguments      None.

Values      **`cwd`**      The current working directory, as a pathname.

Description      This function is used to find the current working directory. It returns a pathname, the directory component of which is the current working directory.

Example      **`CL-USER 1 > (get-working-directory)`**  
**`#P"/u/dubya/"`**

See also      **`cd`**  
**`change-directory`**

## **gethash-ensuring** *Function*

Summary      A thread-safe way to get a value from a **`hash-table`**, adding a value if the key is not already present.

Package      **`hcl`**

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                       |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| Signature   | <code>gethash-ensuring key hash-table constructor &amp;optional in-lock-constructor =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                       |
| Arguments   | <code>key</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | A Lisp object.                                        |
|             | <code>hash-table</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | A <i>hash-table</i> .                                 |
|             | <code>constructor</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | A function designator for a function of no arguments. |
|             | <i>in-lock-constructor</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | A function designator for a function of one argument. |
| Values      | <code>result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | A Lisp object.                                        |
| Description | <p>The function <code>gethash-ensuring</code> gets the value for the key <i>key</i> from the hash table <i>hash-table</i>, and if this fails constructs a new value, puts it in the table and returns it. <code>gethash-ensuring</code> does this in a thread-safe way, which means that all threads calling it with the same <i>key</i> and <i>hash-table</i> return the same value (as long as nothing removes it from the table).</p> <p>If <i>key</i> is not found and <i>constructor</i> is non-nil, <i>constructor</i> is called to construct the new value. <i>constructor</i> is called without any lock, and can do whatever is needed. The value that <i>constructor</i> returns may be discarded by <code>gethash-ensuring</code> if, by the time it returns, there is already a matching value in <i>hash-table</i> (added by another thread or even inside <i>constructor</i>).</p> <p>If <i>in-lock-constructor</i> is non-nil it is called with the result of <i>constructor</i>, or with <code>nil</code> if <i>constructor</i> is <code>nil</code>. <i>in-lock-constructor</i> is called with <i>hash-table</i> locked, and its return value is guaranteed to be put in the table and to be returned by <code>gethash-ensuring</code>. If <i>in-lock-constructor</i> is <code>nil</code> then the value that is returned by <i>constructor</i>, or <code>nil</code>, is used.</p> |                                                       |
| Notes       | <ol style="list-style-type: none"> <li>1. If either the <i>constructor</i> or the <i>in-lock-constructor</i> is not simple, it is easier to use <code>with-ensuring-gethash</code>.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                       |

2. In most situations, using *constructor* to do all the work (which requires minimal holding of the lock) is better than using *in-lock-constructor*. It means that sometimes the work that *constructor* did is wasted, because another thread put the value in the table, but that overhead is normally less significant than the overhead of holding the lock for longer, with the associated potential deadlocks. Use *in-lock-constructor* only if it is essential that the result goes into the table.

See also

`ensure-hash-entry`  
`with-ensuring-gethash`  
 “Modifying a hash table with multiprocessing” on page 279

**\*handle-existing-defpackage\****Variable*

Summary      Controls LispWorks’ response when `defpackage` is used on an existing package that is different from the definition given.

Package      `hcl`

Initial value      `(:warn :modify)`

Description      The standard explicitly declines to define what `defpackage` does if the named package already exists and is in a different state to that described by the `defpackage` form. The variable `*handle-existing-defpackage*` is an extension to Common Lisp which allows you to select between alternative behaviors that are known to be useful.

The two alternatives are to modify the package to conform exactly to the definition, removing features if necessary, or to merely add features specified in the `defpackage` but missing from the package. You can also control whether a condition is signaled.

The variable consists of a list of any of the following:

|                       |                                                                          |
|-----------------------|--------------------------------------------------------------------------|
| <code>:error</code>   | Signal an error.                                                         |
| <code>:warn</code>    | Signal a warning.                                                        |
| <code>:add</code>     | Add the new symbols to the externals, imports, and so on.                |
| <code>:modify</code>  | Modify the package to have only these externals.                         |
| <code>:verbose</code> | The signaled errors or warnings also contain details of the differences. |

The options `:error` and `:warn` cannot be specified at the same time. One of `:add` and `:modify` must be specified. Undistinguished internals (that is, internal symbols that are not imported or shadowed), `:intern` options and sizes are ignored when deciding whether to signal.

Note that when you use `:modify` some symbols can be uninterned if `defpackage` imports another symbol with the same name from another package through `:import-from`, `:shadowing-import-from` or `:export`. This happens whether the symbol has a definition as a function, a variable, or nay other Lisp construct, so after making such a change in the package, you should re-execute the definitions that were (presumably erroneously) attached to the uninterned symbols.

|          |                                                                             |
|----------|-----------------------------------------------------------------------------|
| Notes    | * <code>handle-existing-defpackage</code> * is an extension to Common Lisp. |
| See also | <code>defpackage</code>                                                     |

## **\*`handle-old-in-package`\*** *Variable*

|         |                                                                     |
|---------|---------------------------------------------------------------------|
| Summary | Controls the handling of CLtL1-style <code>in-package</code> forms. |
| Package | <code>hcl</code>                                                    |

|                     |                                                                                                                                                                                                                                                                                                                                |                     |                                                                           |                    |                                              |                     |                             |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------------------------------------------------------------------|--------------------|----------------------------------------------|---------------------|-----------------------------|
| Initial value       | <code>:warn</code>                                                                                                                                                                                                                                                                                                             |                     |                                                                           |                    |                                              |                     |                             |
| Description         | The variable <code>*handle-old-in-package*</code> controls what happens when a CLtL1-style <code>in-package</code> form is processed. This refers to the specification in Common Lisp the Language, first Edition, which preceded ANSI Common Lisp and specified <code>in-package</code> as a function with keyword arguments. |                     |                                                                           |                    |                                              |                     |                             |
|                     | The allowed values are as follows:                                                                                                                                                                                                                                                                                             |                     |                                                                           |                    |                                              |                     |                             |
|                     | <table> <tr> <td><code>:quiet</code></td> <td>Quietly use the CLtL1 definition of the <code>in-package</code> function.</td> </tr> <tr> <td><code>:warn</code></td> <td>Signal a warning and use the old definition.</td> </tr> <tr> <td><code>:error</code></td> <td>Signal a continuable error.</td> </tr> </table>          | <code>:quiet</code> | Quietly use the CLtL1 definition of the <code>in-package</code> function. | <code>:warn</code> | Signal a warning and use the old definition. | <code>:error</code> | Signal a continuable error. |
| <code>:quiet</code> | Quietly use the CLtL1 definition of the <code>in-package</code> function.                                                                                                                                                                                                                                                      |                     |                                                                           |                    |                                              |                     |                             |
| <code>:warn</code>  | Signal a warning and use the old definition.                                                                                                                                                                                                                                                                                   |                     |                                                                           |                    |                                              |                     |                             |
| <code>:error</code> | Signal a continuable error.                                                                                                                                                                                                                                                                                                    |                     |                                                                           |                    |                                              |                     |                             |

See also `*handle-old-in-package-used-as-make-package*`

| <b><code>*handle-old-in-package-used-as-make-package*</code></b> |                                                                                                                                                                                                                                                                                                                                                                                        | <i>Variable</i> |                     |                                                                         |
|------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|---------------------|-------------------------------------------------------------------------|
| Summary                                                          | Controls the handling of CLtL1-style <code>in-package</code> forms.                                                                                                                                                                                                                                                                                                                    |                 |                     |                                                                         |
| Package                                                          | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                       |                 |                     |                                                                         |
| Initial value                                                    | <code>:quiet</code>                                                                                                                                                                                                                                                                                                                                                                    |                 |                     |                                                                         |
| Description                                                      | The variable <code>*handle-old-in-package-used-as-make-package*</code> controls what happens when a CLtL1-style <code>in-package</code> form which attempts to create a package is processed. This refers to the specification in Common Lisp the Language, first Edition, which preceded ANSI Common Lisp and specified <code>in-package</code> as a function with keyword arguments. |                 |                     |                                                                         |
|                                                                  | The allowed values are as follows:                                                                                                                                                                                                                                                                                                                                                     |                 |                     |                                                                         |
|                                                                  | <table> <tr> <td><code>:quiet</code></td> <td>Handle according to the value of <code>*handle-old-in-package*</code>.</td> </tr> </table>                                                                                                                                                                                                                                               |                 | <code>:quiet</code> | Handle according to the value of <code>*handle-old-in-package*</code> . |
| <code>:quiet</code>                                              | Handle according to the value of <code>*handle-old-in-package*</code> .                                                                                                                                                                                                                                                                                                                |                 |                     |                                                                         |

**:warn**      Signal a warning and create the package.  
**:error**      Signal a continuable error.

See also      **\*handle-old-in-package\***

## hash-table-weak-kind                          *Function*

Summary      Returns the weak kind of a hash table.

Signature      **hash-table-weak-kind** *hash-table* => *weakness-state*

Arguments      *hash-table*      A hash table.

Values      *weakness-state*      A keyword or **nil**.

Description      The function **hash-table-weak-kind** returns the weak kind (or weakness state) of the hash table *hash-table*.  
See **set-hash-table-weak** for the meaning of the different values of *weakness-state*.

See also      **set-hash-table-weak**  
**make-hash-table**

## load-data-file                          *Function*

Summary      Loads a binary data file created by **dump-forms-to-file** or **with-output-to-fasl-file**.

Package      **hcl**

Signature      **load-data-file** *pathname* &*rest* **load-args** &**key eval allow-any-type** *callback* => *result*

|           |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-----------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arguments | <i>pathname</i>       | A pathname designator naming a file which must have been created by <code>dump-forms-to-file</code> or <code>with-output-to-fasl-file</code> .                                                                                                                                                                                                                                                                                                                                                                                                                           |
|           | <i>load-args</i>      | Arguments which are passed to <code>load</code> , after removing the keyword-value pairs for <code>:allow-any-type</code> and <code>:callback</code> (if supplied).                                                                                                                                                                                                                                                                                                                                                                                                      |
|           | <i>allow-any-type</i> | A generalized boolean. When <code>allow-any-type</code> is true and the supplied <i>pathname</i> has a type, <code>load-data-file</code> tries to load it as a binary file without checking whether the type is known. When <code>allow-any-type</code> is <code>nil</code> , <code>load-data-type</code> tries to load only pathnames with known binary types (that is, either <code>*binary-file-type*</code> or in the list <code>*binary-file-types*</code> ), exactly like <code>load</code> . The default value of <code>allow-any-type</code> is <code>t</code> . |
|           | <i>callback</i>       | A function of one argument which is called with the result of the evaluation of each form in the file (or the form itself if <code>eval</code> is <code>nil</code> ). When <code>callback</code> is supplied, the keyword <code>:print</code> (which normally would be processed by <code>load</code> ) has no effect.                                                                                                                                                                                                                                                   |
|           |                       | <b>Note:</b> <code>callback</code> works only when the file was generated by LispWorks 7.0 or later.                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|           | <i>eval</i>           | A generalized boolean which controls whether the form is actually evaluated. When it is <code>nil</code> , the form as loaded from the file (without evaluation) is passed to the <code>callback</code> (if supplied) and printed (if <code>:print t</code> is supplied). When <code>eval</code> is non- <code>nil</code> , the form is evaluated before being passed to the <code>callback</code> and/or printed. The default value of <code>eval</code> is <code>t</code> .                                                                                            |

|             |               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Values      | <i>result</i> | A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Description |               | <p>The function <code>load-data-file</code> loads a fasl file created by <code>dump-forms-to-file</code> or <code>with-output-to-fasl-file</code>. <code>load-data-file</code> has similar semantics to <code>load</code>, but treats fasl files differently:</p> <ul style="list-style-type: none"> <li>• It cannot load a fasl generated by <code>compile-file</code>.</li> <li>• It allows loading of fasls generated by <code>dump-forms-to-file</code> or <code>with-output-to-fasl-file</code>, including those generated by a previous version of LispWorks, or other architectures of LispWorks, provided they have the same byte order.</li> <li>• It allows the option of a callback that is called on the result of loading the file.</li> </ul> <p>Fasl files generated by <code>dump-forms-to-file</code> or <code>with-output-to-fasl-file</code> must only be loaded using <code>load-data-file</code>.</p> <p><code>load-data-file</code> never loads a file as a text file, only files that are recognized as binary, which can be one of these possibilities:</p> <ul style="list-style-type: none"> <li>• <i>pathname</i> has a known type (either <code>*binary-file-type*</code> or in the list <code>*binary-file-types*</code>), or</li> <li>• <i>pathname</i> has an unknown type and <code>allow-any-type</code> is non-nil, or</li> <li>• <i>pathname</i> does not have a type and a matching file with the type matching <code>*binary-file-type*</code> is found.</li> </ul> <p>If <code>load-data-file</code> ends up trying to load a file that is not a proper binary file, it signals an error of type <code>fasl-error</code>.</p> <p>During the load, each form is loaded and, if <code>eval</code> is true, evaluated. If there is a <i>callback</i>, it is called with the result of the evaluation. Otherwise, the result may be printed if <code>:print t</code> was passed, and is then discarded.</p> |

|                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes               | <ol style="list-style-type: none"><li>1. The default value of <code>eval</code> is <code>t</code> to give the same behavior as in LispWorks 6.1 and earlier versions. Passing <code>eval</code> as <code>nil</code> and using a callback is probably a better way of transferring data around, because it avoids the calls to <code>eval</code>. If needed, <code>callback</code> can call <code>eval</code> explicitly.</li><li>2. All x86/x64 and ARM architectures have the same byte order, so <code>load-data-file</code> on any x86/x64 or ARM architecture can be used to load a data file that was generated on any x86/x64 or ARM architecture. The reverse byte order is used by Power architecture (IBM AIX and old PowerPC Mac OS X) and SPARC (old Solaris).</li><li>3. <code>load-data-file</code> returns the same value as <code>load</code>. In particular, the return value has nothing to do with the forms in the file. To actually have an effect, either the forms themselves have side effects, or the <code>callback</code> argument is used to perform any required side effects.</li><li>4. <code>load-data-file</code> does not do any read operation, but if the forms in the file contain symbols (except <code>nil</code>) such symbols need to be interned.</li></ol> |
| Compatibility notes | <ol style="list-style-type: none"><li>1. In LispWorks 6.1 and earlier versions <code>load-data-file</code> was in the <code>SYSTEM</code> package. It is still exported from <code>SYSTEM</code> for backwards compatibility.</li><li>2. In LispWorks 6.1 and earlier versions <code>load-data-file</code> gave errors if the type was not recognized, but now by default it allows any type.</li><li>3. In LispWorks 6.1 and earlier versions <code>load-data-file</code>, when given a plain lisp file, would load it the same way that <code>load</code> does. In LispWorks 7.0 or later it signals an error of type <code>fasl-error</code>.</li><li>4. <code>callback</code> works only when the fasl file was generated by LispWorks 7.0 or later.</li></ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Examples            | For a simple example see <code>dump-forms-to-file</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

See also `dump-forms-to-file`  
`with-output-to-fasl-file`  
`fasl-error`  
`*binary-file-type*`  
`*binary-file-types*`  
“Transferring large amounts of data” on page 476

**\*load-fasl-or-lisp-file\*** *Variable*

Summary Controls the behavior of `load` for untyped pathnames.

Package `hcl`

Description The variable `*load-fasl-or-lisp-file*` determines whether `(load "foo")` should load the binary file `(foo.ofasl, foo.ufasl, foo.xfasl` etc, depending on platform) or `foo.lisp`, when both exist. It may take the following values:

- `:load-newer` If the fasl is out-of-date, the lisp file is loaded, and a warning message is output in verbose mode.
- `:load-newer-no-warn`  
Like `:load-newer`, but without the warning.
- `:load-fasl` Always choose fasl files in preference to lisp files, but when verbose, warn if the lisp file is newer.
- `:load-fasl-no-warn`  
Like `:load-fasl`, but without the warning.
- `:load-lisp` Always choose lisp files in preference to fasl.
- `:recompile` If the fasl file is out-of-date or there is none, compile and load the new fasl.
- `:maybe-recompile`

If the fasl is out-of-date, queries whether to load it, recompile and then load it, or load the lisp file.

Initial value :**load-fasl**

| <b>make-ring</b>       | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |                    |             |           |                        |                                                       |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------|-------------|-----------|------------------------|-------------------------------------------------------|
| Summary                | Creates a "ring" object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |                    |             |           |                        |                                                       |
| Package                | <b>hcl</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |                    |             |           |                        |                                                       |
| Signature              | <b>make-ring size name &amp;optional delete-function =&gt; ring</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |                    |             |           |                        |                                                       |
| Arguments              | <table> <tr> <td><i>size</i></td><td>A positive fixnum.</td></tr> <tr> <td><i>name</i></td><td>A string.</td></tr> <tr> <td><i>delete-function</i></td><td>A function designator for a function of one argument.</td></tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <i>size</i> | A positive fixnum. | <i>name</i> | A string. | <i>delete-function</i> | A function designator for a function of one argument. |
| <i>size</i>            | A positive fixnum.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |                    |             |           |                        |                                                       |
| <i>name</i>            | A string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |                    |             |           |                        |                                                       |
| <i>delete-function</i> | A function designator for a function of one argument.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |                    |             |           |                        |                                                       |
| Values                 | <i>ring</i> A "ring" object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |                    |             |           |                        |                                                       |
| Description            | <p>The function <b>make-ring</b> creates a "ring" object, which can hold up to <i>size</i> elements. A ring has stack like behavior but is limited in size, and can be rotated.</p> <p><i>size</i> is the maximum number of elements that the ring <i>ring</i> can hold. Once <i>ring</i> has this number of elements, if an element is added to <i>ring</i> (by <b>ring-push</b>), an element is first removed from the ring.</p> <p><i>name</i> simply names the ring, but has no effect on its functionality. It is used when printing the ring object, and is returned by <b>ring-name</b>.</p> <p><i>delete-function</i>, if supplied, is called each time an element is removed from the ring (by <b>ring-push</b>) because it is full. The default value of <i>delete-function</i> is #'<b>identity</b>.</p> |             |                    |             |           |                        |                                                       |

The ring keeps the elements in a logical ring with an "insertion position". The function `ring-push` adds an element before the insertion position. If the ring is full, it first removes the element immediately after the insertion position.

The function `ring-pop` removes from the ring the element before the insertion point, and returns that element. Thus when using `ring-push` and `ring-pop` on their own, the ring behaves like a stack with limited length.

`rotate-ring` can be used to move the insertion point. `ring-ref` can be used to index into the ring. `map-ring`, `position-in-ring`, and `position-in-ring-forward` can be used to iterate through the ring's elements.

All access to a ring is thread-safe. Therefore access to a ring may hang if another process keeps it locked. If you need to guarantee no hanging, you can use `with-ring-locked` with non-nil `timeout` around the critical calls.

See also

`ring-push`  
`ring-pop`  
`rotate-ring`  
`ring-ref`  
`ring-length`  
`ringp`  
`ring-name`  
`map-ring`  
`position-in-ring`  
`with-ring-locked`

**make-unlocked-queue**  
**unlocked-queue-read**  
**unlocked-queue-peek**  
**unlocked-queue-ready**  
**unlocked-queue-send**  
**unlocked-queue-count**  
**unlocked-queue-size** *Functions*

Summary      Create and use an `unlocked-queue` object.

Package      `hcl`

Signature      `make-unlocked-queue &key size name => unlocked-queue`  
`unlocked-queue-read unlocked-queue => object`  
`unlocked-queue-peek unlocked-queue => object`  
`unlocked-queue-ready unlocked-queue => result`  
`unlocked-queue-send unlocked-queue object => object`  
`unlocked-queue-count unlocked-queue => count`  
`unlocked-queue-size unlocked-queue object => size`

Arguments      `size`      A positive integer.

`name`      A Lisp object.

`unlocked-queue`      An `unlocked-queue` object.

`object`      A Lisp object.

Values      `count`      A positive integer.

`object`      A Lisp object.

`result`      A boolean.

`size`      A positive integer.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The function <code>make-unlocked-queue</code> creates a new, empty <code>unlocked-queue</code> object.</p> <p>The functions <code>unlocked-queue-read</code>, <code>unlocked-queue-peek</code>, <code>unlocked-queue-ready</code>, <code>unlocked-queue-send</code>, <code>unlocked-queue-count</code> and <code>unlocked-queue-size</code> use an <code>unlocked-queue</code> object.</p> <p><code>size</code> is a hint of the maximum number of objects that are expected to be in the queue simultaneously. The queue is extended as needed, so <code>size</code> does not have to be a good guess.</p> <p><code>name</code> is used when printing the <code>unlocked-queue</code> and so it is useful for debugging. <code>name</code> is not used otherwise.</p> <p><code>unlocked-queue-read</code> checks whether there is anything in the queue, and if so removes the first object in the queue and returns it. Otherwise it returns <code>nil</code>.</p> <p><code>unlocked-queue-peek</code> checks whether there is anything in the queue, and if so returns the first object in the queue without modifying the queue. Otherwise it returns <code>nil</code>.</p> <p><code>unlocked-queue-ready</code> returns a boolean specifying whether there is anything in the queue.</p> <p><code>unlocked-queue-send</code> adds <i>object</i> to the end of the queue, extending the queue if needed. It returns its second argument.</p> <p><code>unlocked-queue-count</code> returns the number of objects in the queue.</p> <p><code>unlocked-queue-size</code> returns the current size of the queue. Note that it is increased when needed by <code>unlocked-queue-send</code></p> |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

#### See also

`make-mailbox`  
`unlocked-queue`

|             | <b>map-code-coverage-data</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <i>Function</i> |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Summary     | Calls a function on each of the files in a <code>code-coverage-data</code> object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                 |
| Package     | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                 |
| Signature   | <code>map-code-coverage-data ccd function &amp;key without-stats collect =&gt; list</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                 |
| Arguments   | <p><i>ccd</i>                    A <code>code-coverage-data</code> object or <code>t</code>.</p> <p><i>function</i>              A function designator.</p> <p><i>without-stats</i>          A generalized boolean.</p> <p><i>collect</i>                <code>nil</code>, <code>t</code> or <code>:truenames</code></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                 |
| Values      | <i>list</i> <code>nil</code> or a list either of truenames or of <code>code-coverage-file-stats</code> objects.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                 |
| Description | <p>The function <code>map-code-coverage-data</code> maps <i>function</i> over the files in <i>ccd</i> and optionally collects items for some of them. If <i>ccd</i> is <code>t</code>, this is interpreted as the internal <code>code-coverage-data</code> object.</p> <p>The arguments passed to <i>function</i> depend on <i>without-stats</i>. If <i>without-stats</i> is false then <i>function</i> is called with the truename and a <code>code-coverage-file-stats</code> object for the file. If <i>without-stats</i> is true, then <i>function</i> is applied only to the truename. The default value of <i>without-stats</i> is false.</p> <p>If <i>collect</i> is <code>t</code> (the default), then <code>map-code-coverage-data</code> collects the stats (when <i>without-stats</i> is false) or the truename (when <i>without-stats</i> is true) for each call to <i>function</i> that returns true. If <i>collect</i> is <code>:truenames</code>, then <code>map-code-coverage-data</code> collects the truename for each call to <i>function</i> that returns true.</p> <p>When <i>collect</i> is <code>nil</code>, <code>map-code-coverage-data</code> returns <code>nil</code>. Otherwise, it returns a list of the objects it collected.</p> |                 |

See also      **`filter-code-coverage-data`**  
**`code-coverage-data`**  
**`code-coverage-file-stats`**  
Chapter 10, “Code Coverage”

## **map-ring** *Function*

Summary      Calls a function on each element of a ring, modifying the element.

Package      **`hcl`**

Signature      **`map-ring ring function`**

Arguments      *ring*      A ring object created by **`make-ring`**.

*function*      A function designator for a function of one argument.

Description      The function **`map-ring`** funcalls the function *function* on each element in the ring in turn, and sets that ring element to the result.

Notes      1. *function* is called with the ring locked.

                  2. If you do not intend to modify the elements of *ring*, ensure that *function* returns its argument.

See also      **`make-ring`**  
**`position-in-ring`**  
**`position-in-ring-forward`**

## **mark-and-sweep** *Function*

Summary      Garbage collects a specified generation in 32-bit LispWorks.  
This function is deprecated: use **`gc-generation`** instead.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Signature   | <code>mark-and-sweep gen-number =&gt; bytes</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Arguments   | <p><code>gen-number</code>      0 for the most recent generation, 1 for the most recent two generations, and so on up to a maximum (usually 3). Numbers outside this range signal an error.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Values      | <p><code>bytes</code>      The number of bytes allocated in that generation.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Description | <p><code>mark-and-sweep</code> is used to garbage-collect a specified generation of memory (and all lower generations). A call to this function forces the garbage collector to scan the specified generations. This can be of use in obtaining consistent timings of programs that require memory allocation. Alternatively, performance can sometimes be improved by forcing a garbage collection, when it is known that little memory has been allocated since a previous collection, rather than waiting for a later, more extensive collection. For example, the function could be called outside a loop that allocates a small amount of memory.</p> <p>It is specially helpful to mark and sweep generation 2 when large, long-lived data structures become garbage, because by default it is never marked and swept. The higher the generation number the more time the <code>mark-and-sweep</code> takes, but also the more space recovered.</p> |
| Notes       | <p><code>mark-and-sweep</code> is implemented only in 32-bit LispWorks, and is deprecated. Use <code>gc-generation</code> instead.</p> <p><code>mark-and-sweep</code> is not relevant to the Memory Management API in 64-bit implementations. In 64-bit implementations you can use <code>gc-generation</code> or <code>marking-gc</code>.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Examples    | <pre>(mark-and-sweep 0) ; collect most recent generation (mark-and-sweep 3) ; collect all generations</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

See also [avoid-gc](#)  
[block-promotion](#)  
[get-gc-parameters](#)  
[gc-generation](#)  
[gc-if-needed](#)  
[normal-gc](#)  
[set-array-weak](#)  
[set-gc-parameters](#)  
[set-hash-table-weak](#)  
[without-interrupts](#)  
[with-heavy-allocation](#)  
“Guidance for control of the memory management system”  
on page 130

**\*max-trace-indent\*** *Variable*

|               |                                                                                                                                                                                                                                                                                                                    |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary       | The maximum level of indentation used in trace output.                                                                                                                                                                                                                                                             |
| Package       | <code>hcl</code>                                                                                                                                                                                                                                                                                                   |
| Initial value | 50                                                                                                                                                                                                                                                                                                                 |
| Description   | <code>*max-trace-indent*</code> is the maximum indentation that is used during output from tracing. Typically each successive invocation of tracing causes the output to be further indented, making it easier to see how the calls are nested. The value of <code>*max-trace-indent*</code> should be an integer. |
| Example       | <pre>USER 8 &gt; (setq hcl:*max-trace-indent* 4) 4 USER 9 &gt; (defun sum (n res) (if (= n 0)                                 res                                 (+ n (sum (1- n) res)))) SUM  USER 10 &gt; (trace sum) SUM</pre>                                                                                 |

```

USER 11 > (sum 3 0)
0 SUM > (3 0)
1 SUM > (2 0)
2 SUM > (1 0)
3 SUM > (0 0)
3 SUM < (0)
2 SUM < (1)
1 SUM < (3)
0 SUM < (6)
6

```

Notes      \*`max-trace-indent`\* is an extension to Common Lisp.

See also      `trace`

## `merge-code-coverage-data`

## `destructive-merge-code-coverage-data`

*Functions*

Summary      Merge two `code-coverage-data` objects.

Package      `hcl`

Signature      `merge-code-coverage-data ccd1 ccd2 name => result`

`destructive-merge-code-coverage-data ccd1 ccd2 => ccd1`

Arguments      `ccd1`      A `code-coverage-data` object or (for  
`merge-code-coverage-data` only) t.

`ccd2`      A `code-coverage-data` object or t.

`name`      A Lisp object, normally a symbol or a string.

Values      `result`      A `code-coverage-data` object.

Description      The function `merge-code-coverage-data` and `destructive-merge-code-coverage-data` merge two `code-coverage-data` objects.

Merging means taking all the files from *ccd1* together with those files from *ccd2* which do not have information in *ccd1*. For files that appear in both *ccd1* and *ccd2*, the information in *ccd2* is ignored.

`merge-code-coverage-data` creates a new `code-coverage-data` object containing the information for each file, and with name *name*.

`destructive-merge-code-coverage-data` adds to *ccd1* those files from *ccd2* which are not already there, and returns *ccd1*.

If either of the datas is the internal `code-coverage-data` object, the file information is copied, so it does not change anymore. Otherwise it just copies the pointer, because the file information is read-only.

See also      Chapter 10, “Code Coverage”  
`code-coverage-data`

## modify-hash *Function*

Summary      Reads and writes an entry in a hash table atomically.

Package      `hcl`

Signature      `modify-hash hash-table key function => new-value, key`

Arguments      `hash-table`      A hash table.

`key`          An object.

`function`     A function designator.

Values      `new-value`      An object.

`key`          An object.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The function <code>modify-hash</code> locks the hash table <i>hash-table</i>. It then calls the function <i>function</i> with three arguments: <i>key</i>, the value currently associated with <i>key</i> in <i>hash-table</i> (if any), and a flag which is true if the key was in the table. (This last argument is needed in case the associated value is <code>nil</code>).</p> <p><code>modify-hash</code> then sets the result of the function <i>function</i> as the value for <i>key</i> in the table. <code>modify-hash</code> returns two values, the <i>new-value</i> and the <i>key</i>.</p> <p>The overall effect is like:</p> <pre>(with-hash-table-locked   hash-table   (multiple-value-bind (value found-p)     (gethash key hash-table)     (let ((new-value (funcall function                                key value found-p)))       (setf (gethash key hash-table) new-value)       (values new-value key))))</pre> <p>but <code>modify-hash</code> should be more efficient.</p> <p>It is guaranteed that no other thread can modify the value associated with <i>key</i> until <code>modify-hash</code> returns.</p> |
| Notes       | <i>function</i> is called with <i>hash-table</i> locked, so it should not do anything that may require hanging the modification, or that waits for another process that tries to modify the table.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| See also    | <code>make-hash-table</code><br><code>with-hash-table-locked</code><br>“Atomicity and thread-safety of the LispWorks implementation” on page 265<br>“Modifying a hash table with multiprocessing” on page 279                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

**normal-gc***Function*

|         |                                                                              |
|---------|------------------------------------------------------------------------------|
| Summary | Returns the image to normal garbage collection activity in 32-bit LispWorks. |
|---------|------------------------------------------------------------------------------|

|             |                                                                                                                                                                                                                                                                                           |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>hcl</code>                                                                                                                                                                                                                                                                          |
| Signature   | <code>normal-gc =&gt; t</code>                                                                                                                                                                                                                                                            |
| Arguments   | None.                                                                                                                                                                                                                                                                                     |
| Values      | The function returns the single result <code>t</code> .                                                                                                                                                                                                                                   |
| Description | <p><code>normal-gc</code> resets various internal parameters that determine the frequency and extent of garbage collection to their default settings.</p> <p><code>normal-gc</code> is generally used in conjunction with <code>avoid-gc</code>, to cancel the effects of the latter.</p> |
| Notes       | <code>normal-gc</code> is useful only in 32-bit LispWorks. In 64-bit implementations it does nothing and simply returns <code>nil</code> .                                                                                                                                                |
| See also    | <code>avoid-gc</code><br><code>get-gc-parameters</code><br><code>gc-if-needed</code><br><code>mark-and-sweep</code><br><code>set-gc-parameters</code><br><code>without-interrupts</code><br><code>with-heavy-allocation</code><br>“Memory Management in 32-bit LispWorks” on page 135     |

| <b>*packages-for-warn-on-redefinition*</b> |                                                                                      | <i>Variable</i> |
|--------------------------------------------|--------------------------------------------------------------------------------------|-----------------|
| Summary                                    | A list specifying packages whose symbols should be checked on attempted definitions. |                 |
| Package                                    | <code>hcl</code>                                                                     |                 |
| Initial value                              | <code>(:implementation)</code>                                                       |                 |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The variable <code>*packages-for-warn-on-redefinition*</code> is a list of package names or the keyword <code>:implementation</code>, specifying packages which are "protected". For "protected" packages, LispWorks checks before defining (using any of the definer macros like <code>c1:defun</code>, <code>c1:defclass</code> and so on) any external symbol of these packages, and takes the action specified by <code>*handle-warn-on-redefinition*</code> (which defaults to signaling an error).</p> <p>The symbol <code>:implementation</code> in <code>*packages-for-warn-on-redefinition*</code> indicates all of the packages which are part of the LispWorks implementation. That includes all the documented packages, including COMMON-LISP and KEYWORD but excluding some "user" packages like CL-USER and KW-USER, and some packages that are used internally.</p> <p>For symbol value, setting and rebinding is not checked, but defining using definer macros like <code>c1:defvar</code> and <code>c1:define-parameter</code> is checked.</p> |
| Notes       | <ol style="list-style-type: none"><li>1. The checking is useful because it is relatively easy to redefine an external symbol by mistake, and it leads to undefined behavior which is difficult to debug. It is therefore a bad idea to remove <code>:implementation</code> from the list. In situations when this is required, you should do it by rebinding <code>*packages-for-warn-on-redefinition*</code> rather than setting it.</li><li>2. You can protect your packages by adding their package names to this list.</li><li>3. The check is applied for any definition, whether it is actually a redefinition or not. For example, trying to define the symbol <code>c1:stream</code> as a function gives an error (by default), even though <code>c1:stream</code> has only a class definition, and trying to define <code>c1:car</code> as a class also errors even though <code>c1:car</code> has only a function definition.</li></ol>                                                                                                                    |

4. You can check whether a package is an implementation package by using `package-flagged-p` with the keyword `:implementation`.

|                    |                                                                                                                                                                                                     |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Compatibility note | <code>:implementation</code> was new in LispWorks 7.0.<br>In LispWorks 6.1 and earlier versions, the list could contain only package names, and the initial value was a long list of package names. |
| See also           | <code>*handle-warn-on-redefinition*</code><br><code>package-flagged-p</code><br>“Protecting packages” on page 88                                                                                    |

## parse-float *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                   |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Parses a float from a string and returns it as <code>float</code> .                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                   |
| Package     | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                   |
| Signature   | <code>parse-float string &amp;key start end default-format =&gt; float</code>                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                   |
| Arguments   | <code>string</code>                                                                                                                                                                                                                                                                                                                                                                                                              | A string                                                                                                                                          |
|             | <code>start, end</code>                                                                                                                                                                                                                                                                                                                                                                                                          | Bounding index designators for <code>string</code>                                                                                                |
|             | <code>default-format</code>                                                                                                                                                                                                                                                                                                                                                                                                      | One of the atomic type specifiers <code>short-float</code> , <code>single-float</code> , <code>double-float</code> , or <code>long-float</code> . |
| Values      | <code>float</code>                                                                                                                                                                                                                                                                                                                                                                                                               | A float                                                                                                                                           |
| Description | <p>The function <code>parse-float</code> parses a float from the substring of <code>string</code> delimited by <code>start</code> and <code>end</code> and returns it as <code>float</code>. If the substring represents an integer or the exponent marker is E or is omitted, then <code>float</code> will be of type <code>default-format</code>, which defaults to the value of <code>*read-default-float-format*</code>.</p> |                                                                                                                                                   |

`mat*`. Otherwise, its type will match the exponent marker as specified by 2.3.2.2 "Syntax of a Float" in the Common Lisp standard.

If the substring does not represent an integer or a float, then an error of type `parse-error` is signaled.

### Examples

```
(parse-float "10") => 10.0f0
(parse-float "10" :default-format 'double-float) =>
10.0d0
(parse-float "10d0") => 10.0d0
(parse-float "10.5") => 10.5f0
(parse-float "10.5d0") => 10.5d0
```

## position-in-ring

## position-in-ring-forward

## *Functions*

**Summary**      Finds the first ring element that matches a supplied item and returns its index.

**Package**      `hcl`

**Signature**      `position-in-ring ring item index &key test => result`  
`position-in-ring-forward ring item index &key test => result`

**Arguments**      `ring`      A ring object created by `make-ring`.

`index`      A non-negative integer.

`item`      A Lisp object.

`test`      A function designator for a function of two arguments.

**Values**      `result`      A non-negative integer or `nil`.

|                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description         | <p>The function <b>position-in-ring</b> finds in the ring <i>ring</i> the first element that matches <i>item</i> and returns its index, or <b>nil</b> if there is no match. The search starts from index <i>index</i> and proceeds "backward" up to the length of the ring (its current number of elements). In other words, it tests all the elements that would be returned by <b>ring-ref</b> with indices <i>index</i>, <i>index+1</i>, ..., <i>length-1</i>. It does not wrap around, so elements between indices 0 and <i>index</i> are not tested.</p> <p>The function <b>position-in-ring-forward</b> does the same except that it searches from <i>index</i> "forward" to the insertion point. In other words, it tests the elements that would be returned by <b>ring-ref</b> with indices <i>index</i>, <i>index-1</i>, ..., 0.</p> <p>The comparison is done by calling <i>test</i>, with <i>item</i> as first argument and each element in the ring as the second argument. The default value of <i>test</i> is <b>eq1</b>.</p> |
| Notes               | <i>test</i> is called with the ring locked.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Compatibility notes | In LispWorks 6.1 and earlier versions, these functions are called <b>find-in-ring</b> and <b>find-in-ring-forward</b> . They have been renamed to match the Common Lisp convention that a function returning an index is named <b>position-*</b> . The old names are retained for backwards compatibility, but are deprecated.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| See also            | <b>make-ring</b><br><b>map-ring</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

|           | <i>Function</i>                                                         |
|-----------|-------------------------------------------------------------------------|
| Summary   | Prints a report of symbols that have been profiled.                     |
| Package   | <b>hcl</b>                                                              |
| Signature | <b>print-profile-list &amp;key sort limit cutoff collapse =&gt; nil</b> |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                         |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| Arguments   | <i>sort</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | :call, :profile or :top |
|             | <i>limit</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | An integer.             |
|             | <i>collapse</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | A generalized boolean.  |
|             | <i>cutoff</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | A real number.          |
| Values      | <code>print-profile-list</code> returns nil.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                         |
| Description | <p>The function <code>print-profile-list</code> prints a report of symbols, after profiling using <code>profile</code>, or <code>start-profiling</code> followed by <code>stop-profiling</code>.</p> <p>If the profiler was set up with <code>style :tree</code>, then a tree of calls is printed first, according to <i>limit</i>, <i>cutoff</i> and <i>collapse</i>. Then a columnar report is printed showing how often each function was called, profiled and found on the top of the stack. This report is sorted by the column indicated by the value of <i>sort</i>.</p> <p>If the profiler was set up with <code>style :list</code>, then only the columnar report is printed.</p> <p><i>sort</i> can take these values:</p> <ul style="list-style-type: none"> <li>:call Sort by the number of times the function was called.</li> <li>:profile Sort by the number of times the function was found on the stack.</li> <li>:top Sort by the number of times the function was found at the top of the stack.</li> </ul> <p>If <i>sort</i> is not passed then the results are printed as after the profiling run. The default is the value of the variable <code>*default-profiler-sort*</code>.</p> <p><i>limit</i> is the maximum number of lines printed in the columnar report as described for <code>*default-profiler-limit*</code>. The default is the value of the variable <code>*default-profiler-limit*</code>.</p> |                         |

*cutoff* is the minimum percentage that the profiler will display in the output tree as described for **\*default-profiler-cutoff\***. The default is the value of the variable **\*default-profiler-cutoff\***.

*collapse* controls collapsing of the output tree as described for **\*default-profiler-collapse\***. The default is the value of the variable **\*default-profiler-collapse\***.

Notes You should not call **print-profile-list** while the profiler is running (see **profile** and **start-profiling**) or suspended (see **stop-profiling**).

Example First set up the profiler :

```
CL-USER 1 > (set-up-profiler
                 :symbols
                 '(cadr car eql fixnump + 1+ caaddr caddr))

CL-USER 2 > (profile (dotimes (a 1000000 nil)
                         (+ a a)
                         (car '(foo))))
```

Then call **print-profile-list**:

```

CL-USER 3 > (print-profile-list :sort :call)

profile-stacks called 327 times

Cumulative profile summary
Symbol          called   profile
(%)      top   (%)
CADR           5000012    13
( 4)        13 ( 4)
CDDR           3000000    3
( 1)        3 ( 1)
EQL            2000202    4
( 1)        4 ( 1)
FIXNUMP         2000003    2
( 1)        2 ( 1)
CAR             1000000    1
( 0)        1 ( 0)
+               1000000    3
( 1)        3 ( 1)
CAADR          1000000    2
( 1)        2 ( 1)
1+             1000000    2
( 1)        2 ( 1)

Top of stack not monitored 91% of the time
NIL

```

**Notes** You can suppress printing of those symbols that are currently profiled but which were not called in the profiling run by setting `system:*profiler-print-out-all*` to `nil`.

`system:*profiler-print-out-all*` is a variable defined when the profiler is loaded by `set-up-profiler`. Its initial value is `nil`.

**See also** `*default-profiler-collapse*`  
`*default-profiler-cutoff*`  
`*default-profiler-limit*`  
`*default-profiler-sort*`

## **\*print-string\*** *Variable*

Summary     Specifies a maximum length when printing strings.

Package     `hcl`

Initial value     `t`

Description     The variable `*print-string*` controls whether the printer uses an abbreviated form for strings when `*print-escape*` is true.

If the value of `*print-string*` is `t` then strings are printed in full as specified by ANSI Common Lisp.

If the value of `*print-string*` is `nil`, then strings are printed as unreadable objects with no specific information about the string.

If the value of `*print-string*` is an integer, then strings longer than `*print-string*` are printed as unreadable objects that include the type, length and first `*print-string*` characters.

## **profile** *Macro*

Summary     Profile while executing some forms.

Package     `hcl`

Signature     `profile &body forms => results-of-final-form`

Arguments     `forms`     Lisp forms.

Values     `results-of-final-form`Results of the final form in `forms`.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | The macro <b>profile</b> starts the profiler, evaluates <i>forms</i> , stops the profiler, reports the results of the profiling, and then returns the results of the last form in <i>forms</i> .<br><br>The profiler is described in Chapter 12, “The Profiler”.                                                                                                                                                                     |
| Note        | <b>profile</b> profiles all processes. For better control of this, use <b>start-profiling</b> or <b>do-profiling</b> .<br><br>If <b>profile</b> is invoked before <b>set-up-profiler</b> was ever called, it calls <b>set-up-profiler</b> implicitly without arguments.<br><br><b>profile</b> cannot be called while another profiling operation is running, either by a parallel call to <b>profile</b> or <b>start-profiling</b> . |
| See also    | <b>start-profiling</b><br><b>stop-profiling</b><br><b>set-up-profiler</b><br>Chapter 12, “The Profiler”<br>“Guidance for control of the memory management system” on page 130                                                                                                                                                                                                                                                        |

| <b>*profiler-threshold*</b> <span style="float: right;"><i>Variable</i></span> |                                                                                                                                                       |
|--------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary                                                                        | Controls which symbols are profiled on repeated profiling runs.                                                                                       |
| Package                                                                        | <b>hcl</b>                                                                                                                                            |
| Description                                                                    | <b>*profiler-threshold*</b> is used with repeated profiling runs, to control which symbols are profiled. It is set by <b>set-profiler-threshold</b> . |
| See also                                                                       | <b>set-profiler-threshold</b>                                                                                                                         |

|                              |                                                                                                                                                                                                                                                                                                                                            |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>*profile-symbol-list*</b> | <i>Variable</i>                                                                                                                                                                                                                                                                                                                            |
| Summary                      | Deprecated. The list of symbols to be profiled.                                                                                                                                                                                                                                                                                            |
| Package                      | <code>hcl</code>                                                                                                                                                                                                                                                                                                                           |
| Description                  | <code>*profile-symbol-list*</code> is the list of symbols that are profiled if <code>profile</code> is called. Symbols in this list are monitored by the profiler to see if their function objects are on the stack when the profiler interrupts the Lisp process. The length of this list does not affect the speed of the profiling run. |
| Initial value                | <code>nil</code>                                                                                                                                                                                                                                                                                                                           |
| Notes                        | <code>*profile-symbol-list*</code> should normally be set by one of the above functions which check that the symbol is suitable for profiling before adding them to the list.                                                                                                                                                              |
| See also                     | <code>add-symbol-profiler</code><br><code>remove-symbol-profiler</code><br><code>set-up-profiler</code>                                                                                                                                                                                                                                    |

|                                    |                                                                                                     |
|------------------------------------|-----------------------------------------------------------------------------------------------------|
| <b>profiler-tree-from-function</b> | <i>Function</i>                                                                                     |
| Summary                            | Prints a call tree of profiled code below a given function.                                         |
| Package                            | <code>hcl</code>                                                                                    |
| Signature                          | <code>profiler-tree-from-function <i>function-name</i> &amp;optional <i>max-depth</i></code>        |
| Arguments                          | <i>function-name</i> A symbol naming a function.<br><i>max-depth</i> A number or <code>nil</code> . |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The function <code>profiler-tree-from-function</code> prints a tree with root <i>function-name</i> whose children are the callees of <i>function-name</i> and their callees.</p> <p><code>profiler-tree-from-function</code> uses the data from the previous 'profile session' with style <code>:tree</code>. A profile session ends at the end of <code>profile</code> or when <code>stop-profiling</code> is called, or when the Profiler tool finishes profiling.</p> <p>In both cases the counts of profile calls is the total counts of the calls to <i>function-name</i>. Note that the percentages (the number in parentheses) are percentages from the total number of profile calls, rather than from the numbers of calls to <i>function-name</i>.</p> <p>If <i>max-depth</i> is a number it limits the depth of tree that is printed to that value. The default value of <i>max-depth</i> is <code>nil</code>, meaning no limit on the depth that is printed.</p> |
| See also    | <p><code>profile</code><br/> <code>start-profiling</code><br/> <code>stop-profiling</code><br/>     "Profiler output" on page 170</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

|                                  | <b>Function</b>                                                                                                         |
|----------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| <b>profiler-tree-to-function</b> |                                                                                                                         |
| Summary                          | Prints a reversed call tree of profiled code below a given function.                                                    |
| Package                          | <code>hcl</code>                                                                                                        |
| Signature                        | <code>profiler-tree-to-function <i>function-name</i> &amp;optional <i>max-depth</i></code>                              |
| Arguments                        | <p><i>function-name</i>    A symbol naming a function.</p> <p><i>max-depth</i>        A number or <code>nil</code>.</p> |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The function <code>profiler-tree-to-function</code> prints a tree with root <i>function-name</i> whose children are the callers of <i>function-name</i> and their callers. Note that the tree is reversed, that is, callers appear under their callees.</p> <p><code>profiler-tree-to-function</code> uses the data from the previous 'profile session' with style <code>:tree</code>. A profile session ends at the end of <code>profile</code> or when <code>stop-profiling</code> is called, or when the Profiler tool finishes profiling.</p> <p>In both cases the counts of profile calls is the total counts of the calls to <i>function-name</i>. Note that the percentages (the number in parentheses) are percentages from the total number of profile calls, rather than from the numbers of calls to <i>function-name</i>.</p> <p><i>max-depth</i> limits the depth of tree that is printed. If <i>max-depth</i> is <code>nil</code> there is no limit on the depth that is printed. The default value of <i>max-depth</i> is 7.</p> |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

See also `profile`  
`profiler-tree-from-function`  
`stop-profiling`  
“Profiler output” on page 170

|           |                       | <i>Function</i>                                                                           |
|-----------|-----------------------|-------------------------------------------------------------------------------------------|
| Summary   |                       | Attempts to reduce the size of the Lisp image, without enlarging it even temporarily.     |
| Package   |                       | <code>hcl</code>                                                                          |
| Signature |                       | <code>reduce-memory &amp;optional full =&gt; new-size</code>                              |
| Arguments | <code>full</code>     | <code>nil</code> or <code>t</code> (or 0, 1, 2 or <code>:aggressive</code> on Mobile GC). |
| Values    | <code>new-size</code> | A positive integer.                                                                       |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The function <code>reduce-memory</code> frees memory and tries to reduce the size of the Lisp image, without enlarging it even temporarily.</p> <p><code>reduce-memory</code> has the same effect as <code>clean-down</code>, except that <code>clean-down</code> may temporarily increase the size of the image in order to be able to promote from lower generations. <code>reduce-memory</code> never increases the image size, which means that it may fail to promote. This will cause future garbage collections to be slower, until the promotion actually occurs.</p> <p><code>reduce-memory</code> is intended to be used when the operating system signals that the memory is low, which is a common feature of mobile platforms, for example <code>onTrimMemory</code> and <code>onLowMemory</code> in Android and <code>didReceiveMemoryWarning</code> in iOS. Using <code>clean-down</code> in this situation may cause a temporary increase in size, which may cause the system to run out of memory, or maybe just kill the Lisp process. In other circumstances <code>clean-down</code> should do a better job (and you might also consider <code>try-move-in-generation</code>).</p> <p>In 32-bit LispWorks, if <code>full</code> is <code>nil</code>, <code>reduce-memory</code> frees memory and promotes live objects to generation 2. When <code>full</code> is non-<code>nil</code>, <code>reduce-memory</code> frees and promotes to generation 3.</p> <p>In ordinary (Sparse) 64-bit LispWorks, <code>full</code> is ignored. The call just frees what it can free easily.</p> <p>When using the Mobile GC, if <code>full</code> is <code>nil</code>, <code>reduce-memory</code> just frees what it can free easily. If <code>full</code> is <code>t</code>, <code>reduce-memory</code> performs a garbage collection on generation 2 and then frees what it can free easily. If <code>full</code> is <code>:aggressive</code>, <code>reduce-memory</code> performs one or more garbage collections until memory is no longer being freed and then frees what it can free easily.</p> <p>When <code>full</code> is a integer (0, 1 or 2), it specifies a generation number to garbage collect and <code>reduce-memory</code> garbage collects this generation and then frees what it can free easily. Using 2 is the same as using <code>t</code>.</p> <p>The default value of <code>full</code> is <code>nil</code>.</p> |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

`reduce-memory` returns the new size of the Lisp image after reduction, in bytes.

- Notes
1. The default of *full* is `nil`, which is different from `clean-down` where it defaults to `t`.
  2. In 32-bit LispWorks, `reduce-memory` with no argument or `nil` differs from `(clean-down nil)` by trying to reduce the memory. `(clean-down nil)` frees and promotes, but does not try to reduce the size (and may actually increase it).
  3. When using the Mobile GC, `reduce-memory` releases any reserved memory that the system keeps. As a result any following `reduce-memory` with argument non-`nil` will be less effective because there will be no reserved memory to perform copying garbage collection.

See also      `clean-down`  
                  `try-move-in-generation` (32-bit only)

|             |                 | <i>Function</i>                                                                                                                          |
|-------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     |                 | Lists special variables referenced by a definition.                                                                                      |
| Package     |                 | <code>hcl</code>                                                                                                                         |
| Signature   |                 | <code>references-who function =&gt; result</code>                                                                                        |
| Arguments   | <i>function</i> | A symbol or a function dspec.                                                                                                            |
| Values      | <i>result</i>   | A list.                                                                                                                                  |
| Description |                 | The function <code>references-who</code> returns a list of the special variables referenced by the definition named by <i>function</i> . |

|          |                                                                                                                                                   |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | The cross-referencing information used by <code>references-who</code> is generated when code is compiled with source-level debugging switched on. |
| See also | <code>binds-who</code><br><code>toggle-source-debugging</code><br><code>sets-who</code><br><code>who-references</code>                            |

## **remove-special-free-action** *Function*

|             |                                                                                                                                                                                         |                                                                                                          |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| Summary     | Removes the specified function from the special actions performed when flagged objects are garbage collected.                                                                           |                                                                                                          |
| Package     | <code>hcl</code>                                                                                                                                                                        |                                                                                                          |
| Signature   | <code>remove-special-free-action</code> <i>function</i> => <i>function-list</i>                                                                                                         |                                                                                                          |
| Arguments   | <i>function</i>                                                                                                                                                                         | The function to be removed.                                                                              |
| Values      | <i>function-list</i>                                                                                                                                                                    | A list of the functions currently called to perform special actions, not including the one just removed. |
| Description | Removes the specified function from the special actions performed when flagged objects are garbage-collected. (The special actions are added by <code>add-special-free-action</code> .) |                                                                                                          |
| See also    | <code>add-special-free-action</code><br><code>flag-special-free-action</code><br><code>flag-not-special-free-action</code>                                                              |                                                                                                          |

## **remove-symbol-profiler** *Function*

|             |                                                                                                                        |
|-------------|------------------------------------------------------------------------------------------------------------------------|
| Summary     | Deprecated. Removes a symbol from the list of profiled symbols.                                                        |
| Package     | <code>hcl</code>                                                                                                       |
| Signature   | <code>remove-symbol-profiler symbol =&gt; nil</code>                                                                   |
| Arguments   | <code>symbol</code> A symbol to be removed from the <code>*profile-symbol-list*</code> .                               |
| Values      | Returns <code>nil</code> .                                                                                             |
| Description | The function <code>remove-symbol-profiler</code> is deprecated. It removes a symbol from the list of profiled symbols. |
| See also    | <code>add-symbol-profiler</code>                                                                                       |

## **reset-profiler** *Function*

|           |                                                                                                                                                                                                                                                                                                   |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary   | Resets the profiler so that symbols below a given threshold are no longer profiled.                                                                                                                                                                                                               |
| Package   | <code>hcl</code>                                                                                                                                                                                                                                                                                  |
| Signature | <code>reset-profiler &amp;key according-to =&gt; nil</code>                                                                                                                                                                                                                                       |
| Arguments | <code>according-to</code> One of two values — <code>:profile</code> or <code>:top</code> . This refers to which column of the profiling results <code>reset-profiler</code> uses to determine which symbols to delete from the list of symbols to profile. The default is <code>:profile</code> . |
| Values    | <code>reset-profiler</code> returns <code>nil</code> .                                                                                                                                                                                                                                            |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | This function updates the list of symbols being profiled according to the results of the previous profiling run. <code>reset-profiler</code> runs down the list of symbols being profiled and removes any symbols whose appearance in the previous profiling run falls below the value <code>*profiler-threshold*</code> . In this way the number of symbols being considered by the profiler can be reduced to just those which are important. |
| Example     | <code>(reset-profiler :according-to :top)</code>                                                                                                                                                                                                                                                                                                                                                                                                |
| Notes       | Reducing the number of symbols in the list of symbols to profile does not actually speed up the execution of the form being profiled, but does reduce the setting up time of the profiler and the size of the list of results.                                                                                                                                                                                                                  |
| See also    | <code>profile</code><br><code>*profiler-threshold*</code><br><code>print-profile-list</code><br><code>set-profiler-threshold</code>                                                                                                                                                                                                                                                                                                             |

| <b>reset-ring</b> |                                                                                                            | <i>Function</i>                                   |
|-------------------|------------------------------------------------------------------------------------------------------------|---------------------------------------------------|
| Summary           | Resets a ring.                                                                                             |                                                   |
| Package           | <code>hcl</code>                                                                                           |                                                   |
| Signature         | <code>reset-ring ring =&gt; nil</code>                                                                     |                                                   |
| Arguments         | <code>ring</code>                                                                                          | A ring object created by <code>make-ring</code> . |
| Description       | The function <code>reset-ring</code> resets the ring, that is it makes <code>ring</code> completely empty. |                                                   |
| See also          | <code>make-ring</code>                                                                                     |                                                   |

## **ringp**

### *Function*

|             |                                                                                                               |                |
|-------------|---------------------------------------------------------------------------------------------------------------|----------------|
| Summary     | The predicate for rings.                                                                                      |                |
| Package     | <code>hcl</code>                                                                                              |                |
| Signature   | <code>ringp object =&gt; result</code>                                                                        |                |
| Arguments   | <code>object</code>                                                                                           | A Lisp object. |
| Values      | <code>result</code>                                                                                           | A boolean.     |
| Description | The function <code>ringp</code> is a predicate for rings, that is objects created by <code>make-ring</code> . |                |
| See also    | <code>make-ring</code>                                                                                        |                |

## **ring-length**

### *Function*

|             |                                                                                                                                |                                                   |
|-------------|--------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|
| Summary     | Gets the element count and maximum size of a ring.                                                                             |                                                   |
| Package     | <code>hcl</code>                                                                                                               |                                                   |
| Signature   | <code>ring-length ring =&gt; number-of-elements, size</code>                                                                   |                                                   |
| Arguments   | <code>ring</code>                                                                                                              | A ring object created by <code>make-ring</code> . |
| Values      | <code>number-of-elements</code>                                                                                                | A non-negative fixnum.                            |
|             | <code>size</code>                                                                                                              | A positive fixnum.                                |
| Description | The function <code>ring-length</code> returns as multiple values the number of elements in the ring ring and its maximum size. |                                                   |
| See also    | <code>make-ring</code>                                                                                                         |                                                   |

| <b>ring-name</b> | <i>Function</i>                                                                                                                                                                                                                                                                                            |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary          | Returns the name of a ring.                                                                                                                                                                                                                                                                                |
| Package          | <code>hcl</code>                                                                                                                                                                                                                                                                                           |
| Signature        | <code>ring-name ring =&gt; name</code>                                                                                                                                                                                                                                                                     |
| Arguments        | <code>ring</code> A ring object created by <code>make-ring</code> .                                                                                                                                                                                                                                        |
| Values           | <code>name</code> A string.                                                                                                                                                                                                                                                                                |
| Description      | The function <code>ring-name</code> returns the name of the ring <code>ring</code> .                                                                                                                                                                                                                       |
| See also         | <code>make-ring</code>                                                                                                                                                                                                                                                                                     |
| <b>ring-pop</b>  | <i>Function</i>                                                                                                                                                                                                                                                                                            |
| Summary          | Removes an element from a ring and returns the element before the insertion point.                                                                                                                                                                                                                         |
| Package          | <code>hcl</code>                                                                                                                                                                                                                                                                                           |
| Signature        | <code>ring-pop ring &amp;optional remove =&gt; object</code>                                                                                                                                                                                                                                               |
| Arguments        | <code>ring</code> A ring object created by <code>make-ring</code> .<br><code>remove</code> A generalized boolean.                                                                                                                                                                                          |
| Values           | <code>object</code> A Lisp object.                                                                                                                                                                                                                                                                         |
| Description      | The function <code>ring-pop</code> removes (by default) an element from the ring and returns the element before the insertion point.<br>If <code>remove</code> is true then the element is removed from the ring. If <code>remove</code> is <code>nil</code> then the element remains and instead the ring |

is rotated by 1 as if by (`rotate-ring ring 1`). The default value of `remove` is `t`.

`ring-pop` signals an error when called on an empty ring.

**Examples** These 3 forms all return the same values, but the first form removes an element from the ring, while the other two leave all the elements in the ring:

```
(values (ring-pop ring) (ring-ref ring 0))  
(values (ring-pop ring t) (ring-ref ring 0))  
(values (ring-ref ring 0) (rotate-ring ring 1))
```

**See also** `ring-push`  
`make-ring`  
`rotate-ring`  
`ring-ref`  
`ring-length`

## **ring-push** *Function*

**Summary** Adds a Lisp object to a ring.

**Package** `hcl`

**Signature** `ring-push object ring => object`

**Arguments** `object` A Lisp object.

`ring` A ring object created by `make-ring`.

**Values** `object` A Lisp object.

**Description** The function `ring-push` adds any Lisp object as an element of the ring before the "insertion position", which means that a following `ring-pop` will return it. If the ring is full, that is the number of elements in the ring is the same as its size (see

`make-ring`), then `ring-push` first removes the element after the insertion point.

Once it finished modifying the ring, if `ring-push` removed an element and there is a *delete-function* (see `make-ring`), then `ring-push` calls *delete-function* on the element that it removes.

`ring-push` returns *object*.

See also

`ring-pop`  
`make-ring`  
`rotate-ring`  
`ring-ref`

## **ring-ref** *Function*

Summary      Gets or sets the element at a specified offset from the insertion point in a ring.

Package      `hcl`

Signature      `ring-ref ring index => object`  
`(setf ring-ref) object ring index`

Arguments      `ring`      A ring object created by `make-ring`.

`index`      A non-negative integer.

`object`     A Lisp object.

Values      `object`      A Lisp object.

Description      The function `ring-ref` returns or sets the element at *index* places before the insertion point in the ring *ring*.

*index* must be a non-negative integer smaller than the number of elements in the ring, otherwise an error is signaled.

*index* 0 returns or sets the element *object* just before the inser-

tion point, and a larger *index* goes "back" (in the same direction as `ring-pop` and `rotate-ring`).

The `setf` function replaces the element in the ring with the new element *object* without affecting the ring otherwise (in particular it does not call *delete-function*).

See also

`make-ring`  
`ring-pop`  
`rotate-ring`

## rotate-ring

## *Function*

Summary      Rotates a ring, that is moves the insertion point.

Package      `hcl`

Signature      `rotate-ring ring how-many => object`

Arguments      `ring`      A ring object created by `make-ring`.  
                  `how-many`    A fixnum.

Values      `object`      A Lisp object.

Description      The function `rotate-ring` rotates the ring, that is it moves the insertion point "back", which is the same direction that `ring-pop` would progress.

*how-many* is the number of positions to rotate. It has to be a fixnum, but otherwise is not limited.

`rotate-ring` returns the element before the insertion point after the rotation (the one that (`ring-ref ring 0`) would return if called immediately after `rotate-ring`).

Examples      If the ring contains 3 elements or more, then

```
(progn
  (ring-pop ring)
  (ring-pop ring)
  (ring-ref ring 0))
```

returns the same value as:

```
(rotate-ring ring 2)
```

but the second form does not remove an element from the ring, while the first form removes 2 elements.

See also

[ring-push](#)  
[make-ring](#)  
[ring-pop](#)  
[ring-ref](#)

**safe-format-to-string**

**safe-format-to-limited-string**

**safe-prin1-to-string**

**safe-princ-to-string**

*Functions*

Summary      Print or format "safely", which means catching errors.

Package      **hcl**

Signature      **safe-format-to-string &rest format-args => string**  
**safe-format-to-limited-string limit &rest format-args => string**  
**safe-prin1-to-string object => string**  
**safe-princ-to-string object => string**

Arguments      **format-args**      A control-string and arguments as passed to **format**.

**limit**      A positive integer.

**object**      Any object.

|             |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Values      | <code>string</code> | A string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Description |                     | <p><code>safe-format-to-string</code>, <code>safe-prin1-to-string</code> and <code>safe-princ-to-string</code> are analogs to the standard functions <code>format</code> (with first argument <code>nil</code>), <code>prin1-to-string</code> and <code>princ-to-string</code>. If <i>format-args</i> and <i>object</i> can be printed without any errors then they are equivalent to the standard functions, except that they bind <code>*print-readably*</code> and <code>*print-circle*</code> to <code>nil</code>.</p> <p>The difference is when there is an error during the printing operation. The "safe" functions catch the error, and try to produce something that indicates that an error occurred during the printing operation and what it was, without causing recursive errors.</p> <p><code>safe-format-to-limited-string</code> is like <code>safe-format-to-string</code>, except that the length of the result <i>string</i> is limited to <i>limit</i>. The printing is stopped when the output become longer than <i>limit</i> and the result is a string of length <i>limit</i>, with the last three characters being "...". Limiting the length in this way also copes well when printing deeply nested objects.</p> |
| Notes       |                     | <p>These functions are intended to be used in code that handles and reports errors, where it is important to avoid recursive errors.</p> <p>The debugging tools of the LispWorks IDE use these functions.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| See also    |                     | <p><code>prin1-to-string</code><br/> <code>princ-to-string</code><br/> <code>format</code></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

## save-argument-real-p

## Function

Summary      Deprecated. Returns `t`.

|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package            | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Signature          | <code>save-argument-real-p =&gt; realp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Arguments          | None                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Values             | <i>realp</i> A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Description        | The function <code>save-argument-real-p</code> always returns <code>t</code> .                                                                                                                                                                                                                                                                                                                                                                                                           |
| Compatibility note | In LispWorks 6.1 for Macintosh and earlier versions, <code>save-argument-real-p</code> can be used to determine whether a build script knows the real name of the image being saved. The return value <i>realp</i> is <code>nil</code> only when building an intermediate image for the purpose of building a universal binary.<br><br>In LispWorks 7.0 and later versions, universal binaries are not supported hence <code>save-argument-real-p</code> always returns <code>t</code> . |
| See also           | <code>save-universal-from-script</code><br><code>building-universal-intermediate-p</code><br><code>deliver</code><br><code>save-image</code><br><code>save-image-with-bundle</code>                                                                                                                                                                                                                                                                                                      |

|           | <i>Function</i>                                                  |
|-----------|------------------------------------------------------------------|
| Summary   | Save the current profiler tree to a file.                        |
| Package   | <code>hcl</code>                                                 |
| Signature | <code>save-current-profiler-tree filename name =&gt; path</code> |
| Arguments | <i>filename</i> A pathname designator.<br><i>name</i> An object. |

|             |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Values      | <i>path</i> | A pathname.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Description |             | <p>The function <code>save-current-profiler-tree</code> checks if <i>filename</i> has a type, and if not adds the type "<code>tree</code>". It then opens the file for writing with <code>:if-exists :supersede</code> and <code>:external-format :utf-8</code>, and writes the current profiler tree into it. <i>name</i> is written to the file as the name of the tree, using <code>format</code> with <code>~A</code>.</p> <p>The current profiler tree is set either when <code>profile</code> finishes successfully, or when <code>stop-profiling</code> is called with <code>nil</code> for its <i>suspend</i> argument (the default). There is only one current tree, and it is overwritten each time it is set.</p> <p>The intention of the file is that you can load it into the Profiler tool in the LispWorks IDE to view its contents. However, you can also parse it yourself, or view it as a text file for simple queries.</p> <p><i>name</i> should be useful for you to remember what the tree is about. For example, it may be something like the result of:</p> <pre>(string-append "Computing this and that at "                (date-string))</pre> <p>The Profiler tool displays <i>name</i> in the message area of the interface (at the bottom), and it is used in the <b>History</b> menu.</p> <p><code>save-current-profiler-tree</code> returns the path that was used.</p> <p>The format of the file is described in “Profiler tree file format” on page 174.</p> |
| See also    |             | <p><code>stop-profiling</code></p> <p><code>profile</code></p> <p>“Profiler tree file format” on page 174</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

|                             | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>save-current-session</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Summary                     | Saves the LispWorks session.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Package                     | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Signature                   | <code>save-current-session pathname &amp;rest save-image-args =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Arguments                   | <p><code>pathname</code> A pathname designator.</p> <p><code>save-image-args</code> Arguments.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Values                      | <code>result</code> A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Description                 | <p>The function <code>save-current-session</code> closes all windows and stops multiprocessing, saves an image at the location supplied in <code>pathname</code>, and restarts multiprocessing and the windows. For more information see “Saved sessions” on page 182.</p> <p><code>save-image-args</code> are passed to the saving function, which is <code>save-image</code> on Windows, GTK and Motif, or <code>save-image-with-bundle</code> on Cocoa.</p> <p><code>save-current-session</code> returns <code>nil</code> if the pathname supplied is unacceptable (not writable), otherwise it returns <code>t</code>. The actual operation is done asynchronously.</p> |
| Notes                       | <ol style="list-style-type: none"> <li>1. <code>save-current-session</code> is intended for saving the state of a windowing image. While <code>save-current-session</code> can be used to save a session in a console image, this achieves nothing more than <code>save-image</code>.</li> <li>2. The released LispWorks image runs the default session. Therefore after you have used <code>save-current-session</code>, starting the supplied image (for example via the Windows start menu or Mac OS X Dock) will run itself only if the default session is "LispWorks Release".</li> </ol>                                                                              |

See also **`save-image`**  
**`save-image-with-bundle`**

|                   |                                                                                                                                                                                                                                  | <i>Function</i>                                                                                                                                   |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>save-image</b> |                                                                                                                                                                                                                                  |                                                                                                                                                   |
| Summary           | Saves the image to a new file.                                                                                                                                                                                                   |                                                                                                                                                   |
| Package           | <code>hcl</code>                                                                                                                                                                                                                 |                                                                                                                                                   |
| Signature         | <code>save-image filename &amp;key dll-exports dll-added-files dll-extra-link-options automatic-init gc type normal-gc restart-function multiprocessing console environment remarks clean-down image-type split =&gt; nil</code> | The <code>console</code> argument is available only in LispWorks for Windows and LispWorks for Macintosh.                                         |
| Arguments         | <i>filename</i>                                                                                                                                                                                                                  | A string. It is the name of the file that the image is saved as. This name should not be the same as the original name of the image.              |
|                   | <i>dll-exports</i>                                                                                                                                                                                                               | A list of strings, or the keyword <code>:default</code> .                                                                                         |
|                   | <i>dll-added-files</i>                                                                                                                                                                                                           | A list of strings.                                                                                                                                |
|                   | <i>dll-extra-link-options</i>                                                                                                                                                                                                    | A list of strings.                                                                                                                                |
|                   | <i>automatic-init</i>                                                                                                                                                                                                            | A generalized boolean.                                                                                                                            |
|                   | <i>gc</i>                                                                                                                                                                                                                        | If non-nil, there is a garbage collection before the image is saved. The default value is <code>t</code> .                                        |
|                   | <i>type</i>                                                                                                                                                                                                                      | Determines if some global variables are cleared before the image is saved. You can generally use the default value, which is <code>:user</code> . |
|                   | <i>normal-gc</i>                                                                                                                                                                                                                 | If this is <code>t</code> the function <code>normal-gc</code> is called before the image is saved. The default is <code>t</code> .                |

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>restart-function</i> | A function to be called on restart.                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <i>multiprocessing</i>  | Controls whether multiprocessing is enabled on restart. Possible values are discussed below.                                                                                                                                                                                                                                                                                                                                                                                 |
| <i>console</i>          | On Windows <i>console</i> controls whether the new image will be a Console or GUI application and when, if ever, to make a console window in the latter case.<br>On the Macintosh <i>console</i> controls when, if ever, to make a console window.<br>Possible values are discussed below.                                                                                                                                                                                   |
| <i>environment</i>      | <i>environment</i> controls whether the LispWorks environment is started on restart. Possible values are discussed below.                                                                                                                                                                                                                                                                                                                                                    |
| <i>remarks</i>          | <i>remarks</i> adds a comment to the save history. The value should be a string.                                                                                                                                                                                                                                                                                                                                                                                             |
| <i>clean-down</i>       | When <i>t</i> , calls ( <code>clean-down t</code> ).                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <i>image-type</i>       | One of the keywords : <code>exe</code> , : <code>dll</code> and : <code>bundle</code> .                                                                                                                                                                                                                                                                                                                                                                                      |
| <i>split</i>            | A generalized boolean. If non-nil, the Lisp heap and the executable are saved in two separate files.                                                                                                                                                                                                                                                                                                                                                                         |
| Values                  | Returns <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Description             | <p>The function <code>save-image</code> saves the LispWorks image to a new executable or dynamic library containing any modifications you have made to the supplied image.</p> <p>For information about the sort of changes you might want to save in a new image, see Chapter 13, “Customization of LispWorks”.</p> <p>Do not use <code>save-image</code> when the graphical IDE is running. Instead create a build script and use it with the <code>-build</code> com-</p> |

mand line argument similar to the examples below, or run LispWorks in a subprocess using the Application Builder tool.

You cannot use `save-image` on Windows, Linux, FreeBSD, AIX, x86/x64 Solaris and Mac OS X when multiprocessing is running. It signals an error in this case.

On Cocoa you can combine a call to `save-image` with the creation of an application bundle containing your new LispWorks image, as in the example shown below.

`dll-exports` is implemented only on Windows, Linux, x86/x64 Solaris, Macintosh and FreeBSD. It controls whether the image saved is an executable or a dynamic library (DLL). The default value is `:default` and this value means an executable is saved. The value `:com` is supported on Microsoft Windows only (see below). Otherwise `dll-exports` should be list (potentially `nil`). In this case a dynamic library is saved, and each string in `dll-exports` names a function which becomes an export of the dynamic library and should be defined as a Lisp function using `fli:define-foreign-callable`. Each exported name can be found by `GetProcAddress` (on Windows) or `dlsym` (on other platforms). The exported symbol is actually a stub which ensures that the LispWorks dynamic library has finished initializing, and then enters the Lisp code.

On Microsoft Windows the `dll-exports` list can also contain the keyword `:com`, or `dll-exports` can simply be the keyword `:com`, both of which mean that the DLL is intended to be used as a COM server. See the *LispWorks COM/Automation User Guide and Reference Manual* for details.

On Mac OS X the default behavior is to generate an object of type "Mach-O dynamically linked shared library" with file type `dylib`. See `image-type` below for information about creating another type of library on Mac OS X.

On Linux, Macintosh, x86/x64 Solaris and FreeBSD, to save a dynamic library image the computer needs to have a C compiler installed. This is typically `gcc` (which is available by installing Xcode on the Macintosh).

An image saved as a dynamic library (DLL):

- always runs multiprocessing, and
- may need to be shut down by `QuitLispWorks` or by a callback which uses `dll-quit`.

`automatic-init` specifies whether a LispWorks dynamic library should initialize inside the call to `LoadLibrary` (on Microsoft Windows) or `dlopen` (on other platforms), or wait for further calls. Automatic initialization is useful when the dynamic library does not communicate by function calls. On Microsoft Windows it also allows `LoadLibrary` to succeed or fail according to whether the LispWorks dynamic library initializes successfully or not. Not using automatic initialization allows you to relocate the library if necessary using `InitLispWorks`, and do any other initialization that may be required. The default value of `automatic-init` is `t` on Windows, `nil` on other platforms. For more information about automatic initialization in LispWorks dynamic libraries, see Chapter 14, “LispWorks as a dynamic library”.

`dll-added-files` should be a list of filenames. It is ignored on Microsoft Windows. On other platforms if `dll-added-files` is non-nil then a dynamic library containing each named file is saved. Each file must be of a format that the default C compiler (`scm:*c-default-compiler*`) knows about and can incorporate into a shared library. Typically they will be C source files, but can also be assembler or object files. They must not contain exports that clash with names in the LispWorks dynamic library (see Chapter 54, “Dynamic library C functions” for the predefined exports). The added files are useful to write wrappers around calls into the LispWorks dynamic library. Such wrappers are useful for:

- Calling `InitLispWorks` when required, for example to relocate the LispWorks dynamic library to avoid memory clashes with other software, as described under “Startup relocation” on page 459.
- Calling `QuitLispWorks` when required.
- Changing calls that involve complex C structs or even C++ objects into plain calls, because accessing C structures in Lisp requires defining the structure, while in C it only needs to include the header.
- Creating 'stub' functions that can be called from Lisp, for example for calling a C++ method. The address of the stub function can be passed to Lisp which can call it using a function defined by `fli:define-foreign-funcallable`.
- Adding code that runs automatically inside the call to `dlopen`, by using `__attribute__ ((constructor))`

*dll-extra-link-options* should be a list of strings. It is ignored on Microsoft Windows. On other platforms if *dll-extra-link-options* is non-nil then the strings are passed as extra command line arguments to the linker. See the documentation for the linker (typically called `ld`) for the operating system you are using for the meaning of these arguments. On Macintosh, a default value for the `-install_name` option is generated using the file-namestring of the dynamic library if "`-install_name`" is not specified in *dll-extra-link-options*.

*image-type* defaults to `:exe` or `:dll` according to the value of *dll-exports* and therefore you do not normally need to supply *image-type*.

*image-type :bundle* is used only when saving a dynamic library. On Mac OS X it generates an object of type "Mach-O bundle" and is used for creating shared libraries that will be used by applications that cannot load dylibs (FileMaker for example). It also does not force the filename extension to be `.dylib`. On other Unix-like systems *image-type* merely has the

effect of not forcing the file type of the saved image, and the format of the saved image is the same as the default. On Microsoft Windows *image-type :bundle* is ignored.

**Note:** *image-type :bundle* is completely unrelated to the Mac OS X notion of an application bundle.

If *split* is `nil` (the default), then the saved image is written as a single executable file containing the Lisp heap. If *split* is `t`, then the saved Lisp heap is split into a separate file, named by adding `.lheap` to the name of the executable. When the executable runs, it reloads the Lisp heap from this file automatically.

In addition, when saving LispWorks on the Macintosh as an application bundle (for example by using `create-macos-application-bundle`) or as a framework bundle, *split* can be the symbol `:resources`. This places the Lisp heap file in the `Resources` directory of the bundle, which allows the heap to be included in the bundle's signature. For an application bundle, the `Resources` directory is in the `Contents` directory alongside the `MacOS` directory. For a framework bundle, the `Resources` directory is alongside the shared library. The executable and Lisp heap file must be in these directories within the bundle at run time.

The main use of *split* is to allow third-party code signing to be applied to the executable, which is often not possible when saving an image with the Lisp heap included in a single file.

*restart-function*, if non-`nil`, specifies a function (with no arguments) to be called when the image is started. If *multiprocessing* is true, *restart-function* is called in a new process. *restart-function* is called after the initialization file is loaded. The default value of *restart-function* is `nil`.

**Note:** *restart-function* is not called if the command line argument `-no-restart-function` is present

When *multiprocessing* is `nil`, the executable image will start without multiprocessing enabled. When *multiprocessing* is

true or the image is a DLL, the image will start with multiprocessing enabled, starting processes in the list `*initial-processes*`. When `*initial-processes*` is `nil` or `multiprocessing` is `:with-tty-listener`, a TTY listener process is started as well. The default value of `multiprocessing` is `nil`.

`console` is implemented only in LispWorks for Windows and LispWorks for Macintosh. The possible values for `console` are as follows:

- `:default` Unchanged since previous save.
- `t` On the Macintosh, the value `t` has the same effect as the value `:always`.  
On Windows, a Console application is saved, else a Windows application is saved which creates its own console according to the other possible values.
- `:input, :output, :io` Whenever input, output or any I/O is attempted on `*terminal-io*`.
- `:init` At startup, if input and output are not redirected
- `:always` At startup, even if input and output are redirected.

The LispWorks for Windows and LispWorks for Macintosh images shipped have `console` set to `:input`.

The possible values for `environment` are as follows:

- `:default` Unchanged since previous save.
- `nil` Start with just the TTY listener.
- `t` Start the environment automatically, no TTY listener.

**:with-tty-listener**

Start the environment automatically, but still have a TTY listener.

The LispWorks image shipped is saved with `:environment t` on all platforms except for the Motif images on Mac OS X, and SPARC Solaris

You should not try to save a new image over an existing one. Always save images using a unique image name, and then, if necessary, replace the new image with the old one after the call to `save-image` has returned.

**Notes** 1. Do not supply `:multiprocessing nil` along with a true value of `:environment t`. Multiprocessing is needed for the GUI environment.

2. `load-image` checks that `load-all-patches` has been called. If it is called before `load-all-patches` in a session then an error is signaled.
3. In the example build scripts below, the call to `load-all-patches` is not strictly required when the script is used with the `-build` command line argument, because LispWorks 6.1 and later versions call `load-all-patches` automatically. However, it does no harm for the build script to call `load-all-patches` too.

**Compatibility notes** 1. LispWorks 5.0 and previous versions documented `-init` as the way to run LispWorks with a build script. This way is deprecated.

2. Note that LispWorks quits automatically after processing a build script via `-build`, whereas with `-init` you need to call `quit` explicitly at the end of the build script.
3. In LispWorks 5.0 and previous versions `dll-exports` is supported only on Windows.
4. `dll-added-files` and `automatic-init` were new in LispWorks 5.1.

**Example** Here is an example build script. Save this to a file such as `c:/build-my-image.lisp`:

```
(load-all-patches)
(load "my-code")
(save-image "my-image")
```

Then run LispWorks with the command line argument `-build c:/build-my-image.lisp` to save the image `my-image.exe`.

This example shows a portable build script which, on Cocoa, saves your new LispWorks image in a Mac OS X application bundle. This allows your new LispWorks for Macintosh image to be launchable from the Finder or Dock and to have its own icon or other resources:

```
(load-all-patches)
(load "my-code")
#+:cocoa
(compile-file-if-needed
 (example-file
  "configuration/macos-application-bundle")
 :load t)
(save-image
 #+:cocoa
 (write-macos-application-bundle
  "/Applications/LispWorks 7.1/My LispWorks.app")
 #:-:cocoa
 "my-lispworks")
```

**See also**

- `deliver`
- `dll-quit`
- `*initial-processes*`
- `InitLispWorks`
- `LispWorksDlsym`
- `load-all-patches`
- `quit`
- `QuitLispWorks`
- `save-current-session`

“Guidance for control of the memory management system”  
on page 130

|             | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Saves a LispWorks for Macintosh image with an application bundle, thus allowing it to work properly in the Cocoa windowing system.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Package     | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Signature   | <code>save-image-with-bundle <i>bundle-path</i> &amp;rest <i>save-image-args</i><br/>&amp;key <i>bundle-arguments</i> <i>bundle-function</i> &amp;allow-other-keys</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Arguments   | <p><i>bundle-path</i> A pathname designator.</p> <p><i>save-image-args</i> Arguments passed to <code>save-image</code>.</p> <p><i>bundle-arguments</i> Arguments passed to <i>bundle-function</i>.</p> <p><i>bundle-function</i> A function designator.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Description | <p>The function <code>save-image-with-bundle</code> first creates the application bundle using the function <i>bundle-function</i>, and then saves the LispWorks image in the bundle.</p> <p>The default value of <i>bundle-arguments</i> is <code>nil</code>.</p> <p>The default value of <i>bundle-function</i> is <code>create-macos-application-bundle</code>. You can modify the created bundle by supplying <i>bundle-arguments</i>.</p> <p>With the default values of <i>bundle-function</i> and <i>bundle-arguments</i>, it copies the application bundle of the running image to the bundle path with the minimal necessary modifications, and then saves an image in it.</p> <p><code>save-image-with-bundle</code> operates as follows:</p> <ol style="list-style-type: none"> <li>1. It calls <i>bundle-function</i> with the <i>bundle-path</i> and <i>bundle-arguments</i>, and then uses the result as the <i>filename</i> for <code>save-image</code>.</li> </ol> |

- It applies `save-image` to the path derived in the first step and the remaining arguments passed to `save-image-with-bundle` (other than *bundle-arguments* and *bundle-function*).

Notes      `save-image-with-bundle` is implemented only in Lisp-Works for Macintosh.

See also    `create-macos-application-bundle`  
`save-image`

## **save-universal-from-script** *Function*

Summary     Deprecated. Signals an error.

Package     `hcl`

Signature    `save-universal-from-script target-image script-name &key output-stream => target-image`

Arguments    `target-image`    A pathname designator.  
`script-name`    A pathname designator.  
`output-stream`    A stream or `nil`.

Values       `target-image`    A pathname designator.

Description    The function `save-universal-from-script` is deprecated

Compatibility note    In LispWorks 6.1 for Macintosh and earlier versions, `save-universal-from-script` provides a convenient way to create a universal binary on an Intel Macintosh, using a script designed for saving a mono-architecture image.

LispWorks 7.0 and later versions do not support universal binaries, hence `save-universal-from-script` now simply signals an error.

## See also

`save-image`  
`create-universal-binary`  
`building-universal-intermediate-p`  
`save-argument-real-p`

**set-array-single-thread-p** *Function*

Summary Tells the system whether an array is accessed only in a single thread context, or not.

Package `hcl`

Signature `set-array-single-thread-p array on-p`

Arguments `array` An array.

`on-p` A generalized boolean.

Description Tells the system whether the array *array* is accessed only in a single thread context or not, depending on the value of *on-p*. Arrays that are marked for single thread access are faster for some operations, in particular `vector-push` and `vector-pop`.

See also `array-single-thread-p`  
`make-array`

**set-array-weak** *Function*

Summary Sets the weakness state of an array.

|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                    |                                                                    |                    |                                                                                                                                      |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------------------------------------------------------|--------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| Package            | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                    |                                                                    |                    |                                                                                                                                      |
| Signature          | <code>set-array-weak array weakp =&gt; weakp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                    |                                                                    |                    |                                                                                                                                      |
| Arguments          | <table> <tr> <td><code>array</code></td><td>A non-displaced array, with<br/><code>array-element-type t</code>.</td></tr> <tr> <td><code>weakp</code></td><td>If <code>weakp</code> is non-nil, the array is made weak.<br/>If <code>weakp</code> is <code>nil</code>, the array is made non-weak.</td></tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <code>array</code> | A non-displaced array, with<br><code>array-element-type t</code> . | <code>weakp</code> | If <code>weakp</code> is non-nil, the array is made weak.<br>If <code>weakp</code> is <code>nil</code> , the array is made non-weak. |
| <code>array</code> | A non-displaced array, with<br><code>array-element-type t</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                    |                                                                    |                    |                                                                                                                                      |
| <code>weakp</code> | If <code>weakp</code> is non-nil, the array is made weak.<br>If <code>weakp</code> is <code>nil</code> , the array is made non-weak.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                    |                                                                    |                    |                                                                                                                                      |
| Values             | Returns <code>weakp</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                    |                                                                    |                    |                                                                                                                                      |
| Description        | <p>By default, arrays are non-weak, and they keep alive all the objects that are stored in them. A weak array may remove a pointer if the object that it points to is not pointed to from somewhere else. When a pointer is removed like this, it is replaced in <code>array</code> with <code>nil</code>.</p> <p>Pointers are replaced by <code>nil</code> after a garbage collector (GC) operation that identifies that they can be replaced. This means that if the object that is pointed to has been promoted to a higher generation, a garbage collection of the higher generation is required to remove the pointer. Note that by default the system does not automatically GC the blocking generation or higher.</p> <p>The weakness state of an array can be changed many times.</p> <p>In all implementations, <code>array</code> must not be a displaced array, and the <code>array-element-type</code> of <code>array</code> must be <code>t</code>.</p> <p>In 64-bit LispWorks, an additional requirement is that <code>array</code> must be an adjustable array.</p> <p><code>set-array-weak</code> can be called at any moment.</p> |                    |                                                                    |                    |                                                                                                                                      |
| Notes              | An array can be made weak at creation time using the <code>:weak</code> argument to <code>make-array</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                    |                                                                    |                    |                                                                                                                                      |
| See also           | <code>array-weak-p</code><br><code>copy-to-weak-simple-vector</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                    |                                                                    |                    |                                                                                                                                      |

`set-hash-table-weak`

`make-array`

`mark-and-sweep`

“Freeing of objects by the GC” on page 165

## **set-default-generation** Function

|             |                                                                                                                                                                   |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Set the current generation for memory allocation in 32-bit LispWorks.                                                                                             |
| Package     | <code>hcl</code>                                                                                                                                                  |
| Signature   | <code>set-default-generation num =&gt; num</code>                                                                                                                 |
| Arguments   | <code>num</code> The number of the generation from which to do future allocation.                                                                                 |
| Values      | Returns <code>num</code> .                                                                                                                                        |
| Description | Set the current generation for memory allocation. By default the system allocates memory from the youngest generation (generation 0).                             |
| Notes       | <code>set-default-generation</code> is useful only in 32-bit LispWorks. In 64-bit implementations it does nothing and returns 0.                                  |
| Examples    | <pre>(set-default-generation 1) ;; allocate from an ;; older generation (set-default-generation 0) ;; return to normal</pre>                                      |
| See also    | <a href="#">allocation-in-gen-num</a><br><a href="#">clean-generation-0</a><br><a href="#">collect-generation-2</a><br><a href="#">collect-highest-generation</a> |

`expand-generation-1`  
`get-default-generation`  
`set-promotion-count`  
`*symbol-alloc-gen-num*`

“Memory Management in 32-bit LispWorks” on page 135

## set-gc-parameters *Function*

**Summary** Sets the parameters for the garbage collector in 32-bit LispWorks. This function is deprecated.

**Package** `hcl`

**Signature** `set-gc-parameters &key maximum-buffer-size minimum-buffer-size big-object promote-min-buffer promote-max-buffer new-generation-size minimum-overflow maximum-overflow minimum-for-sweep minimum-for-promote enlarge-by-segments => <no values>`

**Arguments** Unless stated, arguments are in bytes:

***maximum-buffer-size***

Maximum size of the small objects buffer.

***minimum-buffer-size***

Minimum size of the small objects buffer.

***big-object*** An object that is bigger than this value is “big”. That is, it is not allocated from the small objects buffer, but from the big-chunk area (if it is allocated in generation 0 in the normal way).

***promote-min-buffer***

During promotion, a buffer is allocated in the generation being promoted into, and the objects promoted are moved into it. *promote-min-buffer* controls the minimum size of this buffer.

*promote-max-buffer*

Controls the maximum size of the promotion buffer.

*new-generation-size*

Controls the minimum enlargement of generation *gen-num*, for *gen-num* > 0. Value 0 means the generation is not expanded. Otherwise, *new-generation-size* must be a fixnum in the exclusive range (10000, 100000000) and the minimum expansion is then *new-generation-size* \* *gen-num* words.  
*new-generation-size* has no effect on the enlargement of generation 0.

*maximum-overflow*

Maximum size of the small-objects buffer in the big-chunk area.

*minimum-overflow*

Minimum size of the small-objects buffer in the big-chunk area.

*minimum-for-promote*

Controls the frequency of promotions. Setting *minimum-for-promote* to a high value causes the system to promote less frequently. This may improve performance for programs that allocate a lot of data for a short term and then delete it.

*minimum-for-sweep*

Controls when a mark and sweep takes place. Setting *minimum-for-sweep* to a high value causes the system to mark and sweep less often, which means it has to grow. The

CPU time spent in garbage collection is mostly smaller, but the process is bigger and may cause more disk access.

*enlarge-by-segments*

A minimum for how much the image grows each time a segment is enlarged, as a multiple of 64 KB. This parameter is ignored when adding a static segment.

|             |                                                                                                                                                    |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| Values      | None.                                                                                                                                              |
| Description | This function sets the parameters of the garbage collector, using the keywords described above.                                                    |
| Notes       | <code>set-gc-parameters</code> is implemented only in 32-bit LispWorks. It is not relevant to the Memory Management API in 64-bit implementations. |
| See also    | <code>get-gc-parameters</code><br>“Memory Management in 32-bit LispWorks” on page 135                                                              |

## set-hash-table-weak

*Function*

|           |                                                                                                   |                                                                                                                                                                                            |
|-----------|---------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary   | Sets the weakness state of a hash-table.                                                          |                                                                                                                                                                                            |
| Package   | <code>hcl</code>                                                                                  |                                                                                                                                                                                            |
| Signature | <code>set-hash-table-weak hash-table weak &amp;optional free-function =&gt; weakness-state</code> |                                                                                                                                                                                            |
| Arguments | <code>hash-table</code>                                                                           | A hash-table.                                                                                                                                                                              |
|           | <code>weak</code>                                                                                 | Sets the weakness state of <code>hash-table</code> . Value may be:<br><br><code>:value</code> or <code>t</code> — An entry is kept if there is a pointer to the value from another object. |

|                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                      | <p><b>:key</b> — An entry is kept if there is a pointer to the key from another object.</p> <p><b>:both</b> — An entry is kept if there are pointers to both the key and the value.</p> <p><b>:one or :either</b> — An entry is kept if there is a pointer to either the key or the value.</p> <p><b>nil</b> — Make the hash-table non-weak. All entries are kept.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <i>free-function</i> | A designator for a function of two arguments.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Values               | Returns <i>weak</i> , unless <i>t</i> was passed, when <b>:value</b> is returned.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Description          | <p>By default, hash-tables are not weak, which means that they keep alive all the keys and the values in the table.</p> <p>A weak hash-table allows entries to be removed if there are no other pointers to them. The <i>weakness-state</i> tells the system which entries may be removed like this.</p> <p>Entries that can be removed are removed after a garbage collector (GC) operation which identifies that they can be removed. This means that if the relevant object(s) (the key or the value) have been promoted to a higher generation, a garbage collection (GC) of the higher generation is required to remove them from the table. Note that by default the system does not automatically GC the blocking generation or higher.</p> <p>The <i>weakness-state</i> of a hash-table can be changed repeatedly, at any time, at any point using any of the <i>weak</i> values listed above. It can also be set by <b>make-hash-table</b>.</p> <p><i>free-function</i> can be supplied to specify a free function as described for <b>make-hash-table</b>. It has no effect if <i>weak-kind</i> is <b>nil</b>.</p> |

See also [hash-table-weak-kind](#)  
[make-hash-table](#)  
[mark-and-sweep](#)  
[set-array-weak](#)  
“Freeing of objects by the GC” on page 165

## set-minimum-free-space *Function*

|             |                                                                                                                                                                                                                                                                    |  |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Summary     | Sets the minimum free space for a segment of the specified generation in 32-bit LispWorks.                                                                                                                                                                         |  |
| Package     | <code>hcl</code>                                                                                                                                                                                                                                                   |  |
| Signature   | <code>set-minimum-free-space gen-num size &amp;optional segment =&gt; generation-size</code>                                                                                                                                                                       |  |
| Arguments   | <code>gen-num</code> The generation to be affected.<br><code>size</code> The size (in bytes) to set the segment to.<br><code>segment</code> An integer specifying the segment to be affected. The default value is 0, meaning the first segment of the generation. |  |
| Values      | <code>generation-size</code> A list showing information for the generation just specified in the call.                                                                                                                                                             |  |
| Description | Sets the minimum free space for a segment of the specified generation.<br><br>By default, affects the first segment — pass <code>segment</code> to affect a different segment of the generation.<br><br>The minimum free space is shown by <code>room</code> .     |  |
| Notes       | <code>set-minimum-free-space</code> is implemented only in 32-bit LispWorks. It is not relevant to the Memory Management API in 64-bit implementations.                                                                                                            |  |

See also      `clean-generation-0`  
`collect-generation-2`  
`collect-highest-generation`  
`expand-generation-1`  
`room`  
`set-promotion-count`  
“Memory Management in 32-bit LispWorks” on page 135

## **set-process-profiling** *Function*

|                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |             |                        |                  |                                                                                                                                                      |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-------------|------------------------|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary          | Controls the set of processes that are profiled.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |             |                        |                  |                                                                                                                                                      |
| Package          | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |             |                        |                  |                                                                                                                                                      |
| Signature        | <code>set-process-profiling <i>flag processes</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |             |                        |                  |                                                                                                                                                      |
| Arguments        | <table border="0"> <tr> <td><i>flag</i></td> <td>:add, :remove or :set.</td> </tr> <tr> <td><i>processes</i></td> <td>One of :current, :all, :new, a <code>mp:process</code> object, or a list of <code>mp:process</code> objects which may also contain :current or :new.</td> </tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                          |  | <i>flag</i> | :add, :remove or :set. | <i>processes</i> | One of :current, :all, :new, a <code>mp:process</code> object, or a list of <code>mp:process</code> objects which may also contain :current or :new. |
| <i>flag</i>      | :add, :remove or :set.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |             |                        |                  |                                                                                                                                                      |
| <i>processes</i> | One of :current, :all, :new, a <code>mp:process</code> object, or a list of <code>mp:process</code> objects which may also contain :current or :new.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |             |                        |                  |                                                                                                                                                      |
| Description      | <p>The function <code>set-process-profiling</code> modifies the set of processes for which profiling information is (or will be) collected.</p> <p>If <code>set-process-profiling</code> is called while profiling (that is after a call to <code>start-profiling</code> and before the next call to <code>stop-profiling</code> with <code>print</code> non-nil) the system immediately starts collecting profile information for the new set of processes.</p> <p>When <code>start-profiling</code> is called without passing <i>processes</i>, it sets the processes to profile according to the last call to <code>set-process-profiling</code>.</p> <p><i>flag</i> determines how the set of processes to profile is modified:</p> |  |             |                        |                  |                                                                                                                                                      |

|                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                  |
|-------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>:add</code>                                                                                                             | The given processes are added to the set.                                                                                                                                                                                                                                                                                                        |
| <code>:remove</code>                                                                                                          | The given processes are removed from the set.                                                                                                                                                                                                                                                                                                    |
| <code>:set</code>                                                                                                             | The given processes are used as the set.                                                                                                                                                                                                                                                                                                         |
| <i>processes</i> controls which processes are added to the set, removed from the set or are contained in the set, as follows: |                                                                                                                                                                                                                                                                                                                                                  |
| <code>:current</code>                                                                                                         | Means the current process. When <code>start-profiling</code> is called it interprets <code>:current</code> to mean the current process at the time it is called. If <code>set-process-profiling</code> is called while profiling, <code>:current</code> is interpreted as the current process when <code>set-process-profiling</code> is called. |
| <code>:all</code>                                                                                                             | Means all processes, including those which are created after profiling started.                                                                                                                                                                                                                                                                  |
| <code>:new</code>                                                                                                             | All processes created after the call to <code>start-profiling</code> , unless <code>set-process-profiling</code> is called while profiling, in which case it is any process created after this call.                                                                                                                                             |

#### A `mp:process` object

|        |                                                                                                                                                           |
|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
|        | Means that process.                                                                                                                                       |
| A list | Means the processes in that list. The list can contain the symbols <code>:current</code> or <code>:new</code> , which are interpreted as described above. |

`set-process-profiling` can be called whether or not the profiler is collecting information. See `start-profiling` and `stop-profiling`.

Note: This function only works on platforms in SMP LispWorks ; in non-SMP LispWorks, all processes are profiled.

#### Examples

Add *process1* to the set:

```
(set-process-profiling :add process1)
```

Turn off profiling for the current process:

```
(set-process-profiling :remove :current)
```

Turn off all profiling:

```
(set-process-profiling :remove :all)
```

Set all processes for later profiling:

```
(set-process-profiling :set :all)
```

See also

`profile`  
`start-profiling`  
`stop-profiling`  
 Chapter 12, “The Profiler”

## **set-profiler-threshold** *Function*

**Summary** Sets the percentage threshold for symbols to be profiled in a subsequent run.

**Package** `hcl`

**Signature** `set-profiler-threshold value => value`

**Arguments** `value` must be a fixnum between 0 and 100.

**Values** `set-profiler-threshold` returns `value`.

**Description** This function sets the value of `*profiler-threshold*` below which symbols are not profiled in a repeated profiling run. After a profiling run, all the symbols being profiled have a percentage value for the amount of time they were on the top of the stack. If `*profiler-threshold*` is set to 40 then by running `reset-profiler` with argument `:top` all symbols which are found on the top of the stack less than forty percent of the time are removed from the list of those symbols considered for profiling.

Example      `(set-profiler-threshold 40)`

See also     `reset-profiler`  
`profile`  
`*profiler-threshold*`

## set-promotion-count                          *Function*

Summary      Controls when objects can be promoted to the next generation in 32-bit LispWorks. This function is deprecated.

Package      `hcl`

Signature     `set-promotion-count gen-num count &optional segment => count`

Arguments    `gen-num`      The generation number affected.

`count`      The number of garbage collections survived by objects in that generation, before promotion. If `count` is `nil`, the function returns the current promotion count setting.

`segment`     An integer specifying which segment of the generation is to be affected. The default is 0, meaning the lowest segment of the generation.

Values       Returns `count`.

Description    Controls how many garbage collections an object in a segment must survive before promotion to the next generation.

Notes        1. `set-promotion-count` is deprecated, because experience has shown that it is not useful.

2. `set-promotion-count` is implemented only in 32-bit LispWorks. It is not relevant to the Memory Management API in 64-bit implementations, wherein you may be able to achieve the effect with `set-delay-promotion`.

## See also

`block-promotion`  
`clean-generation-0`  
`collect-generation-2`  
`collect-highest-generation`  
`expand-generation-1`

|             |                                                                                          | <i>Function</i>                                                                                                                                                                                                                                                                |
|-------------|------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Manipulates the system message log.                                                      |                                                                                                                                                                                                                                                                                |
| Package     | <code>hcl</code>                                                                         |                                                                                                                                                                                                                                                                                |
| Signature   |                                                                                          | <code>set-system-message-log &amp;key stream collect get callback =&gt; result</code>                                                                                                                                                                                          |
| Arguments   | <code>stream</code><br><code>collect</code><br><code>get</code><br><code>callback</code> | An output stream designator, or <code>:no-change</code> .<br>A boolean, or <code>:no-change</code> .<br><code>t</code> or <code>:keep</code> .<br>A function designator, or <code>:no-change</code> .                                                                          |
| Values      | <code>result</code>                                                                      | A list of strings, or <code>nil</code> .                                                                                                                                                                                                                                       |
| Description |                                                                                          | The function <code>set-system-message-log</code> manipulates the system message log. This log is used by the system to produce messages that indicate that something is not as expected, but is not an error. For example, putting a bad Break-Gesture in a GTK resource file. |

If *stream* is `t` or a stream, the system message log stream is set, with `t` meaning `*standard-output*`. This stream is used when writing messages.

When *collect* is true but not `:no-change`, messages are collected in an internal list, which can be retrieved by using *get*.

*callback* can be a designator for a function of one argument, a string. This function is called when a message is generated. The callback must not try to perform GUI operations.

The default value of each of *stream*, *collect* and *callback* is `:no-change`, which does not change the current setting.

When *get* is supplied `set-system-message-log` returns a list of the messages that has been collected. Each message is a single string. If *get* is `t`, the internal list is reset to `nil`. If *get* is `:keep`, the internal list is not reset, so the next call with *get* will get them again.

`set-system-message-log` returns `nil` if *get* is not supplied.

`set-system-message-log` returns the list of collected messages if *get* is supplied.

**Notes** *stream*, *callback* and *collect* are mutually independent. It is possible to set the system to any combination of these.

The order of operation when a message is generated is first to print, then call the callback, and then collect.

When collecting messages it can accumulate, so it is important to periodically get the message to ensure it does not bloat the memory.

Using *collect* `t` when it is already collecting has no effect, in particular it does not affect the list of collected messages.

## set-up-profiler

## *Function*

**Summary** Declares the parameter values of the profiling function.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Signature   | <code>set-up-profiler &amp;key symbols packages kind interval limit cutoff collapse style gc call-counter show-unknown-frames kw-contexts subfunctions</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Arguments   | <p><code>symbols</code> A symbol or a list of symbols.</p> <p><code>packages</code> A valid package name, or a list of package names, <code>:none</code> or <code>:all</code>.</p> <p><code>kind</code> <code>:profile</code>, <code>:virtual</code> or <code>:real</code>.</p> <p><code>interval</code> An integer greater than or equal to 10000.</p> <p><code>limit</code> An integer or <code>nil</code>.</p> <p><code>cutoff</code> An integer or <code>nil</code>.</p> <p><code>collapse</code> A generalized boolean.</p> <p><code>style</code> <code>:tree</code>, <code>:list</code> or <code>nil</code>.</p> <p><code>gc</code> A generalized boolean.</p> <p><code>call-counter</code> A generalized boolean.</p> <p><code>show-unknown-frames</code> A generalized boolean.</p> <p><code>kw-contexts</code> <code>t</code> or a list of KnowledgeWorks context names.</p> <p><code>subfunctions</code> A boolean.</p> |
| Values      | The time interval is returned.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Description | <p><code>set-up-profiler</code> is used to declare the values of the parameters of the profiling function.</p> <p><code>packages</code> specifies that the symbols in these packages should be monitored, that is added to <code>*profile-symbol-list*</code>. If <code>packages</code> is <code>:all</code>, then symbols in all packages are monitored. If <code>packages</code> is <code>:none</code>, then no package is used to find symbols</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

to monitor. Otherwise, *packages* should be a list of package specifiers, and the symbols in these packages are monitored.

If *symbols* is non-nil, it should be a list of function-dspecs to monitor in addition to the symbols that were specified by *packages*. These are typically symbols, but can be other functions as specified in “Function dspecs” on page 84.

Note: When a symbol that names a generic function should be monitored, LispWorks adds all the methods of the generic function to the profile list.

If both *packages* and *symbols* are nil, then `set-up-profiler` behaves as if *packages* is :all. Thus if you actually want to monitor no symbols, you need to pass :*packages* :none. That is useful if you want to monitor only KnowledgeWorks rules (see *kw-contexts* below).

*kind* specifies the way that the time between samples is measured on Unix-like platforms:

- `:profile`      Process time only.
- `:virtual`      Process time and system time for the process.
- `:real`          Real time.

The default value of *kind* is `:profile`.

**Note:** *kind* is ignored on Microsoft Windows platforms.

*interval* specifies the interval in microseconds between profile samples. The minimum value of *interval* is 10000, that is 10 ms. The default value of *interval* is 10000.

*limit*, when non-nil, sets `*default-profiler-limit*`. This limits the maximum number of lines printed in the profile output (not including the tree). The default value is 100.

*cutoff*, when non-nil, sets `*default-profiler-cutoff*`. This is the default minimum percentage that the profiler will display in the output tree. Functions below this percentage

will not be displayed. The default is `nil`, that is there is no cutoff.

*collapse* specifies whether functions with only one callee in the profile tree should be collapsed, that is, only the child is printed. When passed, sets `*default-profiler-collapse*`. The default value of *collapse* is `nil`.

*style* controls the format of output. If *style* is not passed or passed as `nil`, the format does not change. If *style* is passed, it can take these values:

- |                    |                                                                                                                      |
|--------------------|----------------------------------------------------------------------------------------------------------------------|
| <code>:list</code> | The profiler will show the functions seen on the stack.                                                              |
| <code>:tree</code> | The profiler will generate a tree of calls seen in the profiler, as well as the output shown by <code>:list</code> . |

The default value of *style* is `:tree`.

*gc* specifies whether to profile functions inside the memory management code (more accurately, functions that are called on the GC stack) in addition to any other profiling. The default value of *gc* is `nil`.

*call-counter* specifies whether to add extra code to count calls. The counting is done dynamically. If *call-counter* is `nil`, call counters are not added, and the call counter of all functions is displayed as 0. The default value of *call-counter* is `nil` in SMP LispWorks and `t` in non-SMP LispWorks. This is because the counting significantly affects the performance of applications using Symmetric Multiprocessing (SMP).

*show-unknown-frames* controls whether the profile tree shows nodes where the name of the function is unknown. The default value of *show-unknown-frames* is `nil`.

*kw-contexts* allows you to profile forward chaining rules in KnowledgeWorks (see the *KnowledgeWorks and Prolog User Guide*). When *kw-contexts* is `t` (the default), all context are pro-

filed. Otherwise it should be a list of context names. The profiler profiles all the forward rules in each context.

*subfunctions* controls whether to profile subfunctions of the functions that are profiled. When it is non-nil, for each function that the profiler is profiling, the profiler checks if it has subfunctions, and if it has then it profiles them too. The default value of *subfunctions* is nil.

If *subfunctions* is non-nil then initializing the profiler is somewhat slower, and also, because the names of subfunctions are long, the output is more messy. It is sometimes useful though.

#### Notes

1. If the profiler is invoked before any call to `set-up-profiler`, it calls `set-up-profiler` implicitly without any arguments. That means it will monitor all symbols in the image, and if KnowledgeWorks is loaded also all forward chaining rules. In most cases this is a useful behavior, so it is not necessary to use `set-up-profiler`.
2. `set-up-profiler` finds all the symbols in the specified packages at the time it is called. Thus symbols that are given function definitions after the call to `set-up-profiler` are not profiled, whether or not they are in packages that were passed to `set-up-profiler`. If you want to ensure that all symbols are profiled, you need to call `set-up-profiler` just before invoking the profiler.
3. Call counting can affect performance significantly on some platforms. To get accurate timing (in scales of a few percentage points), pass *call-counter* nil. However, in most cases the profiler is used to find bottlenecks where the slowdown is hundreds of percentage points and so the effect of call counting is less significant.

4. *call-counter* is effective only on x86 platforms or in 64-bit LispWorks. On non-x86 platforms 32-bit LispWorks does call counting for a given function if the compiler optimize quality *debug* is greater than 0 at compile-time, and *call-counter* has no effect.
5. *limit*, *cutoff* and *collapse* affect only the display of the results, not the collection of profiler data.

Examples

```
(set-up-profiler :packages '(my-package common-lisp))

(set-up-profiler :symbols
                  (my-list-all-interesting-functions))
```

See also

- \*default-profiler-collapse\*
- \*default-profiler-cutoff\*
- \*default-profiler-limit\*
- `profile`
- `start-profiling`
- `stop-profiling`
- Chapter 12, “The Profiler”

|             |                 | <i>Function</i>                                                                                                             |
|-------------|-----------------|-----------------------------------------------------------------------------------------------------------------------------|
| Summary     |                 | Lists special variables set by a definition.                                                                                |
| Package     |                 | <code>hcl</code>                                                                                                            |
| Signature   |                 | <code>sets-who function =&gt; result</code>                                                                                 |
| Arguments   | <i>function</i> | A symbol or a function dspec.                                                                                               |
| Values      | <i>result</i>   | A list.                                                                                                                     |
| Description |                 | The function <code>sets-who</code> returns a list of the special variables set by the definition named by <i>function</i> . |

Notes        The cross-referencing information used by `sets-who` is generated when code is compiled with source-level debugging switched on.

See also     `binds-who`  
              `who-sets`  
              `toggle-source-debugging`  
              `references-who`

## **source-debugging-on-p**                          *Function*

Summary      Tests if source level debugging is on for compiled code.

Package       `hcl`

Signature      `source-debugging-on-p => bool`

Arguments     None.

Values        `bool`                          If `t`, source level debugging is on.

Description     Returns `t` if source level debugging is on for compiled code; otherwise returns `nil`.

See also      `toggle-source-debugging`

## **start-gc-timing**

## **stop-gc-timing**

## **get-gc-timing**

## *Functions*

Summary      Time Garbage Collector (GC) operations.

Package       `hcl`

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signature   | <code>start-gc-timing &amp;key initialize</code><br><code>stop-gc-timing</code><br><code>get-gc-timing &amp;key reset</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Arguments   | <code>initialize</code> A generalized boolean.<br><code>reset</code> A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Description | <p>The functions <code>start-gc-timing</code>, <code>stop-gc-timing</code> and <code>get-gc-timing</code> time Garbage Collector (GC) operations.</p> <p><code>start-gc-timing</code> causes the system to start collecting GC timing. If <code>initialize</code> is non-nil, <code>start-gc-timing</code> also resets the Garbage Collector times to 0. The default value of <code>initialize</code> is <code>t</code>.</p> <p><code>stop-gc-timing</code> stops collecting GC timing, but does not affect the times.</p> <p><code>get-gc-timing</code> returns the GC timing as a plist of the form</p> <pre>(:total total :user user :system system)</pre> <p>where <code>total</code>, <code>user</code> and <code>system</code> are real numbers giving the total, user and system times in seconds spent inside the Garbage Collector while GC timing is on since the timing was last reset. When <code>reset</code> is non-nil, <code>get-gc-timing</code> also switches GC timing off and resets the timing to 0. The default value of <code>reset</code> is <code>nil</code>.</p> <p>The GC timing is the same timing that is collected by <code>extended-time</code>. Once <code>start-gc-timing</code> is called, <code>extended-time</code> does not try to collect GC timing and print it until <code>get-gc-timing</code> is called with <code>reset</code> non-nil.</p> <p><code>get-gc-timing</code> can be called while GC timing is being collected.</p> |
| Notes       | <code>stop-gc-timing</code> and <code>start-gc-timing</code> (with <code>initialize = nil</code> ) can be used to collect GC timing only in specific periods without resetting the times. However the points at which the                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

Garbage Collector is invoked are not well-defined, so the program may allocate while GC timing is on, and spend time Garbage Collecting after you stopped collecting.

See also      **extended-time**  
                 **room**  
                 **time**

## **start-profiling** *Function*

|           |                                                                                             |                                                                                                                            |
|-----------|---------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|
| Summary   | Starts collecting profiling information.                                                    |                                                                                                                            |
| Package   | <b>hcl</b>                                                                                  |                                                                                                                            |
| Signature | <b>start-profiling &amp;key initialize processes profile-waiting ignore-in-foreign time</b> |                                                                                                                            |
| Arguments | <i>initialize</i>                                                                           | A boolean.                                                                                                                 |
|           | <i>processes</i>                                                                            | One of <code>:current</code> , <code>:all</code> , a <code>mp:process</code> or a list of <code>mp:process</code> objects. |
|           | <i>profile-waiting</i>                                                                      | A boolean.                                                                                                                 |
|           | <i>ignore-in-foreign</i>                                                                    | A boolean.                                                                                                                 |
|           | <i>time</i>                                                                                 | <code>t</code> , <code>nil</code> or <code>:extended</code> .                                                              |

Description      The function **start-profiling** starts collecting profiling information.

If *initialize* is non-nil any profiling information collected so far is discarded. The default value of *initialize* is `t`.

If *processes* is supplied, the set of processes that will be profiled is set as if by calling:

```
(set-process-profiling :set :processes processes)
```

Otherwise, the set of processes remains unchanged, so is controlled by any previous calls to **set-process-profiling**.

*processes* only works in SMP LispWorks. In non-SMP LispWorks, all processes are profiled.

*profile-waiting* is used only in SMP LispWorks. When *profile-waiting* is true, processes that are marked for profiling are profiled even if they are in a wait state. In non-SMP LispWorks, only processes that are active are profiled.

*ignore-in-foreign* controls whether to ignore processes that are inside foreign calls. The default value of *ignore-in-foreign* is *nil*.

*time* controls whether to output overall timing information with the profiler output. If *time* is *nil* then no timing information is output. If *time* is *t* (the default), then output like *time* is printed. If *time* is *:extended*, output like *extended-time* is printed. The output is done when *stop-profiling* is called with *print* and *suspend nil*, which are the defaults.

*start-profiling* can be repeatedly called without intervening calls to *stop-profiling*, for example to change the setting of *profile-waiting* or the profiled processes.

*start-profiling* cannot be used while *profile* is used or while the Profiler tool is profiling (on any thread). Between the call to *start-profiling* and the next call to *stop-profiling* with *print t* (or omitted), *profile* and the Profiler tool cannot be used.

Various parameters which are set by *set-up-profiler* control the behavior of the profiler. See the documentation for *set-up-profiler*.

If *start-profiling* is called before any call to *set-up-profiler*, it implicitly calls *set-up-profiler* without arguments, which will cause it to monitor all fbound symbols in the image.

## Examples

The following sequence of calls to *start-profiling* and *stop-profiling* can be used to profile only interesting work and print the results:

Start profiling the current process:

```
(start-profiling :processes :current)
(do-interesting-work)
```

Temporarily suspend profiling:

```
(stop-profiling :print nil)
(do-uninteresting-work)
```

Resume profiling:

```
(start-profiling :initialize nil)
(do-more-interesting-work)
(stop-profiling)
```

See also

`profile`

`do-profiling`

`set-process-profiling`

`stop-profiling`

“Guidance for control of the memory management system”

on page 130

Chapter 12, “The Profiler”

## string-trim-whitespace

*Function*

Summary      Trims whitespace characters from the beginning and end of a string.

Package      `hcl`

Signature      `string-trim-whitespace string => trimmed-string`

Arguments      `string`      A string.

Values      `trimmed-string`      A string.

Description      The function `string-trim-whitespace` returns a substring of `string`, with all whitespace characters stripped off the

beginning and end. A whitespace character is a character for which `whitespace-char-p` returns `t`.

See also `whitespace-char-p`  
`cl:string-trim`

## **stop-profiling** *Function*

Summary Stops collecting profiling information.

Package `hcl`

Signature `stop-profiling &key print stream`

Arguments `print` A generalized boolean.

`stream` An output stream.

`suspend` A generalized boolean.

Description The function `stop-profiling` stops collecting profiling information, and optionally prints the results.

If `suspend` is false, then the next call to `start-profiling` must pass `initialize t` or omit the `initialize` argument. In addition, if `print` is true, then the collected profiler information is printed.

If `suspend` is true, then the profiler is put into a suspended state where no profiling information is collected, but can be restarted by calling

```
(start-profiling :initialize nil)
```

The default value of `print` is `t` and the default value of `suspend` is (not `print`). The value of `print` is ignored if `suspend` is true.

`stream` specifies the stream for output when `print` is non-nil. It is ignored when `print` is `nil`. The default value of `stream` is the value of `*trace-output*`.

|          |                                                                                                                                                                                                                                |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | Parameters set by <code>set-up-profiler</code> control the format of the output.                                                                                                                                               |
| See also | <code>do-profiling</code><br><code>profile</code><br><code>set-process-profiling</code><br><code>start-profiling</code><br>“Guidance for control of the memory management system”<br>on page 130<br>Chapter 12, “The Profiler” |

## **sweep-all-objects** *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Summary     | Applies a function to all the live objects in the image.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
| Package     | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |
| Signature   | <code>sweep-all-objects</code> <i>function</i> &optional <i>gen-0</i> => <code>nil</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |
| Arguments   | <i>function</i> A function of one argument, the object.<br><i>gen-0</i> A generalized boolean, default value <code>nil</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |
| Values      | <code>sweep-all-objects</code> returns <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |
| Description | <p>Applies <i>function</i> to all the live objects in the image. Normally it is not useful to sweep objects in generation 0 because they are ephemeral, so by default <code>sweep-all-objects</code> does not sweep generation 0. This can be changed by passing a non-nil value as <i>gen-0</i>.</p> <p><i>function</i> should take one argument, the object. It can allocate, but if it allocates heavily the sweeping becomes unreliable. Small amounts of allocation will normally happen only in generation 0, and so will not affect sweeping of other generations.</p> |  |

To call `sweep-all-objects` reliably, do it inside `with-other-threads-disabled`.

|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | In 64-bit LispWorks and in the Mobile GC there is a more specific alternative: function <code>sweep-gen-num-objects</code> can be used to call a function on all live objects in a particular generation.<br><br>In the Mobile GC, <code>sweep-all-objects</code> does not sweep <code>cons</code> objects. There is also a more specific alternative: function <code>mobile-gc-sweep-objects</code> can be used to call a function on all live objects in particular generations. |
| See also | <code>sweep-gen-num-objects</code><br><code>mobile-gc-sweep-objects</code>                                                                                                                                                                                                                                                                                                                                                                                                         |

|             | <i>Function</i>                                                                                                                                                                         |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Controls whether objects are allocated in the static area.                                                                                                                              |
| Package     | <code>hcl</code>                                                                                                                                                                        |
| Signature   | <code>switch-static-allocation flag =&gt; previous-flag</code>                                                                                                                          |
| Arguments   | <code>flag</code> If <code>flag</code> is non-nil, subsequent objects are allocated in the static area; if <code>flag</code> has any other value, objects are allocated conventionally. |
| Values      | <code>switch-static-allocation</code> returns the previous setting of <code>flag</code> .                                                                                               |
| Description | Objects in the static area are garbage-collected, but not moved.<br><br>You should avoid using this function.                                                                           |

See also [enlarge-static](#)  
[in-static-area](#)

## \*symbol-alloc-gen-num\*

## **Variable**

**Summary** Specifies the generation in which interned symbols and their symbol names are allocated.

## Package hcl

Initial value 2 in 32-bit LispWorks, 3 in 64-bit LispWorks

See also [allocation-in-gen-num](#)  
[get-default-generation](#)  
[set-default-generation](#)  
“Allocation of interned sym”

## symbol-dynamically-bound-p

## *Function*

**Summary** The predicate for whether a symbol is dynamically bound.

## Package hcl

Signature `symbol-dynamically-bound-p symbol => result`

Arguments      *symbol*      A non-nil symbol.

Values              *result*              A boolean.

**Description** The function `symbol-dynamically-bound-p` is the predicate for whether the symbol `symbol` is dynamically bound in the current environment.

See also Chapter 28, “Miscellaneous Utilities”

**throw-if-tag-found** *Macro*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |              |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| Summary     | Throws to a specified catch tag or returns <code>nil</code> if the catch tag is not found.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |              |
| Package     | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |              |
| Signature   | <code>throw-if-tag-found catch-tag result-form =&gt; A non-local exit or nil</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |              |
| Arguments   | <code>catch-tag</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | A catch tag. |
|             | <code>result-form</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | A Lisp form. |
| Description | <p>The macro <code>throw-if-tag-found</code> checks whether it can find the catch tag <code>catch-tag</code> by using <code>find-throw-tag</code>. If it finds <code>catch-tag</code> it throws to <code>catch-tag</code> the value(s) of evaluating <code>result-form</code>. Otherwise <code>throw-if-tag-found</code> returns <code>nil</code>, without evaluating <code>result-form</code>.</p> <p>The throwing operation is done by a normal throw. Therefore the only the difference between this and <code>c1:throw</code> is when the tag is not found. In this case, <code>c1:throw</code> would evaluate the result form and then give an error, but <code>throw-if-tag-found</code> simply returns nil.</p> |              |
| See also    | <code>find-throw-tag</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |              |

**toggle-source-debugging** *Function*

|           |                                                                                       |  |
|-----------|---------------------------------------------------------------------------------------|--|
| Summary   | Changes compiler settings affecting production of source level debugging information. |  |
| Package   | <code>hcl</code>                                                                      |  |
| Signature | <code>toggle-source-debugging &amp;optional on =&gt; bool</code>                      |  |

|             |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arguments   | <i>on</i>   | Flag ( <code>t</code> or <code>nil</code> ) to control the resulting setting of the variables. The default is <code>t</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Values      | <i>bool</i> | The current state of source level debugging:<br><code>t</code> if source level debugging is on.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Description |             | <p><code>toggle-source-debugging</code> sets certain compiler parameters, and also turns leaf case optimizations on (when called with <code>nil</code>) or off (when called with <code>t</code>). For all these parameters, the value <code>nil</code> reduces compilation speed.</p> <p><code>toggle-source-debugging</code> is called in the configuration file <code>a-dot-lispworks.lisp</code>, and the initial state of LispWorks such that source level debugging is on.</p> <p>The parameters relate to information required for source level debugging, cross-referencing and finding all changed definitions.</p> <p>The parameters (all in the <code>compiler</code> package) are:</p> |

**\*produce-xref-info\***

When true, the compiler produces information for the Cross Referencer.

**\*load-xref-info\***

When true, the cross-referencing information produced by the compiler is loaded when the corresponding file is loaded.

**\*notice-changed-definitions\***

When true, the Cross Referencer notices when a function is redefined, including an interpreted redefinition..

**\*source-level-debugging\***

When true, the compiler generates information used by the debugger.

`toggle-source-debugging` modifies the status of the variables, and then returns the new value. To check whether all the variables are set to true, without modifying them, use `source-debugging-on-p`.

Cross-referencing information is used by the functions `who-calls`, `who-binds`, `who-references`, `who-sets`, and friends.

Compatibility notes In LispWorks 4.2 and earlier, `toggle-source-debugging` controlled source file recording information. In LispWorks 4.3 and later, this is controlled independently by `*record-source-files*`.

See also `source-debugging-on-p`

## **total-allocation** *Function*

Summary Calculate memory consumed since the image was started.

Package `hcl`

Signature `total-allocation`

Arguments None.

Values Returns the amount allocated

Description This function calculates the total amount of memory consumed since the current image was created. Use at the start and end of a piece of code, to see how much it allocates.

See also `find-object-size`

`room`

“Memory Management in 32-bit LispWorks” on page 135

## **\*traced-arglist\*** *Variable*

|               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary       | The list of arguments given to the function being traced.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Package       | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Initial value | <code>nil</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Description   | Upon entering a function that is being traced, <code>*traced-arglist*</code> is bound to the list of arguments given to the function. <code>*traced-arglist*</code> is then printed after the function name in the output from tracing. It is accessible in the <code>:before</code> and <code>:after</code> forms to <code>trace</code> . However care should be used when manipulating this variable, since it is the value of <code>*traced-arglist*</code> itself that is used when calling the traced function. Thus if this value is altered by the <code>:before</code> forms then the function receives the altered argument list. |
| Example       | <pre>USER 14 &gt; (trace (+ :before                       ((setq *traced-arglist*                            (mapcar #'1+                                    *traced-arglist*))))) + USER 15 &gt; (+ 1 2 3) 0 + &gt; (1 2 3)           (2 3 4) 0 + &lt; (9) 9</pre>                                                                                                                                                                                                                                                                                                                                                                        |
| Notes         | <code>*traced-arglist*</code> is an extension to Common Lisp.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| See also      | <code>trace</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

## **\*traced-results\*** *Variable*

|         |                                                     |
|---------|-----------------------------------------------------|
| Summary | The list of results from the function being traced. |
|---------|-----------------------------------------------------|

|               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package       | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Initial value | <code>nil</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Description   | Upon leaving a function that is being traced, <code>*traced-results*</code> is bound to the list of results from the function. <code>*traced-results*</code> is then printed after the function name in the output from tracing. It is accessible in the <code>:after</code> forms to <code>trace</code> . However care should be used when manipulating this variable, since it is the value of <code>*traced-results*</code> itself that is used when returning from the traced function. Thus if this value is altered by the <code>:after</code> forms then the caller of the traced function receives the altered results. |
| Example       | <pre>USER 5 &gt; (trace (ceiling                       :after                       ((setq *traced-results*                             (mapcar #'1- *traced-results*)))))  CEILING USER 6 &gt; (multiple-value-call #'+ (ceiling 4 3))  0 CEILING &gt; (4 3) 0 CEILING &lt; (2 -2) (1 -3) -2</pre>                                                                                                                                                                                                                                                                                                                             |
| Notes         | <code>*traced-results*</code> is an extension to Common Lisp.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| See also      | <code>trace</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

| <b>*trace-indent-width*</b> |  | <i>Variable</i>                                                                |
|-----------------------------|--|--------------------------------------------------------------------------------|
| Summary                     |  | The amount of extra indentation in the trace output for each level of nesting. |
| Package                     |  | <code>hcl</code>                                                               |
| Initial value               |  | 2                                                                              |

Description      **\*trace-indent-width\*** is the extra amount by which the traced output for function calls is indented upon entering a deeper level of nesting (that is, a traced call from a function that is itself traced). If it is 0 then no indentation occurs.

Example

```
CL-USER 1 > (setq *trace-indent-width* 4
                     *max-trace-indent* 50)
50

CL-USER 2 > (defun quad (a b c) (- (* b b) (* 4 a c)))
QUAD

CL-USER 3 > (trace quad *)
(QUAD *)

CL-USER 4 > (quad 4 3 14)
0 QUAD > ...
  >> A : 4
  >> B : 3
  >> C : 14
    1 * > ...
      >> SYSTEM::ARGS : (3 3)
    1 * < ...
      << VALUE-0 : 9
    1 * > ...
      >> SYSTEM::ARGS : (4 4 14)
    1 * < ...
      << VALUE-0 : 224
0 QUAD < ...
  << VALUE-0 : -215
-215
```

Notes      **\*trace-indent-width\*** is an extension to Common Lisp.

See also     **trace**

## **\*trace-level\***                                                          *Variable*

Summary     The current depth of tracing.

Package    **hcl**

|               |                                                                                                                                                                                                                                                                                                                    |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Initial value | <code>0</code>                                                                                                                                                                                                                                                                                                     |
| Description   | <code>*trace-level*</code> is a special variable whose value is the current depth of tracing. The current value of <code>*trace-level*</code> is printed before the function name during the output from tracing.                                                                                                  |
| Example       | <pre> USER 8 &gt; (defun fac (n) (if (&lt;= n 1)                                 1                                 (* n (fac (1- n)))))  FAC USER 9 &gt; (trace fac)  FAC USER 10 &gt; (fac 3)  0 FAC &gt; (3)   1 FAC &gt; (2)     2 FAC &gt; (1)     2 FAC &lt; (1)       1 FAC &lt; (2) 0 FAC &lt; (6) 6 </pre> |
| Notes         | <code>*trace-level*</code> is an extension to Common Lisp.                                                                                                                                                                                                                                                         |
| See also      | <code>trace</code>                                                                                                                                                                                                                                                                                                 |

| <b>*trace-print-circle*</b> |                                                                                                                                                                                                  | <i>Variable</i> |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Summary                     | Controls how circular structure are printed in trace output.                                                                                                                                     |                 |
| Package                     | <code>hcl</code>                                                                                                                                                                                 |                 |
| Initial value               | <code>nil</code>                                                                                                                                                                                 |                 |
| Description                 | <code>*trace-print-circle*</code> controls how circular structures are printed during output from tracing. It allows the printing of circular structures by the tracer to be controlled indepen- |                 |

dently of the usual printing mechanism, which is governed by `*print-circle*`. `*print-circle*` is bound to the value of `*trace-print-circle*` while printing tracing information.

Example

```
USER 19 > (setq *trace-print-circle* t)
T
USER 20 > (defun circ (l)
             (rplacd (last l) 1)
             1)

CIRC
USER 21 > (trace second)

SECOND
USER 22 > (second (circ '(1 2 3 4)))
0 SECOND > (#1=(1 2 3 4 . #1#))
0 SECOND < (2) 2
```

Notes `*trace-print-circle*` is an extension to Common Lisp.

See also `trace`

## **\*trace-print-length\*** *Variable*

Summary The number of components of an object that are printed in trace output.

Package `hcl`

Initial value `100`

Description `*trace-print-length*` controls the number of components of an object which are printed during output from tracing. If its value is a positive integer then the first `*trace-print-length*` components are printed.

`*print-length*` is bound to the value of `*trace-print-length*` while printing tracing information. If `*trace-`

**print-length\*** is **nil** then all the components of the object are printed.

**Example**

```
USER 5 > (trace append)
APPEND
USER 6 > (setq *trace-print-length* 3)

3
USER 7 > (dotimes (i 10) (setq li (if (zerop i)
   nil
   (cons i li)))))

NIL
USER 8 > (append li '(a b))
0 APPEND > ((9 8 7 ...) (A B))
0 APPEND < ((9 8 7 ...))
(9 8 7 6 5 4 3 2 1 A B)
```

**Notes**

**\*trace-print-length\*** is an extension to Common Lisp.

**See also**

**trace**

**\*trace-print-level\***

**Variable**

**Summary**

The depth to which nested objects are printed in trace output.

**Package**

**hcl**

**Initial value**

**5**

**Description**

**\*trace-print-level\*** controls the depth to which nested objects are printed during output from tracing. If its value is a positive integer then components at or above that level are suppressed. By definition an object to be printed is considered to be at level 0, its components are at level 1, their sub-components are at level 2, and so on.

**\*print-level\*** is bound to the value of **\*trace-print-level\*** while printing tracing information. If **\*trace-**

`print-level*` is `nil` then objects are printed without regard to depth.

|          |                                                                                                                                                                                                                                                                                                                                                                   |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Examples | <pre>USER 8 &gt; (trace append) APPEND USER 9 &gt; (dotimes (i 10) (setq li (if (zerop i)                                          nil                                          (list i li)))) NIL USER 10 &gt; (append li '(a b)) 0 APPEND &gt; ((9 (8 (7 (6 #)))) (A B)) 0 APPEND &lt; ((9 (8 (7 (6 #))) A B)) (9 (8 (7 (6 (5 (4 (3 (2 (1 NIL))))))) A B)</pre> |
| Notes    | <code>*trace-print-level*</code> is an extension to Common Lisp.                                                                                                                                                                                                                                                                                                  |
| See also | <code>trace</code>                                                                                                                                                                                                                                                                                                                                                |

## **\*trace-print-pretty\*** *Variable*

|               |                                                                                                                                                                                                                                                                                                                                            |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary       | Controls the amount of whitespace in trace output.                                                                                                                                                                                                                                                                                         |
| Package       | <code>hcl</code>                                                                                                                                                                                                                                                                                                                           |
| Initial value | <code>nil</code>                                                                                                                                                                                                                                                                                                                           |
| Description   | <code>*trace-print-pretty*</code> controls the amount of whitespace printed during output from tracing. If it is not <code>nil</code> then extra whitespace is inserted to make the output more comprehensible. <code>*print-pretty*</code> is bound to the value of <code>*trace-print-pretty*</code> while printing tracing information. |

|          |                                                                                                                                       |
|----------|---------------------------------------------------------------------------------------------------------------------------------------|
| Examples | <pre>USER 6 &gt; (trace macroexpand-1) MACROEXPAND-1 USER 7 &gt; (setq *trace-print-pretty* t               *print-pretty* nil)</pre> |
|----------|---------------------------------------------------------------------------------------------------------------------------------------|

```

NIL
USER 8 > (defmacro sum (n)
             '(do ((i 0 (1+ i))
                   (res 0 (+ i res)))
                  ((= i ,n) res)))

SUM
USER 9 > (macroexpand-1 '(sum 3))

0 MACROEXPAND-1 > ((SUM 3))
0 MACROEXPAND-1 < ((DO ((I 0 (1+ I))
                           (RES 0 (+ I RES)))
                           ((= I 3)
                            RES))
                        T)
(DO ((I 0 (1+ I)) (RES 0 (+ I RES))) ((= I 3) RES))
T

```

Notes      **\*trace-print-pretty\*** is an extension to Common Lisp.

See also    **trace**

### **\*trace-verbose\*** *Variable*

Summary     Controls how arguments and values are printed in trace output.

Package     **hcl**

Initial value    **:only**

Description    **\*trace-verbose\*** controls the way arguments and values are printed in trace output.

If the value is not **nil** then **trace** attempts to decode the arguments and values, and prints them.

When the value is **:only**, **trace** does not print the lists of arguments and values after the function name.

Notes      **\*trace-verbose\*** is an extension to Common Lisp.

See also

`trace`

## try-compact-in-generation *Function*

Summary      Compacts the most fragmented segment(s) in a generation in 32-bit LispWorks.

Package      `hcl`

Signature      `try-compact-in-generation generation-number time-threshold`  
                  `&optional fraction-threshold => result`

Arguments      *generation-number*  
                  0 for the most recent generation, 1 for the  
                  most recent two generations, and so on up to  
                  a maximum (usually 3). Numbers outside  
                  this range signal an error.

*time-threshold*      A real number.

*fraction-threshold*

A real number between 0 and 1, defining the minimum fragmentation to actually compact. The default is 0.25.

Values      *result*      A boolean.

Description      `try-compact-in-generation` finds the most fragmented segment in the generation specified. If *time-threshold* is positive, it compacts this segment, and repeats this operation until *time-threshold* seconds have elapsed. At this point `try-compact-in-generation` returns, with value `t` if at least one segment was compacted and value `nil` otherwise. Because the operation cannot be stopped in the middle, the actual time taken will always be larger than *time-threshold*.

If *fraction-threshold* is 1, `try-compact-in-generation` does nothing. If *fraction-threshold* is 0,

`try-compact-in-generation` will compact all uncompacted segments (unless it runs out of time). With the default (0.25) `try-compact-in-generation` compacts only moderately fragmented segments.

If *time-threshold* is negative, then `try-compact-in-generation` does not actually compact any segments. *result* is a boolean indicating whether `try-compact-in-generation` would actually try to compact a segment if it were to be called with a positive *time-threshold* and the other arguments unchanged.

This function is typically used after a call to `check-fragmentation`. For more information, see “Controlling Fragmentation” on page 144.

**Notes** `try-compact-in-generation` is implemented only in 32-bit LispWorks. It is not relevant to the Memory Management API in 64-bit implementations, where `marking-gc` with the *what-to-copy* argument offers similar functionality (although `set-blocking-gen-num` is intended to solve the problem of fragmentation automatically).

**See also** `check-fragmentation`  
`try-move-in-generation`  
“Memory Management in 32-bit LispWorks” on page 135

## try-move-in-generation *Function*

**Summary** Moves objects out of the most fragmented segment(s) in a generation, leaving them empty in 32-bit LispWorks.

**Package** `hcl`

**Signature** `try-move-in-generation generation-number time-threshold &optional fraction-threshold => result`

|             |                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arguments   | <i>generation-number</i>  | 0 for the most recent generation, 1 for the most recent two generations, and so on up to a maximum (usually 3). Numbers outside this range signal an error.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|             | <i>time-threshold</i>     | A real number.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|             | <i>fraction-threshold</i> | A real number between 0 and 1, defining the minimum fragmentation to actually move. The default is 0.25.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Values      | <i>result</i>             | A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Description |                           | <p><code>try-move-in-generation</code> finds the most fragmented segment in the generation specified. If <i>time-threshold</i> is positive, it moves objects out of this segment, leaving it empty, and repeats this operation until <i>time-threshold</i> seconds have elapsed. At this point <code>try-move-in-generation</code> returns, with value <code>t</code> if at least one segment was moved and value <code>nil</code> otherwise. Because the operation cannot be stopped in the middle, the actual time taken will always be larger than <i>time-threshold</i>.</p> <p>If <i>fraction-threshold</i> is 1, <code>try-move-in-generation</code> does nothing. If <i>fraction-threshold</i> is 0, <code>try-move-in-generation</code> will move all uncompacted segments (unless it runs out of time). With the default (0.25) <code>try-move-in-generation</code> moves only moderately fragmented segments.</p> <p>If <i>time-threshold</i> is negative, then <code>try-move-in-generation</code> does not actually move any segments. <i>result</i> is a boolean indicating whether <code>try-move-in-generation</code> would actually try to move a segment if it were to be called with a positive <i>time-threshold</i> and the other arguments unchanged.</p> <p>This function is typically used after a call to <code>check-fragmentation</code>. For more information, see “Controlling Fragmentation” on page 144.</p> |

|          |                                                                                                                                                                                                                                                                                                                                                      |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | <b>try-move-in-generation</b> is implemented only in 32-bit LispWorks. It is not relevant to the Memory Management API in 64-bit implementations, where <b>marking-gc</b> with the <i>what-to-copy</i> argument offers similar functionality (although <b>set-blocking-gen-num</b> is intended to solve the problem of fragmentation automatically). |
| See also | <b>check-fragmentation</b><br><b>try-compact-in-generation</b><br>“Guidance for control of the memory management system”<br>on page 130                                                                                                                                                                                                              |

## **undefine-declaration** *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Summary     | Remove a user declaration handler.                                                                                                                                                                                                                                                                                                                                                                                                                            |  |
| Package     | <b>hcl</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
| Signature   | <b>undefine-declaration</b> <i>decl-name</i> => <i>decl-name</i>                                                                                                                                                                                                                                                                                                                                                                                              |  |
| Arguments   | <i>decl-name</i> A symbol.                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
| Values      | <i>decl-name</i> A symbol.                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
| Description | The function <b>undefine-declaration</b> causes <i>decl-name</i> not to be recognized as a declaration. It can be used to undo the effect of <b>define-declaration</b> , but also to undo the effect of proclaiming <i>decl-name</i> as a declaration by <b>proclaim</b> or <b>declare</b> . Note that <b>undefine-declaration</b> is a function, unlike <b>define-declaration</b> which is a macro.<br><br><b>undefine-declaration</b> returns its argument. |  |
| See also    | <b>define-declaration</b><br><b>declare</b><br><b>declaration-information</b><br><b>function-information</b>                                                                                                                                                                                                                                                                                                                                                  |  |

`variable-information`  
`augment-environment`

## **unlocked-queue** *Type*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | A fast queue.                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Package     | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Description | The type <code>unlocked-queue</code> is a fast queue (first in, first out) that is unlocked, not thread-safe and does not have waiting functionality. It does not do anything that <code>mailbox</code> cannot do, but it is faster. It is useful when you always access the queue together with other operations that need to be "atomic", so that you need a lock around them anyway, or when queueing and de-queueing is done on the same process. |
| See also    | <code>make-unlocked-queue</code>                                                                                                                                                                                                                                                                                                                                                                                                                      |

## **unwind-protect-blocking-interrupts** *Macro*

|           |                                                                                                                             |                                       |
|-----------|-----------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| Summary   | Does <code>unwind-protect</code> blocking interrupts.                                                                       |                                       |
| Package   | <code>hcl</code>                                                                                                            |                                       |
| Signature | <code>unwind-protect-blocking-interrupts</code> <i>protected-form</i> &<br><i>rest</i><br><i>cleanups</i> => <i>results</i> |                                       |
| Arguments | <i>protected-form</i>                                                                                                       | A form.                               |
|           | <i>cleanups</i>                                                                                                             | Forms.                                |
| Values    | <i>results</i>                                                                                                              | The values of <i>protected-form</i> . |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | The macro <code>unwind-protect-blocking-interrupts</code> executes <i>protected-form</i> with interrupts blocked. On exit, whether local or not, the <i>cleanups</i> are executed with interrupts blocked.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|             | In compiled code, the macro is equivalent to                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|             | <pre>(mp:with-interrupts-blocked   (unwind-protect     <i>protected-form</i>     (mp:current-process-block-interrupts)     <i>cleanup1 cleanup2 ...)))</i></pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Notes       | <p>However, in interpreted code the macro is expanded to ensure that the call to <code>(mp:current-process-block-interrupts)</code> actually happens. If the above form is interpreted and <i>protected-form</i> uses <code>current-process-unblock-interrupts</code>, the evaluator may throw (if the process is killed, for example) before calling <code>current-process-unblock-interrupts</code>.</p> <ol style="list-style-type: none"> <li>1. Both the protected form and the cleanups can block and unblock interrupts using <code>current-process-block-interrupts</code> and <code>current-process-unblock-interrupts</code>. Typically the protected form would set up something and then unblock the interrupts. The cleanups may unblock interrupts if some of the cleanups are essential and others are not.</li> <li>2. Blocking interrupts causes the process to not respond to interrupts, including killing. You should make sure that forms which are executed with interrupts blocked do not hang.</li> </ol> |
| See also    | <a href="#">current-process-block-interrupts</a><br><a href="#">current-process-unblock-interrupts</a><br><a href="#">unwind-protect-blocking-interrupts-in-cleanups</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

|             | <i>Macro</i>                                                                                                                                                                                                                                                                                                                                        |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Does <code>unwind-protect</code> blocking interrupts around the cleanups.                                                                                                                                                                                                                                                                           |
| Package     | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                    |
| Signature   | <code>unwind-protect-blocking-interrupts-in-cleanups <i>protected-form</i> &amp;rest <i>cleanups</i> =&gt; <i>results</i></code>                                                                                                                                                                                                                    |
| Arguments   | <p><i>protected-form</i> A form.</p> <p><i>cleanups</i> Forms.</p>                                                                                                                                                                                                                                                                                  |
| Values      | <i>results</i> The values of <i>protected-form</i> .                                                                                                                                                                                                                                                                                                |
| Description | The macro <code>unwind-protect-blocking-interrupts-in-cleanups</code> executes <i>protected-form</i> . On exit, whether local or not, the <i>cleanups</i> are executed with interrupts blocked.<br><br>In compiled code, the macro is equivalent to                                                                                                 |
|             | <pre>(unwind-protect   <i>protected-form</i>   (mp:with-interrupts-blocked <i>cleanup1 cleanup2 ...</i>)</pre>                                                                                                                                                                                                                                      |
|             | However, in interpreted code the macro is expanded to ensure that the body of <code>mp:with-interrupts-blocked</code> actually happens. If the form above is interpreted the evaluator may throw (if the process is killed, for example) before completing macroexpansion of <code>mp:with-interrupts-blocked</code> and doing the actual blocking. |
| Notes       | <ol style="list-style-type: none"> <li>1. <i>cleanups</i> can block and unblock interrupts using <code>current-process-block-interrupts</code> and <code>current-process-unblock-interrupts</code>. This may be useful if some of the cleanups are essential and others are not.</li> </ol>                                                         |

2. Blocking interrupts causes the process to not respond to interrupts, including killing. You should make sure that forms which are executed with interrupts blocked do not hang.

## See also

`current-process-block-interrupts`  
`current-process-unblock-interrupts`  
`unwind-protect-blocking-interrupts`  
`with-interrupts-blocked`

**variable-information** *Function*

**Summary**      Returns information about the variable bindings of a symbol in an environment.

**Package**      `hcl`

**Signature**      `variable-information variable &optional env => kind,  
localp, decls`

**Arguments**      `variable`      A symbol

`env`      An environment or `nil`

**Values**      `kind`      `nil` or one of the keywords `:special`,  
`:lexical`, `:symbol-macro` and `:constant`.

`localp`      A boolean

`decls`      An a-list

**Description**      The function `variable-information` returns information about how the variable *symbol* is bound in the environment *env*.

The value of *kind* will be as follows:

`nil`      There is no information about *variable* in *env*

`:special`      *variable* has a special binding in *env*

**:lexical**      *variable* has a lexical binding in *env*  
**:symbol-macro** *variable* has a symbol-macro binding in *env*  
**:constant**      *variable* has a constant binding in *env*

*localp* will be true if *variable* is bound by a form that has lexical scope (for example `let`, `lambda`) or false if *variable* has global scope (for example `defvar`).

*decls* is an a-list of declarations that refer to *variable*. The `cdr` of each pair is specified according to the `car` of the pair as follows:

**dynamic-extent**

The `cdr` is non-nil if *variable* is declared **dynamic-extent** in *env*.

**ignore**      The `cdr` is non-nil if *variable* is declared **ignore** in *env*.

**type**      The `cdr` is the type specifier that is declared for *variable* in *env* if any.

Notes      **variable-information** is part of the environment access API which is based on that specified in *Common Lisp: the Language (2nd Edition)*.

See also     **augment-environment**  
              **declaration-information**  
              **define-declaration**  
              **function-information**  
              **map-environment**

## who-binds

## *Function*

Summary     Returns the definitions which bind a special variable.

Package     `hcl`

|             |                                                                                                                                              |                     |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| Signature   | <code>who-binds symbol =&gt; result</code>                                                                                                   |                     |
| Arguments   | <code>symbol</code>                                                                                                                          | A special variable. |
| Values      | <code>result</code>                                                                                                                          | A list.             |
| Description | The function <code>who-binds</code> returns a list of dspecs naming the definitions which bind the special variable <code>symbol</code> .    |                     |
| Notes       | The cross-referencing information used by <code>who-binds</code> is generated when code is compiled with source-level debugging switched on. |                     |
| See also    | <code>binds-who</code><br><code>toggle-source-debugging</code><br><code>who-sets</code><br><code>who-references</code>                       |                     |

|                  | <i>Function</i>                                                                                                                           |          |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------|----------|
| <b>who-calls</b> |                                                                                                                                           |          |
| Summary          | Returns the callers of a function.                                                                                                        |          |
| Package          | <code>hcl</code>                                                                                                                          |          |
| Signature        | <code>who-calls dspec =&gt; callers</code>                                                                                                |          |
| Arguments        | <code>dspec</code>                                                                                                                        | A dspec. |
| Values           | <code>callers</code>                                                                                                                      | A list.  |
| Description      | The function <code>who-calls</code> returns a list of dspecs naming the definitions which call the function named by <code>dspec</code> . |          |
|                  | See also the editor commands <code>List Callers</code> and <code>Show Paths To</code> .                                                   |          |

|          |                                                                                                                                              |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | The cross-referencing information used by <code>who-calls</code> is generated when code is compiled with source-level debugging switched on. |
| See also | <code>calls-who</code><br><code>toggle-source-debugging</code>                                                                               |

## **who-references** *Function*

|             |                                                                                                                                                     |                     |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| Summary     | Returns the definitions which reference a special variable.                                                                                         |                     |
| Package     | <code>hcl</code>                                                                                                                                    |                     |
| Signature   | <code>who-references symbol =&gt; result</code>                                                                                                     |                     |
| Arguments   | <code>symbol</code>                                                                                                                                 | A special variable. |
| Values      | <code>result</code>                                                                                                                                 | A list.             |
| Description | The function <code>who-references</code> returns a list of dspecs naming the definitions which reference the special variable <code>symbol</code> . |                     |
| Notes       | The cross-referencing information used by <code>who-references</code> is generated when code is compiled with source-level debugging switched on.   |                     |
| See also    | <code>references-who</code><br><code>toggle-source-debugging</code><br><code>who-binds</code><br><code>who-sets</code>                              |                     |

## **who-sets** *Function*

|         |                                                       |
|---------|-------------------------------------------------------|
| Summary | Returns the definitions which set a special variable. |
|---------|-------------------------------------------------------|

|             |                                                                                                                                                |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>hcl</code>                                                                                                                               |
| Signature   | <code>who-sets symbol =&gt; result</code>                                                                                                      |
| Arguments   | <i>symbol</i> A special variable.                                                                                                              |
| Values      | <i>result</i> A list.                                                                                                                          |
| Description | The function <code>who-sets</code> returns a list of dspecs naming the definitions which set the value of the special variable <i>symbol</i> . |
| Notes       | The cross-referencing information used by <code>who-sets</code> is generated when code is compiled with source-level debugging switched on.    |
| See also    | <code>sets-who</code><br><code>toggle-source-debugging</code><br><code>who-binds</code><br><code>who-references</code>                         |

## with-code-coverage-generation *Macro*

|                              |                                                                                                                                                                                                                                                                                                    |           |            |                 |            |                 |            |              |            |                              |  |
|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|------------|-----------------|------------|-----------------|------------|--------------|------------|------------------------------|--|
| Summary                      | Switches code coverage generation during the execution of a body of code.                                                                                                                                                                                                                          |           |            |                 |            |                 |            |              |            |                              |  |
| Package                      | <code>hcl</code>                                                                                                                                                                                                                                                                                   |           |            |                 |            |                 |            |              |            |                              |  |
| Signature                    | <code>with-code-coverage-generation (&amp;key on atomic-p counters force count-implicit-branch) &amp;body body =&gt; result</code>                                                                                                                                                                 |           |            |                 |            |                 |            |              |            |                              |  |
| Arguments                    | <table> <tr> <td><i>on</i></td> <td>A boolean.</td> </tr> <tr> <td><i>atomic-p</i></td> <td>A boolean.</td> </tr> <tr> <td><i>counters</i></td> <td>A boolean.</td> </tr> <tr> <td><i>force</i></td> <td>A boolean.</td> </tr> <tr> <td><i>count-implicit-branch</i></td> <td></td> </tr> </table> | <i>on</i> | A boolean. | <i>atomic-p</i> | A boolean. | <i>counters</i> | A boolean. | <i>force</i> | A boolean. | <i>count-implicit-branch</i> |  |
| <i>on</i>                    | A boolean.                                                                                                                                                                                                                                                                                         |           |            |                 |            |                 |            |              |            |                              |  |
| <i>atomic-p</i>              | A boolean.                                                                                                                                                                                                                                                                                         |           |            |                 |            |                 |            |              |            |                              |  |
| <i>counters</i>              | A boolean.                                                                                                                                                                                                                                                                                         |           |            |                 |            |                 |            |              |            |                              |  |
| <i>force</i>                 | A boolean.                                                                                                                                                                                                                                                                                         |           |            |                 |            |                 |            |              |            |                              |  |
| <i>count-implicit-branch</i> |                                                                                                                                                                                                                                                                                                    |           |            |                 |            |                 |            |              |            |                              |  |

|             |               |                                                                                                                                                                                                                             |
|-------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             |               | A boolean.                                                                                                                                                                                                                  |
| Values      | <i>result</i> | The result of executing <i>body</i> .                                                                                                                                                                                       |
| Description |               | The macro <code>with-code-coverage-generation</code> switches code coverage generation on or off inside the dynamic scope of <i>body</i> .<br><br>The arguments are interpreted as by <code>generate-code-coverage</code> . |
| See also    |               | <code>generate-code-coverage</code>                                                                                                                                                                                         |

## with-ensuring-gethash *Macro*

|           |                                                                                                                                                                                  |                                                                             |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| Summary   | A thread-safe way to get a value from a <code>hash-table</code> , adding a value if the key is not present. Allows a complicated form to construct the new value.                |                                                                             |
| Package   | <code>hcl</code>                                                                                                                                                                 |                                                                             |
| Signature | <code>with-ensuring-gethash <i>key hash-table &amp;key constructor</i><br/> <i>constructor-form in-lock-constructor in-lock-constructor-form =&gt;</i><br/> <i>result</i></code> |                                                                             |
| Arguments | <i>key</i>                                                                                                                                                                       | A Lisp object.                                                              |
|           | <i>hash-table</i>                                                                                                                                                                | A <code>hash-table</code> .                                                 |
|           | <i>constructor</i>                                                                                                                                                               | A function designator for a function of no arguments, or <code>nil</code> . |
|           | <i>constructor-form</i>                                                                                                                                                          | A Lisp form, or <code>nil</code> .                                          |
|           | <i>in-lock-constructor</i>                                                                                                                                                       |                                                                             |
|           |                                                                                                                                                                                  | A function designator for a function of one argument, or <code>nil</code> . |
|           | <i>in-lock-constructor-form</i>                                                                                                                                                  |                                                                             |

|             |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             |                     | A Lisp form, or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Values      | <code>result</code> | A Lisp object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Description |                     | <p>The macro <code>with-ensuring-gethash</code> gets the value for the key <code>key</code> from the hash table <code>hash-table</code>, and if this fails constructs a new value, puts it in the table and returns it. <code>with-ensuring-gethash</code> does this in a thread-safe way, which means that all threads calling it with the same <code>key</code> and <code>hash-table</code> return the same value (as long as nothing removes it from the table).</p> <p>Only one of <code>constructor-form</code> or <code>constructor</code> can be non-<code>nil</code>. When <code>key</code> is not found, <code>constructor-form</code> or <code>constructor</code> is used to construct the new value. If <code>constructor</code> is non-<code>nil</code>, it is called without arguments. If <code>constructor-form</code> is non-<code>nil</code>, it is executed. If both are <code>nil</code>, the new value is <code>nil</code> unless the <code>in-lock-constructor</code> or <code>in-lock-constructor-form</code> construct it. The call or execution of the <code>constructor</code> or <code>constructor-form</code> is done without any lock. The result may be discarded if, by the time it returned, there is a match for the key in the table.</p> <p>Only one of <code>in-lock-constructor</code> or <code>in-lock-constructor-form</code> can be non-<code>nil</code>, which is used when the key is not found after constructing the new value. If <code>in-lock-constructor-form</code> is non-<code>nil</code>, it is executed and the result is the actual value to use (the result of the construction by <code>constructor-form</code> or <code>constructor</code> is ignored). If <code>in-lock-constructor</code> is non-<code>nil</code>, it is called with the result of the construction by <code>constructor-form</code> or <code>constructor</code>, and the result is used as the new value. In either case, the call or execution is done with <code>hash-table</code> locked, and the result is guaranteed to be put in <code>hash-table</code> and returned. If both <code>in-lock-constructor</code> and <code>in-lock-constructor-form</code> are <code>nil</code>, the result of the construction is used.</p> |
| Notes       |                     | <ol style="list-style-type: none"> <li>When both <code>constructor-form</code> and <code>in-lock-constructor-form</code> are <code>nil</code>, <code>gethash-ensuring</code> is probably simpler and better.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

2. In most situations, doing all the construction out of the lock is better than doing anything inside the lock. It means that sometimes the work that was done in the constructions is wasted because another thread put the value in the table, but that overhead is normally less significant than the overhead of holding the lock for longer, with the associated potential deadlocks.

See also `ensure-hash-entry`  
`gethash-ensuring`  
“Modifying a hash table with multiprocessing” on page 279

## with-hash-table-locked *Macro*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                               |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|
| Summary     | Evaluates code with a hash-table locked against modification by other threads.                                                                                                                                                                                                                                                                                                                                                                                           |                                               |
| Package     | <code>hcl</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                               |
| Signature   | <code>with-hash-table-locked hash-table &amp;body body =&gt; results</code>                                                                                                                                                                                                                                                                                                                                                                                              |                                               |
| Arguments   | <code>hash-table</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A hash table.                                 |
|             | <code>body</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Forms.                                        |
| Values      | <code>results</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                     | The results of evaluating <code>body</code> . |
| Description | <p>The macro <code>with-hash-table-locked</code> evaluates <code>body</code> with the hash table <code>hash-table</code> locked against modification by other threads. The current thread can modify <code>hash-table</code>.<br/><br/><code>with-hash-table-locked</code> is useful not only for multiple accesses to the same table, but also when an access to the table must be consistent with some other operation, avoiding the need to make a separate lock,</p> |                                               |

See also [gethash-ensuring](#)  
[make-hash-table](#)  
[modify-hash](#)  
[with-ensuring-gethash](#)  
“Atomicity and thread-safety of the LispWorks implementation” on page 265

## **with-heavy-allocation** *Macro*

**Summary** Slows up garbage collection during the execution of code that allocates a lot of space.

**Package** `hcl`

**Signature** `with-heavy-allocation &rest body => result`

**Arguments** `body` The forms for which you want the garbage collector to behave differently from normal.

**Values** `result` The result of executing `body`.

**Description** The macro `with-heavy-allocation` is for use with code that allocates a lot of space but is not interactive. It ensures that garbage collection (GC) is carried out less frequently while these forms are being executed. However, each GC may take longer.

**Compatibility notes** In LispWorks 5.0 `with-heavy-allocation` is implemented only in 32-bit LispWorks. In version 5.1 and later it is implemented in 64-bit LispWorks as well.

See also [avoid-gc](#)  
[gc-if-needed](#)  
[get-gc-parameters](#)  
[mark-and-sweep](#)  
[normal-gc](#)

```
set-gc-parameters
finish-heavy-allocation
without-interrupts
```

“Memory Management in 32-bit LispWorks” on page 135

## with-output-to-fasl-file

### dump-form

### dump-forms-to-file

### *Macro and Functions*

**Summary**      Dump forms to a file in a binary format, which can then be loaded using `load-data-file`.

**Package**      `hcl`

**Signature**      `with-output-to-fasl-file (fasl-stream-var pathname &key overwrite dump-standard-objects delete-on-error) &body body => nil`  
  
`dump-form form fasl-stream => nil`  
  
`dump-forms-to-file pathname forms &key overwrite dump-standard-objects delete-on-error => nil`

**Arguments**      `fasl-stream-var`    A variable.

`pathname`        A pathname designator.

`overwrite`       A boolean.

`dump-standard-objects`

                      A boolean.

`delete-on-error` A boolean.

`body`            Lisp code that calls `dump-form`.

`form`            A form.

`fasl-stream` The value of `fasl-stream-var`.

`forms`          A list of forms.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Values      | Each of these macros and functions returns <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Description | <p>The macro <code>with-output-to-fasl-file</code> and the functions <code>dump-form</code> and <code>dump-forms-to-file</code> allow you to dump forms to a file in a binary format, which can then be loaded using <code>load-data-file</code>.</p> <p>They provide these two ways to achieve the same thing:</p> <ul style="list-style-type: none"> <li>• <code>dump-forms-to-file</code> simply dumps the forms in <i>forms</i> into the file specified by <i>pathname</i>.</li> <li>• <code>with-output-to-fasl-file</code> binds <i>fasl-stream-var</i> to an opaque structure associated with <i>pathname</i>. Inside the <i>body</i>, <code>dump-form</code> is used to dump individual forms to the file.</li> </ul> <p><i>overwrite</i> specifies what to do if <i>pathname</i> already exists. If <i>overwrite</i> is non-nil, <code>dump-forms-to-file</code> and <code>with-output-to-fasl-file</code> overwrite the existing file, otherwise they signal an error. The default value of <i>overwrite</i> is <code>t</code>.</p> <p><i>delete-on-error</i> specifies what to do in case of a non-local exit from the <i>body</i> of <code>with-output-to-fasl-file</code> or from <code>dump-forms-to-file</code> (typically abort after an error). By default, the file is deleted, but if <i>delete-on-error</i> is <code>nil</code> then the file is left as it is. The default value of <i>delete-on-error</i> is <code>t</code>.</p> <p><i>dump-standard-objects</i> specifies what to do when trying to dump a standard object (that is, an instance of a subclass of <code>standard-object</code>) which does not have a user-defined <code>make-load-form</code>. If <i>dump-standard-objects</i> is <code>nil</code>, an error is signaled. If <i>dump-standard-objects</i> is non-nil, the instance is dumped using <code>make-load-form-saving-slots</code>. The default value of <i>dump-standard-objects</i> is <code>nil</code>.</p> <p>When the generated file is loaded by <code>load-data-file</code>, the forms are loaded and by default evaluated, though <code>load-data-file</code> can also load without evaluating. If <i>callback</i> is passed to <code>load-data-file</code>, it gets each of the results. Otherwise the results are discarded (except being printed when</p> |

passing `:print t`). Hence to be useful, either `load-data-file` must be called with *callback*, or evaluation of the forms should have some side effect, for example setting the value of some special symbol or adding entries to some global table.

For a form which is not a list or an object with `make-load-form`, or is a quoted list, `eval` does nothing. Dumping such forms and then using the *callback* in `load-data-file` to do some work with them is the natural way of using `dump-forms-to-file` or `with-output-to-fasl-file` and `load-data-file` to transfer large amounts of data.

Files generated by `dump-forms-to-file` or `with-output-to-fasl-file` can be loaded (by `load-data-file`) on any LispWorks platform with the same byte order. All x86/x64 architectures have the same byte order (little-endian), so `load-data-file` on any x86/x64 architecture can be used to load a data file that was generated on any x86/x64 architecture. The ARM architectures have the same byte order as x86/x64. The reverse byte order (big-endian) is used by AIX and SPARC (old Solaris).

## Notes

1. The dumping of objects is done the same way that `compile-file` dumps when it creates a fasl file, except for the treatment of standard objects when `dump-standard-objects` is non-nil.
2. Dumping means creating a deep copy of the form. The elements and slots of lists, arrays of element type `t`, structures (unless they have a `make-load-form`), and, when `dump-standard-objects` is non-nil, standard objects without `make-load-form` are dumped recursively.
3. `dump-forms-to-file` and `with-output-to-fasl-file` cope with cyclic structures.
4. If you want to dump parts of cyclic structures, you can stop the recursion by defining an appropriate `make-load-form` method for the objects at the nodes where the recursion should stop.

5. A fasl file created using `with-output-to-fasl-file` must be loaded only by `load-data-file`, and not by `load`.

Example

```
(dump-forms-to-file "my-forms.data"
  '(#(1 2 3)
    89
    (* 7 7)
    '(* 9 9)))
```

Note that the first \* form lacks a quote while the second has a quote.

Then (potentially in a different LispWorks version and/or on a different architecture) this:

```
(load-data-file "my-forms.data"
  :callback 'print)
```

prints this:

```
 #(1 2 3)
 89
 49
 (* 9 9)
```

In contrast, loading the same binary file without evaluation:

```
(load-data-file "my-forms.data"
  :callback 'print
  :eval nil)
```

prints this:

```
 #(1 2 3)
 89
 (* 7 7)
 (QUOTE (* 9 9))
```

See also

`load-data-file`

|             |                 | <i>Macro</i>                                                                                                                                                                                                                                                                                            |
|-------------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     |                 | Locks a ring such that no other thread can access it while some code is executed.                                                                                                                                                                                                                       |
| Package     |                 | <code>hcl</code>                                                                                                                                                                                                                                                                                        |
| Signature   |                 | <code>with-ring-locked (ring &amp;optional whostate timeout) &amp;body body =&gt; result</code>                                                                                                                                                                                                         |
| Arguments   | <i>ring</i>     | A ring object created by <code>make-ring</code> .                                                                                                                                                                                                                                                       |
|             | <i>whostate</i> | The status of the process while the ring is locked.                                                                                                                                                                                                                                                     |
|             | <i>timeout</i>  | A timeout period, in seconds.                                                                                                                                                                                                                                                                           |
|             | <i>body</i>     | Lisp code.                                                                                                                                                                                                                                                                                              |
| Values      | <i>result</i>   | The result of executing <i>body</i> .                                                                                                                                                                                                                                                                   |
| Description |                 | <p>The macro <code>with-ring-locked</code> locks the ring <i>ring</i> that during the execution of <i>body</i> no other thread can access ring, whether for modification or merely reading values.</p> <p><i>whostate</i> and <i>timeout</i> are used in the same way as in <code>with-lock</code>.</p> |
| See also    |                 | <code>make-ring</code>                                                                                                                                                                                                                                                                                  |

|           |             | <i>Macro</i>                                                   |
|-----------|-------------|----------------------------------------------------------------|
| Summary   |             | Prevents generation of code coverage for a body of code.       |
| Package   |             | <code>hcl</code>                                               |
| Signature |             | <code>without-code-coverage &amp;body body =&gt; result</code> |
| Arguments | <i>body</i> | Lisp forms.                                                    |

|             |               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Values      | <i>result</i> | The result of evaluating <i>body</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Description |               | <p>The macro <code>without-code-coverage</code> prevents generation of code coverage for the forms of <i>body</i>.<br/> <i>body</i> is evaluated as an implicit <code>progn</code>, except that inside <i>body</i> the compiler does not generate code coverage counters, unless <code>force</code> was supplied non-nil to <code>generate-code-coverage</code> OR <code>with-code-coverage-generation</code>.<br/> <code>without-code-coverage</code> is useful for error forms that you do not want to be counted.</p> |
| Notes       |               | <p>There will be a counter for the <code>(without-code-coverage ...)</code> form itself. If you do not want this counter, use <code>error-situation-forms</code> instead.</p>                                                                                                                                                                                                                                                                                                                                            |
| See also    |               | <code>error-situation-forms</code><br><code>generate-code-coverage</code><br><code>with-code-coverage-generation</code>                                                                                                                                                                                                                                                                                                                                                                                                  |

| <b>write-string-with-properties</b> |                   | <i>Function</i>                                                                                                  |
|-------------------------------------|-------------------|------------------------------------------------------------------------------------------------------------------|
| Summary                             |                   | Writes the string to the stream, and adds properties if the stream supports it.                                  |
| Package                             |                   | <code>hcl</code>                                                                                                 |
| Signature                           |                   | <code>write-string-with-properties string properties &amp;optional stream &amp;key start end =&gt; string</code> |
| Arguments                           | <i>string</i>     | A string.                                                                                                        |
|                                     | <i>properties</i> | A property list.                                                                                                 |
|                                     | <i>stream</i>     | An output stream designator.                                                                                     |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                               |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|
|             | <i>start, end</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Bounding index designators of <i>string</i> . |
| Values      | <i>string</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | A string.                                     |
| Description | <p>The function <code>write-string-with-properties</code> writes a part of <i>string</i>, bounded by <i>start</i> and <i>end</i>, to <i>stream</i> exactly like <code>cl:write-string</code> does, and then adds <i>properties</i> if <i>stream</i> supports this operation. Currently the only types of <code>stream</code> that support properties are Editor streams, which means streams that write to Editor buffers.</p> <p><i>properties</i> must be a property list, with alternating <i>key</i> and <i>value</i>. When adding the properties, each pair of <i>key</i> and <i>value</i> is processed separately, in the order they occur in the list.</p> <p>If <i>key</i> is <code>:highlight</code>, then <i>value</i> must specify a <code>editor:face</code>. It can be an <code>editor:face</code> object, a face name (which means a symbol that was used as the name in <code>editor:make-face</code>), or one of the following keywords:</p> <ul style="list-style-type: none"> <li><code>:underline</code> Underline the text.</li> <li><code>:bold</code> Make the text bold.</li> <li><code>:italic</code> Make the text italic.</li> <li><code>:bold-italic</code> Make the text bold and italic.</li> <li><code>:inverse</code> Invert the background and foreground.</li> <li><code>:compiler-error-highlight</code><br/>or <code>:compiler-warning-highlight</code><br/>or <code>:compiler-note-highlight</code><br/>The faces that the compiler use when it outputs to an editor buffer.</li> <li><code>:editor-error-highlight</code><br/>The face that the editor uses in the echo area when it reports an editor error.</li> </ul> |                                               |

If `key` is `:menu-items`, `value` specifies menu items that are added to the context menu that is displayed when the current point is inside `string` in the Editor buffer. The value must be a list where each element specifies a menu-item by a list of three elements: `title`, `function` and `arg`. `title` must be a string, and is what the end user sees. If the user selects this item, `function` is called with `arg` as a single argument.

If `key` is not `:menu-items` or `:highlight`, the `key / value` is added as a text property using `editor:put-text-property`, with `key` as the `property` argument and `value` as `value`.

**Example** Output "A string in bold" in bold face to `mp:*background-standard-output*`:

```
(write-string-with-properties
  "A string in bold"
  '(:highlight :bold)
  mp:*background-standard-output*)
```

**Note** `write-string-with-properties` can be used wherever `write-string` is used, because it does exactly the same for streams that do not implement properties.

The LispWorks compiler uses `write-string-with-properties` to write compiler errors, warnings and notes with `:complier-....-highlight` keywords above. This is how it produces the colored errors/warnings/notes when it writes to the Listener or is invoked in the Editor.

Support for `:menu-items` is implemented by the method:

```
(method capi:pane-popup-menu-items
  (capi:editor-pane capi:interface))
```

Therefore, if this method is not called, for example if you make a `capi:editor-pane` and pass it `:pane-menu`, then items will not be added to the menu.

**See also** `cl:write-string`

# 39

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## The LINK-LOAD Package

This chapter describes the symbols in the `LINK-LOAD` package.

**Note:** this chapter applies only to LispWorks for SPARC Solaris.

|             |                                                                 | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                              |
|-------------|-----------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>link-load</code>                                          |                                                                                                                                                                                                                                                                                                                                                                                              |
| Signature   | <code>break-on-unresolved-functions &amp;optional stream</code> |                                                                                                                                                                                                                                                                                                                                                                                              |
| Arguments   | <code>stream</code>                                             | An output stream for message reporting. If set to <code>nil</code> , then no output will be produced.<br>By default this is <code>t</code> .                                                                                                                                                                                                                                                 |
| Description |                                                                 | The function <code>break-on-unresolved-functions</code> produces break-on-entry code for all currently undefined but referenced (that is, unresolved) foreign symbols, so that if an undefined foreign function is called from within the foreign code, a Lisp error will occur. Break-on-entry code will also be produced for any new unresolved symbols loaded later in your Lisp session. |

The special variable `foreign:*break-on-unresolved-functions*` will, when set to non-nil, produce break-on-entry code for all new unresolved symbols that are loaded, but won't do so for symbols already loaded. By default this variable is set to nil.

See also [read-foreign-modules](#)

## **foreign-symbol-address** *Function*

Package [link-load](#)

Signature `foreign-symbol-address name &key errorp functionp => result`

Arguments `name` The name of a foreign symbol.

`errorp` A boolean.

`functionp` A boolean.

Values `result` The address of `name` or `nil`.

Description The function `foreign-symbol-address` is used to find out whether a foreign symbol is defined, by looking for it in the foreign-symbol table. If its associated object code has been loaded into the image, its address is returned. Otherwise nil is returned, unless `errorp` is `nil`.

The `errorp` keyword defines the behavior of the function when a symbol has not been defined. If it is non-nil (which is the default value), then an error will be signaled. If it is `nil`, no error will be reported, and the function will return `nil`.

The `functionp` keyword is used to specify the kind of symbol sought. If it is t, `foreign-symbol-address` will assume that `name` is the name of a function. If it is `nil` it will assume that `name` is the name of a variable. The default value is t.

Example      `(foreign-symbol-address 'chmod)`

See also     `get-foreign-symbol`

## **get-foreign-symbol**

## *Function*

Package     `link-load`

Signature    `get-foreign-symbol name &optional force => result`

Arguments    *name*        A symbol or string.

*force*        A keyword.

Values        *result*      A foreign symbol.

Description    This function gets a foreign symbol or it may be used to explicitly register an undefined symbol.

*name* is a symbol or string to look up or to create as a foreign symbol. If it is a symbol, the symbol looked for is that which the function `lisp-name-to-foreign-name` would produce. If *name* is a string, it is taken literally

If supplied and the symbol is not already defined as a foreign symbol, *force* forces it to be an undefined foreign symbol. This provides a reference to the symbol so that a subsequent call to `read-foreign-modules` will attempt to resolve it

Example      `(get-foreign-symbol 'my-func-not-yet-loaded t)`

Notes        It is not usually necessary to use this function. In order to examine whether a foreign symbol is defined, use `foreign-symbol-address`. The act of defining a foreign function using `fli:define-foreign-function` makes the symbol undefined, so the use of force is not usually needed.

See also      **[foreign-symbol-address](#)**  
**[lisp-name-to-foreign-name](#)**  
**[read-foreign-modules](#)**

## **lisp-name-to-foreign-name** *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                 |                                                                                         |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| Package     | <b><a href="#">link-load</a></b>                                                                                                                                                                                                                                                                                                                                |                                                                                         |
| Signature   | <b><a href="#">lisp-name-to-foreign-name</a></b> <i>name</i> &key <i>language</i>                                                                                                                                                                                                                                                                               |                                                                                         |
| Arguments   | <i>name</i>                                                                                                                                                                                                                                                                                                                                                     | A symbol representing a Lisp name. (Strings are passed unchanged through the function.) |
|             | <i>language</i>                                                                                                                                                                                                                                                                                                                                                 | If :c then an equivalent ‘C’ name is produced. :FORTRAN is an alternative.              |
| Description | This function provides an equivalent foreign name for a Lisp name, depending on the keyword language.                                                                                                                                                                                                                                                           |                                                                                         |
| Values      | A string is returned which is a foreign equivalent of the Lisp name supplied. If name is a string, the function returns the string unchanged. If language is a symbol, the ‘C’ version replaces occurrences of ‘-’ with ‘_’ and adds a leading underscore. The Fortran version replaces occurrences of ‘-’ with ‘_’ and adds a leading and trailing underscore. |                                                                                         |
| Example     | <b>(lisp-name-to-foreign-name 'lisp-name-with-hyphens)</b><br><b>"_lisp_name_with_hyphens"</b>                                                                                                                                                                                                                                                                  |                                                                                         |
| See also    | <b><a href="#">get-foreign-symbol</a></b>                                                                                                                                                                                                                                                                                                                       |                                                                                         |

## **read-foreign-modules** *Function*

Package      **[link-load](#)**

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signature   | <code>read-foreign-modules &amp;rest module-names =&gt; t</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Arguments   | <code>module-names</code> A sequence of strings or pathnames.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Values      | <code>t</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Description | <p>The function <code>read-foreign-modules</code> reads object files of various formats into the Lisp image. Unresolved references are resolved wherever possible and the names of the foreign functions are made available to the Lisp for direct calling from the Lisp if desired. With no argument, <code>read-foreign-modules</code> scans the default libraries looking for definitions of referenced but undefined symbols.</p> <p>The <code>module-names</code> argument is a sequence of items representing object files to be loaded. The items may be of type string or pathname, and will be used to look up a corresponding file in the file system. The only exception is if an item is a string beginning “-1” in which case the rest of the string is used to look up a library file using format strings constructed from the values of the variable <code>*default-library-name-search-paths*</code>, the environment variable <code>LD_LIBRARY_PATH</code> and the variable <code>*default-library-names*</code>. Object files of various formats and library files can be handled by <code>read-foreign-modules</code>.</p> |
| Example     | <pre>(read-foreign-modules "/usr/users/clc/projects/head.o"                       "~clc/projects/libs.a"                       "-1W")</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Notes       | <p>The function <code>read-foreign-modules</code> actually adds the module-names to the list of modules in the variable <code>*default-libraries*</code> and then tries to resolve any undefined symbols using this list. The function <code>get-foreign-symbol</code> may be called to explicitly force a symbol onto the undefined list or the act of defining a foreign function (<code>fli:define-foreign-function</code>) will do it implicitly.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

`read-foreign-modules` may be called at any time during the running of a program and a particular object file may be loaded as often as is necessary.

A warning of any new unresolved references will be printed out after the reading has finished if the flag `*unresolved-messages*` is set to `t` (the default is `nil`). By default messages are printed out about which object modules are being loaded. This may be switched off by setting `*coff-loading-verbose*` to `nil`.

See also      `get-foreign-symbol`

# 40

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## The LISPWORKS Package

This chapter describes symbols available in the `LISPWORKS` package. This package is used by default. Its symbols are visible in the `CL-USER` package.

Various uses of the symbols documented here are discussed throughout this manual.

|             |                                         | <i>Type</i>                                                                                                                                    |
|-------------|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | The 8 bit string type.                  |                                                                                                                                                |
| Package     | <code>lispworks</code>                  |                                                                                                                                                |
| Signature   | <code>8-bit-string <i>length</i></code> |                                                                                                                                                |
| Arguments   | <code><i>length</i></code>              | The length of the string (or <code>*</code> , meaning any).                                                                                    |
| Description |                                         | The type of strings that can hold simple chars of codes 0...255. This is the string type that is guaranteed to always take 8 bits per element. |

| <b>16-bit-string</b> | <i>Type</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary              | The 16 bit string type.                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Package              | <b>lispworks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Signature            | <b>16-bit-string <i>length</i></b>                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Arguments            | <b><i>length</i></b> The length of the string (or *, meaning any).                                                                                                                                                                                                                                                                                                                                                                                                              |
| Description          | The type of strings that can hold simple chars of codes 0...65533. This is the string type that is guaranteed to always take 16 bits per element.                                                                                                                                                                                                                                                                                                                               |
| <br>                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>append-file</b>   | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Summary              | Appends the contents of a file to another file.                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Package              | <b>lispworks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Signature            | <b>append-file <i>from to</i></b>                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Arguments            | <b><i>from</i></b> A pathname designator.<br><b><i>to</i></b> A pathname designator.                                                                                                                                                                                                                                                                                                                                                                                            |
| Description          | The function <b>append-file</b> appends the contents of the file <i>from</i> to another file. The file <i>from</i> must exist.<br><br><b>append-file</b> opens <i>from</i> for input and <i>to</i> for output using <i>if-exists :append</i> (see <b>c1:open</b> in the <i>Common Lisp HyperSpec</i> ) and copies the contents from <i>from</i> to <i>to</i> .<br><br>On any failure <b>append-file</b> signals an error.<br><b>append-file</b> does not return a useful value. |
| See also             | <b>copy-file</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

|                |                                                                                                                                                                              |                 |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>appendf</b> |                                                                                                                                                                              | <i>Macro</i>    |
| Summary        | Appends lists to the end of a given list.                                                                                                                                    |                 |
| Package        | <code>lispworks</code>                                                                                                                                                       |                 |
| Signature      | <code>appendf place &amp;rest lists =&gt; result</code>                                                                                                                      |                 |
| Arguments      | <code>place</code>                                                                                                                                                           | A place.        |
|                | <code>lists</code>                                                                                                                                                           | A set of lists. |
| Values         | <code>result</code>                                                                                                                                                          | An object.      |
| Description    | The modify macro <code>appendf</code> appends the lists given by <code>lists</code> to the end of the list in <code>place</code> . See <code>append</code> for more details. |                 |
| See also       | <code>removef</code>                                                                                                                                                         |                 |

|                                    |                                                                                                                                                                                                                                                                                                                                                      |                 |
|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>*autoload-asdf-integration*</b> |                                                                                                                                                                                                                                                                                                                                                      | <i>Variable</i> |
| Summary                            | Determines whether ASDF integration code is loaded automatically.                                                                                                                                                                                                                                                                                    |                 |
| Signature                          | <code>*autoload-asdf-integration*</code>                                                                                                                                                                                                                                                                                                             |                 |
| Package                            | <code>lispworks</code>                                                                                                                                                                                                                                                                                                                               |                 |
| Initial value                      | <code>t</code>                                                                                                                                                                                                                                                                                                                                       |                 |
| Description                        | The variable <code>*autoload-asdf-integration*</code> is consulted used when the LispWorks IDE starts. If its value is true, then the system arranges for ASDF integration code to be loaded automatically when ASDF is loaded.<br><br>The ASDF integration code makes the LispWorks IDE tools (System Browser, Search Files) work with ASDF systems |                 |

(defined with `asdf:defsystem`) as well as 'native' systems defined with `defsystem`.

See “Using ASDF” on page 311 for more information about using ASDF with LispWorks.

See also      `defsystem`

## **base-character** *Type*

Summary      The base character type.

Package      `lispworks`

Signature      `base-character`

Description      The type of base characters.

`base-character` is a synonym for the Common Lisp type `base-char`.

See also      `base-char-code-limit`

## **base-character-p** *Function*

Summary      A predicate for base characters.

Package      `lispworks`

Signature      `base-character-p object => result`

Arguments      `object`                  The object to be tested.

Values      `result`                  A boolean.

|             |                                                                                                                                                                           |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | The function <b>base-character-p</b> is a predicate for base characters.<br><br><i>result</i> is <b>t</b> if <i>object</i> is a base character, and <b>nil</b> otherwise. |
| See also    | <b>base-character</b>                                                                                                                                                     |

## **base-char-p** *Function*

|             |                                                                                                                                                                                                       |  |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Summary     | A predicate for base characters.                                                                                                                                                                      |  |
| Package     | <b>lispworks</b>                                                                                                                                                                                      |  |
| Signature   | <b>base-char-p</b> <i>object</i> => <i>result</i>                                                                                                                                                     |  |
| Arguments   | <i>object</i> The object to be tested.                                                                                                                                                                |  |
| Values      | <i>result</i> A boolean.                                                                                                                                                                              |  |
| Description | The function <b>base-char-p</b> is a predicate for base characters.,<br>only with standard spelling.<br><br><i>result</i> is <b>t</b> if <i>object</i> is a base character, and <b>nil</b> otherwise. |  |
| See also    | <b>base-character-p</b>                                                                                                                                                                               |  |

## **base-char-code-limit** *Constant*

|             |                                                                                                    |  |
|-------------|----------------------------------------------------------------------------------------------------|--|
| Summary     | Upper bound for character codes in base characters.                                                |  |
| Package     | <b>lispworks</b>                                                                                   |  |
| Description | The upper exclusive bound for values of ( <b>char-code</b> <i>char</i> )<br>among base characters. |  |

**base-string-p** *Functions*

**simple-base-string-p**

|             |                                  |                                                                                                                                                                                                                                                                                         |
|-------------|----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | The predicates for base strings. |                                                                                                                                                                                                                                                                                         |
| Package     | <b>lispworks</b>                 |                                                                                                                                                                                                                                                                                         |
| Signature   |                                  | <b>base-string-p</b> <i>object</i> => <i>result</i><br><b>simple-base-string-p</b> <i>object</i> => <i>result</i>                                                                                                                                                                       |
| Arguments   | <i>object</i>                    | The object to be tested.                                                                                                                                                                                                                                                                |
| Values      | <i>result</i>                    | A boolean.                                                                                                                                                                                                                                                                              |
| Description |                                  | <p>The functions <b>base-string-p</b> and <b>simple-base-string-p</b> are the predicates for base strings and simple base strings respectively.</p> <p><i>result</i> is <b>t</b> if <i>object</i> is a <b>base-string</b> (or <b>simple-base-string</b>), and <b>nil</b> otherwise.</p> |
| See also    |                                  | <b>base-string</b><br><b>simple-base-string</b>                                                                                                                                                                                                                                         |

|                 |                                                                  |                                                                                                                                                                                                                                                      |
|-----------------|------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>bmp-char</b> | <span style="float: right;"><i>Type</i></span>                   |                                                                                                                                                                                                                                                      |
| Summary         | The type of characters that fit in the Basic Multilingual Plane. |                                                                                                                                                                                                                                                      |
| Package         | <b>lispworks</b>                                                 |                                                                                                                                                                                                                                                      |
| Description     |                                                                  | <p>The type <b>bmp-char</b> is the type of characters that fit in the Unicode Basic Multilingual Plane, that is all characters that fit in 16 bits.</p> <p>The Basic Multilingual Plane (BMP) is the range of Unicode code points below #x10000.</p> |

|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes              | <ol style="list-style-type: none"> <li>1. Normally you should not be able to produce a Lisp character object corresponding to a surrogate code point. If such an object is created, it is treated as <code>bmp-char</code>.</li> <li>2. The corresponding string types are <code>bmp-string</code> and <code>simple-bmp-string</code>. <code>bmp-char</code> can be written to a stream or passed to the FLI with external format :<code>bmp</code> without ever getting an error.</li> </ol>                             |
| Compatibility note | <p><code>bmp-char</code> was new in LispWorks 7.0. In LispWorks 6.1 and earlier versions <code>simple-char</code> has the most similar meaning.</p> <p><code>bmp-char</code> has no obvious equivalent in LispWorks 6.1 and earlier versions, where <code>simple-char</code> is the closest thing, but in most cases when you used <code>simple-char</code> it actually better to use <code>c1:character</code> (or leave it as <code>simple-char</code>, because it is now a synonym for <code>c1:character</code>).</p> |
| See also           | <code>bmp-char-p</code><br><code>bmp-string</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

| <b>bmp-char-p</b> |                                                                                                                                                                                 | <i>Function</i> |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Summary           | The predicate for <code>bmp-char</code> objects.                                                                                                                                |                 |
| Package           | <code>lispworks</code>                                                                                                                                                          |                 |
| Signature         | <code>bmp-char-p object =&gt; result</code>                                                                                                                                     |                 |
| Arguments         | <code>object</code>                                                                                                                                                             | A Lisp object.  |
| Values            | <code>result</code>                                                                                                                                                             | A boolean.      |
| Description       | The function <code>bmp-char-p</code> returns <code>t</code> if its argument is a character with a code less than <code>#x10000</code> , otherwise it returns <code>nil</code> . |                 |

**Compatibility note** `bmp-char-p` was new in LispWorks 7.0. In LispWorks 6.1 and earlier versions `simple-char-p` has the most similar meaning.

**See also** `bmp-char`

## **bmp-string**

### **simple-bmp-string**

*Types*

**Summary** String types that hold `bmp-chars`.

**Package** `lispworks`

**Description** The type `bmp-string` is a string that can hold `bmp-chars`, that is characters with code below `#x10000` (that is 16-bit). This corresponds to the Basic Multilingual Plane of Unicode.

`simple-bmp-string` is the simple version of `bmp-string`, that is it is a simple-array of `bmp-chars`.

**Notes**

1. `bmp-strings` use less memory than `c1:character` strings (type `text-string`), but cannot hold supplementary characters (that is, characters with code `#x10000` or greater).
2. The corresponding character type is `bmp-char`.

**Compatibility note** `bmp-string` was new in LispWorks 7.0. In LispWorks 6.1 and earlier versions `text-string` is similar to `bmp-string`. However, in most cases where you use `text-string` you probably still want to use `text-string` (using its new meaning, covering all the Unicode range).

**See also** `text-string`  
`bmp-char`  
“Character and String types” on page 436

**bmp-string-p****simple-bmp-string-p***Functions*

Summary      The predicates for **bmp-string** and **simple-bmp-string**.

Package      **lispworks**

Signature      **bmp-string-p** *object* => *result*  
**simple-bmp-string-p** *object* => *result*

Arguments      *object*      A Lisp object.

Values      *result*      A boolean.

Description      The functions **bmp-string-p** and **simple-bmp-string-p** test whether their argument is a **bmp-string** or a **simple-bmp-string** respectively.

See also      **bmp-string**  
                 **simple-bmp-string**

**\*browser-location\****Variable*

Signature      **\*browser-location\***

Package      **lispworks**

Initial value      **nil**

Description      Controls how the online documentation interface and the function **open-url** find a web browser executable (either Netscape, Firefox, Mozilla or Opera) to use. The value should be **nil** or a string.

If the value is **nil**, LispWorks attempts to find the browser using the value of the environment variable **PATH**.

If the value is a string, it specifies the directory in which the browser is installed. Typical values are `"/usr/bin/"` and `"/usr/local/bin/"`.

**Note:** do not omit the trailing slash.

**Note:** `*browser-location*` is used only in the Motif-based IDE.

See also      [open-url](#)

|                         | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>call-next-advice</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Summary                 | Calls the next piece of advice associated with a function.                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Package                 | <b>lispworks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Signature               | <b>call-next-advice args</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Arguments               | <code>args</code> are arguments to be given to the next piece of advice to be called. Any number of arguments may be given in this way, including keyword arguments, and there is no requirement for pieces of around advice to receive the same number of arguments as the original definition expected.                                                                                                                                                                                                     |
| Values                  | <b>call-next-advice</b> returns the values produced by the call to the next piece of advice (or to the combination of before and after advice and the original definition).                                                                                                                                                                                                                                                                                                                                   |
| Description             | <b>call-next-advice</b> is the local function used to invoke the next item in the ordering of pieces of advice associated with a function. It can only be called from within the scope of the around advice. Advice may be attached to a function by <b>defadvice</b> and this allows the behavior of a function to be modified. Extra code to be performed before or after the function may be simply added by creating before or after advice for it. Around advice is more powerful and replaces the orig- |

inal definition. All the advice for a function is ordered with the around advice coming first.

The first piece of around advice receives the arguments to the function and may return any values at all. It has access to the rest of the advice, and to the original definition, by means of `call-next-advice`. A call to this from within the body of the around advice invokes the next piece of around advice with the arguments given to `call-next-advice`. The last piece of around advice in the ordering invokes the sequence of before advice, the original definition, and after advice if it calls `call-next-advice`. Around advice may contain any number of calls to `call-next-advice`, including no calls.

Notes

1. `call-next-advice` is an extension to Common Lisp. See Chapter 6, “The Advice Facility” for a broader discussion of `advice`.

`call-next-advice` is not like `cl:call-next-method`, where passing no arguments has a special meaning. To pass the same arguments to the next advice, you need something like:

```
(lw:defadvice (my-func my-func-advice :around)
  (a b c &rest other-args)
  (format t "my-func advice-%")
  (apply #'lw:call-next-advice a b c other-args)
)
```

or

```
(lw:defadvice (my-func my-func-advice :around)
  (&rest args)
  (format t "my-func advice-%")
  (apply #'lw:call-next-advice args)
)
```

See also

`defadvice`

Chapter 6, “The Advice Facility”

**choose-unicode-string-hash-function** *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                 |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Summary     | Returns a hash function suitable for strings, ignoring case using specified Unicode rules.                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                 |
| Package     | <code>lispworks</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                 |
| Signature   | <code>choose-unicode-string-hash-function &amp;key style =&gt; hash-function</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                 |
| Arguments   | <code>style</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A keyword       |
| Values      | <code>hash-function</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | A hash function |
| Description | <p>The function <code>choose-unicode-string-hash-function</code> return a function which is suitable for use as the <i>hash-function</i> argument to <code>make-hash-table</code>. The function <i>hash-function</i> generates a hash value for a string, ignoring case using specified Unicode comparison rules specified by <i>style</i>.</p> <p>The current implementation only supports one value of <i>style</i>:</p> <p><code>:simple-case-fold</code></p> <p>Compares each character of the string using the simple case folding rules in Unicode 6.3.0.</p> |                 |
| See also    | <code>make-hash-table</code><br><code>unicode-string-equal</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                 |

**compile-system** *Function*

|         |                                                                                                                                 |
|---------|---------------------------------------------------------------------------------------------------------------------------------|
| Summary | The function <code>compile-system</code> compiles all the files in a system necessary to make a consistent set of object files. |
| Package | <code>lispworks</code>                                                                                                          |

|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signature | <code>compile-system system-name &amp;key force simulate load args target-directory</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Arguments | <p><i>system-name</i> A symbol representing the name of the system. The system must have been defined already using the <code>defsystem</code> macro.</p> <p><i>force</i> If <code>t</code> then all the files in the system are compiled regardless. (This argument was formerly called <code>force-p</code>. The old name is currently still accepted for compatibility.)</p> <p><i>simulate</i> If <code>nil</code> or not present then <code>compile-system</code> works silently. Otherwise a plan of the actions which <code>compile-system</code> intends to carry out is printed. What happens next depends on the value of <i>simulate</i>:</p> <ul style="list-style-type: none"> <li><code>t</code> — do nothing.</li> <li><code>:ask</code> — you are asked if you wish the plan to be carried out using <code>y-or-n-p</code>.</li> <li><code>:each</code> — <code>compile-system</code> displays each action in the plan one at a time, and asks you whether you want to carry out this particular action. The answer <code>c</code> executes the rest of the plan without further prompting, returns from <code>compile-system</code> without further processing, and <code>y</code> and <code>n</code> work as expected.</li> </ul> <p><code>:simulate</code> may be abbreviated as <code>:sim</code>.</p> <p><i>load</i> If <code>t</code> then <code>load-system</code> is called after <code>compile-system</code> has finished. If <code>:no</code> then no files are loaded at all. The default is <code>nil</code>.</p> <p><i>args</i> Arguments to be passed directly to the compiler.</p> |

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>target-directory</i> | This must be a string representing a valid directory. It defaults to the <code>:default-pathname</code> option to <code>defsystem</code> . This is the directory where the object files created are put. If the <i>target-directory</i> is given then dependency information expressed in the system rules is ignored. <code>:target-directory</code> may be abbreviated as <code>:t-dir</code> .                                                                                                                                                                                                   |
| Values                  | <code>compile-system</code> returns <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Examples                | <pre>(compile-system 'blackboard :simulate :ask)  (compile-system 'tms :load t)  (compile-system 'packages :load :no                  :target-directory "/usr/users/386i/")</pre>                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Notes                   | If <code>load</code> is <code>t</code> then <code>load-system</code> is called after the system has been compiled.<br><br>C source files, for example <code>foo.c</code> , can be included in a system (see the use of <code>:default-type</code> and <code>:type</code> in <code>defsystem</code> ). The corresponding object file name is <code>foon.so</code> on Linux, FreeBSD, AIX and x86/x64 Solaris, <code>foon.dylib</code> on Mac OS X and <code>foon.o</code> on SPARC Solaris, where <i>n</i> is a platform-specific integer. On Windows the object file name is <code>foo.dll</code> . |
| See also                | <code>concatenate-system</code><br><code>defsystem</code><br><code>load-system</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

## **concatenate-system** *Function*

|         |                                                                                       |
|---------|---------------------------------------------------------------------------------------|
| Summary | Produces a single, concatenated fasl from a <code>defsystem</code> system or systems. |
|---------|---------------------------------------------------------------------------------------|

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>lispworks</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Signature   | <pre><code>concatenate-system <i>output system</i> &amp;key <i>force simulate sim</i> <i>source-only args target-directory t-dir script-p =&gt; result</i>  <i>system</i> ::= <i>system-name*</i></code></pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Arguments   | <p><i>output</i>            The name of the required concatenated fasl.</p> <p><i>system-name</i>      The name of a system defined using <code>def-system</code>.</p> <p><i>simulate</i>         Verbosity conditions, see Description for more detail.</p> <p><i>sim</i>               Same as <i>simulate</i>.</p> <p><i>force</i>             If <code>t</code>, then all files in the system will be concatenated.</p> <p><i>source-only</i>       If <code>t</code>, the source files of the system are concatenated.</p> <p><i>target-directory</i> The directory to search for the object files.</p> <p><i>t-dir</i>             Same as <i>target-directory</i>.</p> |
| Values      | <p><i>result</i>           A list containing the name or names of the concatenated systems.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Description | <p>This function produces a single, concatenated fasl, <i>output-file</i>, from a list of individual systems (named amongst the <i>args</i>). Since concatenated fasl files may be produced in this way, you do not need to be wary of MS filename conventions if developing sources on UNIX for a Microsoft Windows application. This clearly allows more freedom for naming source files. However, <i>output-file</i> must, in such cases, be a MS-Window-compatible filename.</p> <p>If <i>simulate</i> is <code>nil</code> or is not present, <code>concatenate-system</code> will work silently. Otherwise, a plan of the actions which</p>                              |

`concatenate-system` intends to carry out is printed. What happens next depends upon the value of *simulate*:

- If it is `t`, the function does nothing.
- If `:ask`, then the user is asked, using `y-or-n-p`, if the plan should be carried out.
- If it is `:each`, the user is asked at each stage in the plan if the current action should be carried out. The responses `y` and `n` work as normal. If `e` is typed, `concatenate-system` exits without further processing.

If *source-only* is `t`, files will be loaded only if they are sources.

If, when searching *target-directory* for an object file, the file cannot be found, the appropriate source file from the system's default directory will be loaded instead.

#### See also

`compile-system`  
`defsystem`  
`load-system`

| <b>copy-file</b> | <i>Function</i>                                                                                                                                       |             |                        |           |                        |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|------------------------|-----------|------------------------|
| Summary          | Copies the contents of a file to another file.                                                                                                        |             |                        |           |                        |
| Package          | <code>lispworks</code>                                                                                                                                |             |                        |           |                        |
| Signature        | <code>copy-file from to</code>                                                                                                                        |             |                        |           |                        |
| Arguments        | <table border="0"> <tr> <td><i>from</i></td><td>A pathname designator.</td></tr> <tr> <td><i>to</i></td><td>A pathname designator.</td></tr> </table> | <i>from</i> | A pathname designator. | <i>to</i> | A pathname designator. |
| <i>from</i>      | A pathname designator.                                                                                                                                |             |                        |           |                        |
| <i>to</i>        | A pathname designator.                                                                                                                                |             |                        |           |                        |
| Description      | The function <code>copy-file</code> copies the contents of the file <i>from</i> to another file. The file <i>from</i> must exist.                     |             |                        |           |                        |

`copy-file` opens *from* for input and *to* for output using *if-exists :supersede* (see `cl:open` in the *Common Lisp Hyper-Spec*) and copies the contents from *from* to *to*.

On any failure `copy-file` signals an error.

`copy-file` does not return a useful value.

See also [append-file](#)

## count-regexp-occurrences *Function*

Summary Count the occurrences of a pattern in a string.

Package `lispworks`

Signature `count-regexp-occurrences pattern string &key start end overlap  
case-sensitive => count`

Arguments `pattern` A string or precompiled regular expression object.

`string` A string.

`start, end` Bounding index designators of *string*.

`overlap` A generalized boolean.

`case-sensitive` A generalized boolean.

Values `count` An integer.

Description The function `count-regexp-occurrences` counts the occurrences of *pattern* in the part of *string* bounded by *start* and *end*.

If *pattern* is a string, `count-regexp-occurrences` precompiles it first. If you use `count-regexp-occurrences` with the same pattern string several times, it is better to precompile it using `precompile-regexp`.

*start* and *end* have the same meaning as in `count` and other Common Lisp sequence functions.

`case-sensitive` controls whether a string *pattern* is precompiled as a case sensitive or case insensitive search. A non-nil value means a case sensitive search. The value `nil` (the default) means a case insensitive search.

If *overlap* is false (the default), then `count-regexp-occurrences` counts matches that do not overlap. If *overlap* is non-nil, matches can overlap, and `count-regexp-occurrences` finds all of the ways in which the pattern can be matched inside *string*.

The regular expression syntax used by `count-regexp-occurrences` is similar to that used by Emacs, as described in the "Regular expression syntax" section of the *LispWorks Editor User Guide*. If you use **Help > Search** to locate this section in the LispWorks IDE, then select the **Contents** radio button.

### Examples

```
(count-regexp-occurrences "aaa" "aaaaaa")
=>
1

(count-regexp-occurrences "aaa" "aaaaaa" :overlap t)
=>
3

(count-regexp-occurrences "12" "81267124")
=>
2

(count-regexp-occurrences "12" "81267124" :start 4)
=>
1

(let* ((path (example-file
              "capi/elements/text-input-pane.lisp"))
       (file-string (file-string path)))
  (count-regexp-occurrences ":title" file-string))
=>
20 ; in LispWorks 7.1
```

See also [find-regexp-in-string](#)  
[precompile-regexp](#)

| <b>current-pathname</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <i>Function</i>          |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| Summary                 | Computes a pathname relative to the current path.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                          |
| Package                 | <b>lispworks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                          |
| Signature               | <b>current-pathname &amp;optional relative-pathname type =&gt; pathname</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                          |
| Arguments               | <i>relative-pathname</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | A pathname designator.   |
|                         | <i>type</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | A string or <b>nil</b> . |
| Values                  | <i>pathname</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | A pathname.              |
| Description             | <p>The function <b>current-pathname</b> is useful for loading other files relative to a file.</p> <p><b>current-pathname</b> computes a pathname from the current operation as follows:</p> <ul style="list-style-type: none"> <li>When loading a file<br/>Uses <b>*load-pathname*</b>.</li> <li>When compiling a file<br/>Uses <b>*compile-file-pathname*</b>.</li> <li>When evaluating or compiling an Editor buffer<br/>Uses the pathname of the buffer, if available, otherwise uses the current working directory.</li> <li>Otherwise<br/>Uses the current working directory.</li> </ul> |                          |

The pathname computed above is then translated to a physical pathname, and the argument *relative-pathname* is merged with this physical pathname. The `pathname-type` of the result `pathname` is set to *type* if supplied, the `pathname-version` is set to `:newest`, and `pathname` is returned.

A useful value for *type* is `nil`, which can be used to allow `load` to choose between lisp or fasl regardless of the type of the current pathname.

**Notes**      `defsystem` uses `current-pathname` with its `:default-host` argument.

**Examples**      Suppose you want the file `foo` to load the file `bar`.

While loading the source file `foo.lisp`:

```
(current-pathname "bar")
=>
#P"C:/temp/bar.lisp"
```

While loading the binary file `foo.ofasl`:

```
(current-pathname "bar")
=>
#P"C:/temp/bar.ofasl"
```

To load `bar.lisp` or `bar.ofasl` according to the value of `*load-fasl-or-lisp-file*`, regardless of whether `foo.lisp` or `foo.ofasl` is being loaded, specify *type nil*:

```
(load (current-pathname "bar" nil))
```

**See also**      `defsystem`  
`pathname-location`

## **defadvice** *Macro*

**Summary**      Defines a new piece of advice.

**Package**      `lispworks`

|           |                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signature | <pre><b>defadvice</b> (<i>function-dspec name advice-type &amp;key where documentation</i>)           <i>lambda-list &amp;body body =&gt; nil</i>  <i>advice-type ::= :before   :after   :around</i></pre> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Arguments | <i>function-dspec</i>                                                                                                                                                                                      | A function-dspec Specifies the function definition to which the piece of advice belongs. See “Function dspecs” on page 84 for description of function-dspec.                                                                                                                                                                                                                                                                                                                    |
|           | <i>name</i>                                                                                                                                                                                                | A symbol naming the piece of advice being created. It should of course be unique to the advised function, but does not need to be globally unique.                                                                                                                                                                                                                                                                                                                              |
|           | <i>advice-type</i>                                                                                                                                                                                         | A keyword specifying the kind of advice wanted.                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|           | <i>where</i>                                                                                                                                                                                               | Specifies where this advice should be placed in the ordering of pieces of advice for the function. By default a piece of advice is placed at the start of the corresponding section. If this argument is present and is <code>:end</code> then the advice is instead placed at the end of its section. The other permissible value for this argument is <code>:start</code> , which places the advice at the start of its section in the ordering (as in the default behavior). |
|           | <i>documentation</i>                                                                                                                                                                                       | A string providing documentation on the piece of advice.                                                                                                                                                                                                                                                                                                                                                                                                                        |
|           | <i>lambda-list</i>                                                                                                                                                                                         | A lambda list for the piece of advice. In the case of before and after advice this should be compatible with the lambda list for the original definition, since such advice receives the same arguments as that function.                                                                                                                                                                                                                                                       |
|           | <i>body</i>                                                                                                                                                                                                | The main body of the advice.                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Values    | <b>defadvice</b> returns <code>nil</code> .                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p><code>defadvice</code> is the macro used to define a new piece of advice. Advice provides a way to change the behavior of existing functional definitions in the system. In a simple instance advice might be used to carry out some additional actions before or after the original definition. More sophisticated uses allow the definition to be replaced by new code that can access the original function repeatedly or as rarely as desired, and that can receive different numbers of arguments and return any values. A function may have any number of pieces of advice attached to it by using <code>defadvice</code>.</p> <p>When <i>function-dspec</i> names a macro, then the function with which the advice is associated is the expansion function for that macro. Thus before and after advice for a macro receive the arguments given to the macro expansion function, which are normally the macro call form and an environment.</p> <p>There are three kinds of advice that may be defined: before, after and around advice. The first two kinds attach auxiliary code to be carried out alongside the original definition (before it for before advice, after it in the case of after advice). Around advice replaces the function altogether; it may define code that never accesses the original definition, that receives different numbers of arguments, and returns different values. All the pieces of advice for a function are ordered. The ordering is important in determining how all the pieces of advice for a function are combined. Around advice always comes first, then before advice, then the original definition, and lastly the after advice.</p> <p>Conceptually the before advice, the original definition and the after advice are amalgamated into one new construct. If this gets called then each of its components receives the same arguments in turn, and the values returned are those produced by the last piece of after advice to be called in this way (or the original function if there is no after advice). The code associated with before and after advice should not destructively modify its arguments.</p> |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

If around advice is present then the first piece of around advice is called, instead of the combination involving before and after advice discussed above. It does not have to access any of the other advice, nor the original definition. Its only link to the rest of the advice is by means of a call to `call-next-advice`. It may invoke this as often as it chooses, and by doing so it accesses the next piece of around advice if present, or else it accesses the combination of before and after advice together with the original definition.

Remove advice using `remove-advice` or `delete-advice`.

Notes      `defadvice` is an extension to Common Lisp.

See also    `call-next-advice`  
              `delete-advice`  
              `remove-advice`  
              Chapter 6, “The Advice Facility”

## **\*default-action-list-sort-time\*** *Variable*

Summary     Determines when actions in action lists are sorted.

Package     `lispworks`

Signature    `*default-action-list-sort-time*`

Initial value    `:execute`

Description    The variable `*default-action-list-sort-time*` is a keyword that is either `:execute` or `:define-action`, denoting when actions in action-lists are sorted (see `define-action-list` for an explanation of ordering specifiers). Actions are sorted either at time of definition (`:define-action`) or when their action-list is executed (`:execute`). The default sort time is `:execute`.

See also [define-action](#)  
[define-action-list](#)

## \*default-character-element-type\* *Parameter*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Provides defaults for all character type parameters.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Package     | <code>lispworks</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Description | <p>This parameter provides defaults for all character type parameters. The legal values are <code>cl:base-char</code>, <code>lw:bmp-char</code> and <code>cl:character</code>. <code>lw:simple-char</code> is also supported for backwards compatibility.</p> <p>Its value must only be set via a call to <code>set-default-character-element-type</code>.</p> <p>This is intended for efficiency of applications with only 8-bit strings, where you can do</p> <pre>(set-default-character-element-type 'base-char)</pre> <p>and also for efficiency of applications with only 16-bit strings, where you can do</p> <pre>(set-default-character-element-type 'lw:bmp-char)</pre> <p>If your program uses 16-bit or 32-bit strings you should already be aware of these issues, and make some attempt to provide explicit types.</p> <p>When the compiler does type inferencing it behaves as if this variable was bound to <code>cl:character</code>; if you want assumptions about types to be hard-coded into your program, you must supply explicit declarations and type arguments.</p> |

See also [string](#)  
[simple-string](#)  
[make-string](#)  
[open](#)

```
set-default-character-element-type  
with-output-to-string
```

## define-action *Macro*

|                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     |                               |                    |                        |             |            |              |         |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------------|--------------------|------------------------|-------------|------------|--------------|---------|
| Summary             | Adds a new action to a specified list.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                     |                               |                    |                        |             |            |              |         |
| Package             | <code>lispworks</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                     |                               |                    |                        |             |            |              |         |
| Signature           | <code>define-action <i>name-or-list</i> <i>action-name</i> <i>data</i> &amp;rest <i>specs</i> =&gt;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                               |                    |                        |             |            |              |         |
| Arguments           | <table><tr><td><i>name-or-list</i></td><td>A list or action list object.</td></tr><tr><td><i>action-name</i></td><td>A general lisp object.</td></tr><tr><td><i>data</i></td><td>An object.</td></tr><tr><td><i>specs</i></td><td>A list.</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <i>name-or-list</i> | A list or action list object. | <i>action-name</i> | A general lisp object. | <i>data</i> | An object. | <i>specs</i> | A list. |
| <i>name-or-list</i> | A list or action list object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |                               |                    |                        |             |            |              |         |
| <i>action-name</i>  | A general lisp object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                     |                               |                    |                        |             |            |              |         |
| <i>data</i>         | An object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                               |                    |                        |             |            |              |         |
| <i>specs</i>        | A list.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                     |                               |                    |                        |             |            |              |         |
| Description         | <p>The macro <code>define-action</code> adds a new action to the action list specified by <i>name-or-list</i>; this action will be executed according to the action-list's execution-function (see <code>execute-actions</code>) when executed. If the action-list specified by <i>name-or-list</i> does not exist, then this is handled according to the value of <code>*handle-missing-action-list*</code>.</p> <p><i>name-or-list</i> is evaluated to give either a list UID (to be looked up in the global registry of lists) or an action list object. <i>action-name</i> is a UID (general lisp object, to be compared by <code>equalp</code>). It uniquely identifies this action within its list (as opposed to among all lists).</p> <p><i>data</i> specifies an object referring to data relevant to the action.</p> <p><i>specs</i> is a free-form list of ordering specifiers and extra key-words, used to control more details of how and when this action is executed.</p> <p>Action-items are normally expected not to be redefined. If an action-item with that action-name already exists in the</p> |                     |                               |                    |                        |             |            |              |         |

action-list (that is, one with an identifier `equalp` to the action-name), then the notification and subsequent handling of this attempt is controlled by the values in the list `*handle-existing-action-in-action-list*`. This is to prevent problems due to re-evaluating an action definition inappropriately. Notification and redefine behavior can be overridden by using the `:force` keyword argument. In this case, any required redefinition is performed unconditionally and without notification.

The following keywords are recognized in the `specs` argument:

- |                                                                                                                                                                                      |                                                                                                                                                                                                                                                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>:after</code>                                                                                                                                                                  | The following element in <code>specs</code> is a UID.<br><code>:after</code> specifies that the action-item being defined must be run after the action-item named. If there is no action-item with a matching name, the restriction is ignored. |
| <code>:before</code>                                                                                                                                                                 | Like <code>:after</code> , but this action-item must be run before the one specified.                                                                                                                                                           |
| <br><code>:after</code> and <code>:before</code> can be specified as many times as necessary to describe the ordering constraints of this action-item with respect to its neighbors. |                                                                                                                                                                                                                                                 |
| <code>:once</code>                                                                                                                                                                   | Specifies that this action-item should be executed only once; after execution, it is disabled.                                                                                                                                                  |
| <code>:force</code>                                                                                                                                                                  | Specifies that this definition should override any previous definition of this action-item, rather than be subject to the value of <code>*handle-existing-action-in-action-list*</code> .                                                       |

#### Example

```
(define-action :network-startup "Reset decnet buffers"
  '(decnet::reset-network-buffers
    *net-buffers*)
  :after "Reset core network"
  :once))
```

See also      [undefined-action](#)

## define-action-list *Macro*

Summary      Defines a registered action list.

Package      `lispworks`

Signature      `define-action-list uid &key documentation sort-time dummy-actions default-order execution-function =>`

Arguments      `uid`      A Lisp object.

`documentation`      A string.

`sort-time`      One of `:execute` or `:define-action`.

`dummy-actions`      A list.

`default-order`      A list.

`execution-function`      A function.

Description      The macro `define-action-list` defines an action list.

`uid` is a unique identifier, and must be a general Lisp object, to be compared by `equalp`. It names the list in the global registry of action lists. See `make-unregistered-action-list` to create unnamed, “unregistered” action-lists. The `uid` may be quoted, but is not required to be. It is possible, but not recommended, to define an action-list with unique identifier `nil`. If a registered action-list with the `uid` already exists (that is, one which returns `t` when compared with `equalp`), then notification and subsequent handling is controlled by the value of the variable `*handle-existing-action-list*`.

The `documentation` string allows you to provide documentation for the action list.

*sort-time* is a keyword specifying when added actions are sorted for the given list — either `:execute` or `:define-action` (see `*default-action-list-sort-time*`).

*dummy-actions* is a list of action-names that specify placeholder actions; they cannot be executed and are constrained to the order specified in this list, for example

```
'(:beginning :middle :end)
```

*default-order* specifies default ordering constraints for subsequently defined action-items where no explicit ordering constraints are specified. An example is

```
'(:after :beginning :before :end)
```

*execution-function* specifies a function that you define. It must accept arguments of the form:

*(the-action-list other-args-list &rest keyword-value-pairs)*

where the two required arguments are the action-list and a list of additional arguments passed to `execute-actions`, respectively. The remaining arguments are any number of keyword-value pairs that may be specified in the call to `execute-actions`. If no execution function is specified, then the default execution function will be used to execute the action-list.

See the manual entries for `with-action-list-mapping` and `with-action-item-error-handling` for examples of execution-functions.

To add an action to an action list you have defined, use `define-action`.

#### See also

- `*default-action-list-sort-time*`
- `define-action`
- `*handle-existing-action-list*`
- `undefine-action-list`
- `with-action-item-error-handling`
- `with-action-list-mapping`

## **defsystem** *Macro*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Summary     | <b>defsystem</b> is used to define systems for use with the Lisp-Works system tools. A system is a collection of files and other systems that, together with rules expressing the interdependencies of those files and subsystems, make a complete program. The LispWorks system tools support the development and maintenance of large programs. Find a full description at “Common Defsystem and ASDF” on page 305.                  |           |
| Package     | <b>lispworks</b>                                                                                                                                                                                                                                                                                                                                                                                                                       |           |
| Signature   | <b>defsystem name options &amp;key members rules =&gt; system-name</b>                                                                                                                                                                                                                                                                                                                                                                 |           |
| Arguments   | <p><i>name</i>           A string or a symbol, not evaluated.<br/><i>options</i>        A list of keyword-value pairs.<br/><i>members</i>       A list of strings or lists.<br/><i>rules</i>           A list.</p>                                                                                                                                                                                                                     |           |
| Values      | <i>system-name</i>                                                                                                                                                                                                                                                                                                                                                                                                                     | A string. |
| Description | <p>The name of the system to be made is a string specified by <i>name</i>. If <i>name</i> is a symbol, then its symbol name is used.</p> <p><i>options</i> are expressed as a list of keyword-value pairs. The following keywords are recognized:</p> <p><b>:package</b>       The default package that files are compiled and loaded in. If not specified, this defaults to the value of <b>*package*</b> at macroexpansion time.</p> |           |

**:default-pathname**

Used to compute a default pathname in which to find files. `defsystem` uses `current-pathname` to compute the pathname. `defsystem` checks that all the files given as members actually exist.

**:default-host** The root pathname of a system is defined to be the `:default-host` if it is given. Otherwise, it is taken to be the directory containing the defsystem file.

Absolute pathnames are interpreted literally, and relative pathnames are taken relative to the root pathname.

**:default-type** This is the default type of the members of the system. This may be `:lisp-file`, `:lsp-file`, `:c-file`, or `:system`.

The corba module adds `:idl-file`, `:idl-client-definition`, `:idl-client-definition-only`, `:idl-server-definition` and `:idl-server-definition-only`.

The com module adds the type `:midl-file` and the automation module adds `:midl-type-library-file`.

The default is `:lisp-file`, which means files with file type (extension) "lisp".

**:documentation** This is a string.

**:object-pathname**

A string or pathname specifying a directory where object files are written.

**Note:** This option will not work if the names in `members` represent absolute pathnames.

**:optimize** A declaration specifying default compilation qualities within the scope of `compile-system`. These settings override the current global setting. They can be overridden per member by the `:optimize` option (for subsystems) or `proclaim` (in files). The `:optimize defsystem` option accepts the same optimize qualities as `proclaim` and which are fully described in “Compiler control” on page 104. See below for examples.

*members* is a list defining the members of the system. Elements of the list may be a string *name* representing the name of the physical file or system referred to. Elements of the list may also be a symbol, which is interpreted as its symbol name.

Elements of the *members* list can also be a list of the form `(name {keyword value}*)` where *name* is once again a string or a symbol naming a file or system.

The members of the system *name* must have unique names, as compared by `equalp`. For example, if *members* contains `"foo"` then there cannot be another member (either a file or a system) named `"foo"`, `"FOO"` or `foo`.

The possible keywords and their values are:

**:type** The type of this member. Allowed values are as for `:default-type`. If not specified it defaults to the value of `:default-type` given as an *option*.

**:root-module** If `nil` then this member is not loaded unless its loading is specifically requested as a result of a dependency on another module

**:source-only** Only the source file for this member is ever loaded

|                               |                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>:load-only</b>             | The member is never compiled by <code>defsys-tem</code> , objects are loaded in preference to source files                                                                                                                                                                                                                                                                                  |
| <b>:load-for-compile-only</b> | The member is only loaded as necessary during compilation and is never loaded independently                                                                                                                                                                                                                                                                                                 |
| <b>:features</b>              | The member is only considered during planning if the feature expression is true.                                                                                                                                                                                                                                                                                                            |
| <b>:package</b>               | A default package for the member.                                                                                                                                                                                                                                                                                                                                                           |
| <b>:embedded-module</b>       | Only allowed when the value for <code>:type</code> is <code>:c-file</code> . The value <i>embedded-module</i> is used to create a FLI embedded module named <i>embedded-module</i> instead of loading the object file. See <code>fli:install-embedded-module</code> in the <i>LispWorks Foreign Language Interface User Guide and Reference Manual</i> for how to load the embedded module. |

On Windows, the automation module adds the keyword `:com` for a member with type `:midl-type-library-file`. Then a member of the form

```
("mso97.tlb" :type :midl-type-library-file :com nil)
```

can be specified when you use only Automation client code, reducing the memory used.

*rules* is a list of rules of the following format :

```
({:in-order-to} action {:all | ({ member-name }* )}
  (:caused-by {(action {:previous | {member-name }* }) }* )
  (:requires {(action {:previous | { member-name }* }) }*))
```

The keyword `:all` refers to all the members of the system. It provides a shorthand for specifying that a rule should apply to all the system's members. The keyword `:previous` refers

to all the members of the system that are before the member in the list of members. This makes it easy, for example, to specify that in order to compile a file in a system, all the members that come before it must be loaded.

The name of the system is returned.

There are more details about the rules in “DEFSYSTEM rules” on page 308.

## Examples

```
(defsystem defsys-macros
  (:default-pathname "/usr/users/james/scm/defsys/"
    :default-type :lisp-file
    :package defsystem)
  :members ("new-macros"
            "scm-timemacros"))

(defsystem clos-sys
  (:default-pathname "/usr/users/clc/defsys/"
    :default-type :lisp-file
    :package defsystem)
  :members
  ((("defsys-macros" :type :system :root-module nil)
    "class"
    "time-methods"
    ("scm-pathname" :source-only t)
    "execute-plan"
    "file-types"
    "make-system"
    "conv-defsys"))
  :rules
  ((:in-order-to :compile ("class" "time-methods")
    (:caused-by (:compile "defsys-macros"))
    (:requires
      (:load "defsys-macros")))
   (:in-order-to :compile
     ("time-methods" "execute-plan")
     (:requires (:load "class")))))
```

```
(defsystem dataworks-demo
  (:default-type :system)
  :members (
    "db-class"
    "planar"
    "dataworks-dep"
    "dataworks-interface-tk"
    "dataworks-interface-tools"
    "drugs-demo"
    ("gen-demo" :type :lisp-file)
    ("load-icon" :type :lisp-file :source-only t)
  )
  :rules ((:in-order-to :compile :all
  (:requires (:load :previous)))))
```

This example illustrates the use of `:optimize`.

```
(defsystem foo (:optimize ((speed 3) (space 3)
                           (safety 0)))
  :members ("bar"
            "baz")
  :rules ((:compile :all
  (:requires (:load :previous)))))
```

This last example illustrates the use of `:embedded-module`.

```
(defsystem my-foreign-code ()
  :members
  (("my-c-code.c" :type :c-file
    :embedded-module my-module)))
```

Then initialize at run time with

```
(fli:install-embedded-module 'my-module)
```

#### Notes

1. Subsystems must be defined before any system of which they are part.
2. The order of *members* is important and reflects the order in which operations are carried out on the members of the system, subject to the *rules*.

#### See also

`load-system`  
`compile-system`  
`concatenate-system`

```
current-pathname  
*defsystem-verbose*
```

## \*defsystem-verbose\*

## Variable

|               |                                                                                                                                                                                                                                                                                       |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary       | Controls the amount of messages printed by <code>defsystem</code> about system (re)definition.                                                                                                                                                                                        |
| Package       | <code>lispworks</code>                                                                                                                                                                                                                                                                |
| Initial value |                                                                                                                                                                                                                                                                                       |
| Description   | <p>The variable <code>*defsystem-verbose*</code> is a generalized boolean controlling the amount of messages printed by <code>defsystem</code>. When the value is true, the system prints messages about system definition and redefinition. The default value is <code>t</code>.</p> |
| See also      | <code>defsystem</code>                                                                                                                                                                                                                                                                |

## delete-directory

## Function

|           |                                                                          |                                                                    |
|-----------|--------------------------------------------------------------------------|--------------------------------------------------------------------|
| Summary   | Deletes a directory.                                                     |                                                                    |
| Package   | <code>lispworks</code>                                                   |                                                                    |
| Signature | <code>delete-directory directory &amp;optional error =&gt; result</code> |                                                                    |
| Arguments | <code>directory</code>                                                   | A pathname designator.                                             |
|           | <code>error</code>                                                       | <code>nil</code> , <code>:error</code> or <code>:no-error</code> . |
| Value     | <code>result</code>                                                      | <code>t</code> or <code>nil</code> .                               |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The function <code>delete-directory</code> attempts to delete the directory <i>directory</i>. It returns <code>t</code> on success, and on failure either returns <code>nil</code> or signals an error.</p> <p><i>error</i> determines what happens when <code>delete-directory</code> fails. When <i>error</i> is <code>nil</code> (the default), if <i>directory</i> does not exist <code>delete-directory</code> returns <code>nil</code>, otherwise any failure causes an error to be signaled. If <i>error</i> is <code>:no-error</code>, <code>delete-directory</code> returns <code>nil</code> on any failure. If <i>error</i> is <code>:error</code>, any failure causes an error to be signaled.</p> <p>Typical reasons for failures in <code>delete-directory</code> are that <i>directory</i> is not empty, or that the user does not have the right permissions.</p> |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>deliver</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Summary        | The main interface to the Delivery tools.                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Package        | <code>lispworks</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Signature      | <code>deliver function file level &amp;rest keywords</code>                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Description    | <p>The function <code>deliver</code> is the main interface to the LispWorks delivery tools. You use it to create LispWorks executable applications and dynamic libraries.</p> <p>For more information about Delivery including a detailed description of <code>deliver</code>, see the <i>LispWorks Delivery User Guide</i>.</p> <p>For information about invoking <code>deliver</code> using the IDE, see "The Application Builder" in the <i>LispWorks IDE User Guide</i>.</p> |
| See also       | <code>delivered-image-p</code><br><code>save-image</code><br>"Guidance for control of the memory management system" on page 130                                                                                                                                                                                                                                                                                                                                                  |

| <b>*describe-length*</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                 | <i>Variable</i> |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Summary                  | Determines how many attributes of a composite object are described.                                                                                                                                                                                                                                                                                                                                                             |                 |
| Package                  | <code>lispworks</code>                                                                                                                                                                                                                                                                                                                                                                                                          |                 |
| Initial value            | 20                                                                                                                                                                                                                                                                                                                                                                                                                              |                 |
| Description              | The variable <code>*describe-length*</code> controls how many attributes of a composite object the function <code>describe</code> describes.<br><br>This means the number of elements of a sequence, entries in a hash table, slots of a structure instance, and so on.<br><br>If <code>*describe-length*</code> is <code>nil</code> then <code>describe</code> describes all of the attributes. Use this value only with care. |                 |
| Notes                    | The <code>describe</code> functionality is load-on-demand in the Lisp-Works image as shipped. Therefore if you have not done <code>(require "describe")</code> or called <code>describe</code> , <code>*describe-length*</code> may be unbound.                                                                                                                                                                                 |                 |
| See also                 | <code>describe</code>                                                                                                                                                                                                                                                                                                                                                                                                           |                 |

| <b>*describe-level*</b> |                                                                                            | <i>Variable</i> |
|-------------------------|--------------------------------------------------------------------------------------------|-----------------|
| Summary                 | Controls the depth to which <code>describe</code> describes arrays, structures and conses. |                 |
| Package                 | <code>lispworks</code>                                                                     |                 |
| Initial value           | 1                                                                                          |                 |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | The variable <code>*describe-level*</code> controls the depth to which the function <code>describe</code> describes arrays, structures and conses.                                                                                                                                                                                                                                                                                                                                                                                                          |
| Notes       | The <code>describe</code> functionality is load-on-demand in the Lisp-Works image as shipped. Therefore if you have not do <code>(require "describe")</code> or called <code>describe</code> , <code>*describe-level*</code> may be unbound.                                                                                                                                                                                                                                                                                                                |
| Example     | <pre>CL-USER 23 &gt; (describe 1) [... load output not shown ...]  1 is a BIT DECIMAL      1 HEX          1 OCTAL        1 BINARY       1  CL-USER 24 &gt; *describe-level* 1  CL-USER 25 &gt; (defstruct foo a s d) FOO  CL-USER 26 &gt; (defmethod describe-object ((f foo) (s stream))                (format s "FOO ~S~%" f)                (describe (foo-a f) s)) #&lt;STANDARD-METHOD DESCRIBE-OBJECT NIL (FOO STREAM) 2068295C&gt;  CL-USER 27 &gt; (describe (make-foo :a (vector 1 2 3) :s 42))  FOO #S(FOO A #(1 2 3) S 42 D NIL) #(1 2 3)</pre> |

To make `describe` operate on objects inside the structure instance, increase the value of `*describe-level*`:

```
CL-USER 28 > (setf *describe-level* 2)
2

CL-USER 29 > (describe (make-foo :a (vector 1 2 3) :s
42))

FOO #S(FOO A #(1 2 3) S 42 D NIL)
#(1 2 3) is a SIMPLE-VECTOR
  0      1
  1      2
  2      3
```

See also      **describe**

### **\*describe-print-length\*** *Variable*

Summary      Specifies a print length for **describe** and **apropos**.

Package      **lispworks**

Initial value      10

Description      If **\*print-length\*** is nil, **describe** and **apropos** bind **\*print-length\*** to the value of **\*describe-print-length\***.

See also      **describe**

### **\*describe-print-level\*** *Variable*

Summary      Specifies a print level for **describe** and **apropos**.

Package      **lispworks**

Initial value      10

|             |                                                                                                                                                                                          |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | If <code>*print-level*</code> is <code>nil</code> , <code>describe</code> and <code>apropos</code> bind <code>*print-level*</code> to the value of <code>*describe-print-level*</code> . |
| See also    | <code>describe</code>                                                                                                                                                                    |

| Function    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Makes a LispWorks dynamic library quit.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Package     | <code>lispworks</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Signature   | <code>dll-quit &amp;key kill-all-processes timeout output force =&gt; result, quit-output</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Arguments   | <p><i>kill-all-processes</i> A generalized boolean.</p> <p><i>timeout</i> A positive integer or <code>nil</code>.</p> <p><i>output</i> An output stream designator.</p> <p><i>force</i> A generalized boolean.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Values      | <p><i>result</i> <code>t</code> or <code>nil</code>.</p> <p><i>quit-output</i> A string or <code>nil</code>.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Description | <p>The function <code>dll-quit</code> makes a LispWorks dynamic library (or DLL) quit on returning from the callback in which it was called. It must be called only:</p> <ul style="list-style-type: none"><li>• In an image running as a dynamic library, meaning an image created by <code>save-image</code> with <code>:dll-exports</code> or by <code>deliver</code> with <code>:dll-exports</code>, and</li><li>• Inside the dynamic scope of a callback into the dynamic library. That is, not in a process that was started by <code>process-run-function</code>.</li></ul> <p><code>dll-quit</code> sets up the internal state such that just before returning into its caller in the LispWorks dynamic library it</p> |

causes LispWorks to quit. After quitting the callback returns as normal. The library can be unloaded using `FreeLibrary`, or you can re-use it (without re-loading).

By default `kill-all-processes` is `nil` which means that, if there are other running processes, `dll-quit` just returns `nil`. If `kill-all-processes` is non-`nil`, `dll-quit` tries to kill all the other processes, and if it succeeds, it quits.

If `kill-all-processes` is true, `timeout` is a maximum time to wait after killing the other processes. It allows `timeout` seconds for all processes to die.

`dll-quit` should be called when no other processes are running, whether they were created by a callback or by `process-run-function`. If such processes exist, by default `dll-quit` does nothing and returns `nil`. If `force` is non-`nil`, `dll-quit` always tries to set LispWorks up for quitting. LispWorks will quit even after a failure to kill all other processes and complete any required shut down operations. A true value of `force` automatically implies `kill-all-processes` true. However, if any of the other processes is stuck in a foreign call, the quitting may fail to finish properly. The default value of `force` is `nil`.

If `output` is supplied, `dll-quit` generates output if it is called when other processes are still running, or a required shut down operation was not completed. `output` can be an output stream, `t` (interpreted as `*standard-output*`) or `nil`. If `output` is `nil`, `dll-quit` collects the output and returns it as second argument `quit-output`. Otherwise it writes the output to the stream and `quit-output` is `nil`.

The output contains a list of the other processes that are still running. If `kill-all-processes` or `force` was supplied, and killing the other processes failed, the output also contains backtraces of the other processes, and possibly other debugging information.

*result* is `t` on success: the LispWorks dynamic library is set to quit on returning from the callback. *result* is `nil` when other processes are running: the image is not set to quit.

*quit-output* contains the output which was generated when *output nil* was passed. Otherwise *quit-output* is `nil`.

If `dll-quit` is called inside a recursive foreign callback, the LispWorks dynamic library quits only when the outermost callback returns.

#### Notes

1. `dll-quit` is intended for use when a LispWorks dynamic library is loaded by a main process which you (the LispWorks programmer) do not control. If you control the main process, then use `QuitLispWorks` instead.

It is expected that the main process will call into the dynamic library with some "shutdown" call, and then calls `FreeLibrary` to free the library. The shutdown call should close and free everything that needs to be closed or freed, call `dll-quit`, and return.

2. `dll-quit` is supported only where LispWorks can be a dynamic library. Currently this is in LispWorks on Microsoft Windows, Intel Macintosh, Linux, x86/x64 Solaris and FreeBSD.

#### See also

- `deliver`  
`save-image`

## **dotted-list-length**

## *Function*

Summary      Similar to `list-length`

Package      `lispworks`

Signature      `dotted-list-length list => result`

|             |               |                                                                                                                                                                                                                                                               |
|-------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arguments   | <i>list</i>   | A list.                                                                                                                                                                                                                                                       |
| Value       | <i>result</i> | An integer.                                                                                                                                                                                                                                                   |
| Description |               | The function <code>dotted-list-length</code> performs the same action as <code>list-length</code> , except that if the last <code>cdr</code> is not <code>nil</code> then instead of signaling an error, it returns the number of <code>conses</code> plus 1. |
| See also    |               | <code>dotted-list-p</code>                                                                                                                                                                                                                                    |

## dotted-list-p *Function*

|             |                                                                                    |                                                                                                                                                                                                                                               |
|-------------|------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Tests whether a <code>cons</code> is a list ending in a non-nil <code>cdr</code> . |                                                                                                                                                                                                                                               |
| Package     |                                                                                    | <code>lispworks</code>                                                                                                                                                                                                                        |
| Signature   |                                                                                    | <code>dotted-list-p list =&gt; result</code>                                                                                                                                                                                                  |
| Arguments   | <i>list</i>                                                                        | A list, which must be a <code>cons</code> .                                                                                                                                                                                                   |
| Values      | <i>result</i>                                                                      | A generalized boolean.                                                                                                                                                                                                                        |
| Description |                                                                                    | The function <code>dotted-list-p</code> is a predicate which tests whether <i>list</i> (which must be a <code>cons</code> ) is a list ending in a non-nil <code>cdr</code> . It returns true if this is the case, otherwise it returns false. |
| See also    |                                                                                    | <code>dotted-list-length</code>                                                                                                                                                                                                               |

## do-nothing *Function*

|         |                                                         |                        |
|---------|---------------------------------------------------------|------------------------|
| Summary | Ignores its arguments and returns an unspecified value. |                        |
| Package |                                                         | <code>lispworks</code> |

|             |                                                                                                                                   |                            |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| Signature   | <code>do-nothing &amp;rest ignore =&gt; unspecified</code>                                                                        |                            |
| Arguments   | <code>ignore</code>                                                                                                               | All arguments are ignored. |
| Values      | <code>unspecified</code>                                                                                                          | An unspecified value.      |
| Description | The function <code>do-nothing</code> ignores its arguments and returns an unspecified value. It is useful as a function argument. |                            |
| See also    | <a href="#"><code>false</code></a><br><a href="#"><code>true</code></a>                                                           |                            |

## \*enter-debugger-directly\* *Variable*

|               |                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary       | Controls direct entry into the Debugger tool.                                                                                                                                                                                                                                                                                                                                                                                                          |
| Package       | <code>lispworks</code>                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Initial value | <code>nil</code>                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Description   | <p>The variable <code>*enter-debugger-directly*</code> is a generalized boolean which affects the behavior of the LispWorks IDE when an error is signaled outside of the Listener REPL.</p> <p>Value <code>nil</code> causes an error notifier window to be displayed (from which you can abort, report a bug, or raise a Debugger tool).</p> <p>A true value causes the Debugger tool to be displayed immediately, and no error notifier appears.</p> |
| Notes         | Errors signaled in a Listener Read-Eval-Print loop are handled in the REPL and therefore <code>*enter-debugger-directly*</code> has no effect on the behavior in this case.                                                                                                                                                                                                                                                                            |

|  | <i>Function</i> |
|--|-----------------|
|--|-----------------|

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Reads the value of an environment variable from the environment table of the calling process.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Package     | <code>lispworks</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Signature   | <code>environment-variable name =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Arguments   | <code>name</code> A string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Values      | <code>result</code> A string or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Description | <p>The function <code>environment-variable</code> reads the environment variable specified by <code>name</code> and returns its value, or <code>nil</code> if the variable could not be found.</p> <p>A <code>setf</code> method is also defined, allowing you to set the value of an environment variable:</p> <pre>(setf (environment-variable name) value)</pre> <p>If <code>value</code> is a string, then <code>name</code> is set to be <code>value</code>. If <code>value</code> is <code>nil</code> then <code>name</code> is removed from the environment table.</p>                              |
| Example     | In this first example the value of the environment variable <code>PATH</code> is returned:<br><br><pre>(environment-variable "PATH")</pre> <p>The result is a string of all the defined paths:</p><br><pre>"c:\\hqbin\\nt\\x86;c:\\hqbin\\nt\\x86\\perl;c:\\hqbin\\\nwin32;c:\\usr\\local\\bin;C:\\WINNT35\\system32;C:\\WINNT35;;C:\\MSTOOLS\\bin;C:\\TGS3D\\PROGRAM;c:\\program\nfiles\\devstudio\\sharedide\\bin\\ide;c:\\program\nfiles\\devstudio\\sharedide\\bin;c:\\program\nfiles\\devstudio\\vc\\bin;c:\\msdev\\bin;C:\\WINDOWS;C:\\WINDOWS\\COMMAND;C:\\WIN95\\COMMAND;C:\\MSINPUT\\MOUSE"</pre> |

In the second example, the variable **MYTZONE** is found not to be in the environment table:

```
(environment-variable "MYTZONE")
```

```
NIL
```

It is set to be **GMT** using the **setf** method:

```
(setf (environment-variable "MYTZONE") "GMT")
```

See also “Accessing environment variables” on page 458

|                    |                 |
|--------------------|-----------------|
| <b>errno-value</b> | <i>Function</i> |
|--------------------|-----------------|

Summary Returns the current value of the UNIX variable **errno**.

Package **lispworks**

Signature **errno-value => value**

Arguments None.

Values **value** The current value of **errno**.

Description The function **errno-value** returns the current value of the UNIX variable **errno**.

Notes **errno-value** is implemented only on non-Windows platforms.

Example **USER 10 > (errno-value)**  
2

```
USER 11 > (get-unix-error 2)
"no such file or directory"
```

See also **get-unix-error**

|             | <i>Function</i>                                                                                                                                                                                                     |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Returns a path in the <code>examples</code> folder.                                                                                                                                                                 |
| Package     | <code>lispworks</code>                                                                                                                                                                                              |
| Signature   | <code>example-file file =&gt; path</code>                                                                                                                                                                           |
| Arguments   | <code>file</code> A pathname designator.                                                                                                                                                                            |
| Values      | <code>path</code> A pathname.                                                                                                                                                                                       |
| Description | The function <code>example-file</code> returns an absolute path to a file <i>file</i> in the <code>examples</code> folder of the LispWorks library.<br><br>It does not actually test for the existence of the file. |
| Example     | <pre>(example-file "capi/applications/othello.lisp") =&gt; #P"C:/Program Files/LispWorks/lib/7-1-0- 0/examples/capi/applications/othello.lisp"</pre>                                                                |
| See also    | <code>example-compile-file</code><br><code>example-edit-file</code>                                                                                                                                                 |

|           | <i>Function</i>                                                                                                   |
|-----------|-------------------------------------------------------------------------------------------------------------------|
| Summary   | Compiles a file in the <code>examples</code> folder to a temporary output file.                                   |
| Package   | <code>lispworks</code>                                                                                            |
| Signature | <code>example-compile-file file &amp;rest args =&gt; output-truename, warnings-p, failure-p</code>                |
| Arguments | <code>file</code> A pathname designator.<br><br><code>args</code> Arguments passed to <code>compile-file</code> . |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Values      | <i>output-truename</i> A pathname or <code>nil</code> .<br><i>warnings-p</i> A generalized boolean.<br><i>failure-p</i> A generalized boolean.                                                                                                                                                                                                                                                                                                             |
| Description | The function <code>example-compile-file</code> constructs the path to <i>file</i> in the <code>examples</code> folder of the LispWorks library, and a path to an output file in a temporary location which is likely to be writable.<br><br>It then calls <code>compile-file</code> with these paths as the <i>input-file</i> and <i>output-file</i> , also passing the other <i>args</i> , and returns the values returned by <code>compile-file</code> . |
| See also    | <code>get-temp-directory</code><br><code>example-file</code><br><code>example-edit-file</code>                                                                                                                                                                                                                                                                                                                                                             |

| <b>example-edit-file</b> <span style="float: right;"><i>Function</i></span> |                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary                                                                     | Displays a file from the examples folder in an Editor.                                                                                                                                                                                                                                                                                                                                                                  |
| Package                                                                     | <code>lispworks</code>                                                                                                                                                                                                                                                                                                                                                                                                  |
| Signature                                                                   | <code>example-edit-file file</code>                                                                                                                                                                                                                                                                                                                                                                                     |
| Arguments                                                                   | <i>file</i> A pathname designator.                                                                                                                                                                                                                                                                                                                                                                                      |
| Description                                                                 | The function <code>example-edit-file</code> constructs the path to the file <i>file</i> in the examples folder of the LispWorks library, adding the "lisp" extension if no extension is specified, and opens the file in an Editor tool in the LispWorks IDE.<br><br>If <i>file</i> is a directory name (ending in a slash), then the list of files with "lisp" extension in that directory is displayed in the Editor. |

Examples      This form displays the file `lib/7-1-0-0/examples/capi/applications/othello.lisp` from the Lisp-Works library:

```
(example-edit-file "capi/applications/othello")
```

See also      `example-file`  
                 `example-compile-file`

## **example-load-binary-file** *Function*

Summary      Loads a fasl file compiled by `example-compile-file`.

Package      `lispworks`

Signature      `example-load-binary-file file => result`

Arguments      `file`      A pathname designator.

Values      `result`      A generalized boolean.

Description      The function `example-load-binary-file` constructs the path to an output file in a temporary location which would be used as the *output-file* by `example-compile-file`.

It then calls `load` on that path, and returns the value *result* returned by `load`.

See also      `example-compile-file`

## **execute-actions** *Macro*

Summary      Executes in sequence the actions on a given list.

Package      `lispworks`

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signature   | <code>execute-actions <i>name-or-list</i> &amp;rest <i>keyword-value-pairs</i> &amp;rest<br/><i>other-args</i> =&gt;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Arguments   | <p><i>name-or-list</i>      An action list</p> <p><i>keyword-value-pairs</i></p> <p style="text-align: center;">See description.</p> <p><i>other-args</i>      A list.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Description | <p>The macro <code>execute-actions</code> executes, in sequence, the actions on the specified list. If the action-list specified by <i>name-or-list</i> does not exist, then this is handled according to the value of <code>*handle-missing-action-list*</code>. Note that <i>name-or-list</i> is evaluated.</p> <p>If a user-defined execution function was specified when the action list was defined, then it should accept the following arguments:</p> <p style="padding-left: 40px;"><code>(<i>action-list</i> <i>other-args</i> &amp;rest <i>keyword-value-pairs</i>)</code></p> <p>Note that <i>other-args</i> is passed as a single list.</p> <p>If a user-defined execution function was not specified when the action list was defined, then the following default mapping occurs. Each action's data is invoked via apply on <i>other-args</i>:</p> <p style="padding-left: 40px;"><code>(apply <i>data</i> <i>other-args</i>)</code></p> <p>This behavior is modified by the keyword-value-pairs, thus:</p> <ul style="list-style-type: none"> <li>• If the keyword parameter <code>:ignore-errors-p</code> is non-nil, any otherwise-unhandled errors signaled inside the execution of that function will be trapped, and a warning issued. Execution continues with the next action-item. If <code>:ignore-errors-p</code> is nil (or not specified), then the error is not trapped.</li> </ul> |

- If the keyword parameter `:post-process` is non-nil, the first value returned by each action is handled, according to `:post-process`, thus:

|                       |                                                                                                                                    |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------|
| <code>:collect</code> | collect values into list                                                                                                           |
| <code>:and</code>     | return <code>t</code> only if all values are <code>t</code> . Return <code>nil</code> immediately if any value is <code>nil</code> |
| <code>:or</code>      | return first non-nil value                                                                                                         |

See also      `define-action`  
`with-action-list-mapping`

## **extended-char** *Type*

|             |                                                                                                              |
|-------------|--------------------------------------------------------------------------------------------------------------|
| Summary     | The extended character type.                                                                                 |
| Package     | <code>lispworks</code>                                                                                       |
| Signature   | <code>extended-char</code>                                                                                   |
| Description | The type of extended characters. A synonym for <code>extended-character</code> , but with standard spelling. |

## **extended-character** *Type*

|             |                                  |
|-------------|----------------------------------|
| Summary     | The extended character type.     |
| Package     | <code>lispworks</code>           |
| Signature   | <code>extended-character</code>  |
| Description | The type of extended characters. |

| <b>extended-character-p</b> |                                                                                                                                                                                        | <i>Function</i>          |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| Summary                     | A predicate for extended characters.                                                                                                                                                   |                          |
| Package                     | <b>lispworks</b>                                                                                                                                                                       |                          |
| Signature                   | <b>extended-character-p <i>object</i> =&gt; <i>result</i></b>                                                                                                                          |                          |
| Arguments                   | <i>object</i>                                                                                                                                                                          | The object to be tested. |
| Values                      | <i>result</i>                                                                                                                                                                          | A boolean.               |
| Description                 | The function <b>extended-character-p</b> is a predicate for extended characters.<br><br><i>result</i> is <b>t</b> if <i>object</i> is an extended character, and <b>nil</b> otherwise. |                          |
| See also                    | <b>extended-character</b>                                                                                                                                                              |                          |

| <b>extended-char-p</b> |                                                                                                                                                                                                                | <i>Function</i>          |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| Summary                | A predicate for extended characters.                                                                                                                                                                           |                          |
| Package                | <b>lispworks</b>                                                                                                                                                                                               |                          |
| Signature              | <b>extended-char-p <i>object</i> =&gt; <i>result</i></b>                                                                                                                                                       |                          |
| Arguments              | <i>object</i>                                                                                                                                                                                                  | The object to be tested. |
| Values                 | <i>result</i>                                                                                                                                                                                                  | A boolean.               |
| Description            | The function <b>extended-char-p</b> is a predicate for extended characters, only with standard spelling.<br><br><i>result</i> is <b>t</b> if <i>object</i> is an extended character, and <b>nil</b> otherwise. |                          |

See also [extended-char](#)  
[extended-character-p](#)

## \*external-formats\*

## **Variable**

**Summary** A list of the names of the defined external formats.

## Package lispworks

Initial value Microsoft Windows platforms:

```
(WIN32:CODE-PAGE FLI::UNICODE-WCHAR FLI::LATIN-1-WCHAR  
FLI:ASCII-WCHAR :KOI8-R :MACOS-ROMAN :UTF-32 :UTF-32BE  
:UTF-32LE :UTF-32-REVERSED :UTF-32-NATIVE :UTF-16 :UTF-  
16BE :UTF-16LE :UTF-16-REVERSED :UTF-16-NATIVE :UTF-8  
:GBK :WINDOWS-CP936 EXTERNAL-FORMAT:DOUBLE-BYTE-TABLE-  
LOOKUP :JIS :EUC-JP :SJIS :LATIN-1-TERMINAL :BMP  
:UNICODE :LATIN-1-SAFE :LATIN-1-CHECKED :LATIN-1 :EUC  
:SHIFT-JIS :NIHONGO-MS :NIHONGO-EUC :NIHONGO-JIS  
CHARACTER :BMP-REVERSED :BMP-NATIVE EXTERNAL-  
FORMAT::RAW-BASE-CHARACTER :ASCII-TERMINAL :ASCII)
```

On all other platforms:

```
(FLI::UNICODE-WCHAR FLI::LATIN-1-WCHAR FLI:ASCII-WCHAR  
:KOI8-R :MACOS-ROMAN :UTF-32 :UTF-32BE :UTF-32LE :UTF-  
32-REVERSED :UTF-32-NATIVE :UTF-16 :UTF-16BE :UTF-16LE  
:UTF-16-REVERSED :UTF-16-NATIVE :UTF-8 :GBK :WINDOWS-  
CP936 EXTERNAL-FORMAT:DOUBLE-BYTE-TABLE-LOOKUP :JIS  
:EUC-JP :SJIS :LATIN-1-TERMINAL :BMP :UNICODE :LATIN-1-  
SAFE :LATIN-1-CHECKED :LATIN-1 :EUC :SHIFT-JIS  
:NIHONGO-MS :NIHONGO-EUC :NIHONGO-JIS EXTERNAL-  
FORMAT::HOST-PORTABLE EXTERNAL-FORMAT::LATIN-PORTABLE  
CHARACTER :BMP-REVERSED :BMP-NATIVE EXTERNAL-  
FORMAT::RAW-BASE-CHARACTER :ASCII-TERMINAL :ASCII)
```

**Description** The variable **\*external-formats\*** contains a list of the names of the defined external formats.

The platform-specific external format names are:

## code-page

Uses the encoding in the Microsoft Windows code page specified by the :id parameter.

**latin-portable**

Intended for use when communicating with X servers, for example when passing XLFD names. Uses the X Portable Character Set.

**host-portable**

A synonym for **latin-portable**.

**false** *Function*

Summary      Ignores its arguments and returns **nil**.

Package      **lispworks**

Signature      **false &rest ignore => nil**

Arguments      *ignore*      All arguments are ignored.

Value      **nil**

Description      The function **false** takes any number of arguments, which it ignores, and returns **nil**. It is useful as a functional argument.

See also      **do-nothing**  
**true**

**file-directory-p** *Function*

Summary      Tests for the presence of a directory.

Package      **lispworks**

|             |                                                                                                      |                                                                                                                                                          |
|-------------|------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signature   | <code>file-directory-p pathname =&gt; bool</code>                                                    |                                                                                                                                                          |
| Arguments   | <i>pathname</i>                                                                                      | A pathname, string, or file-stream.                                                                                                                      |
| Values      | <i>bool</i>                                                                                          | If <i>t</i> , the pathname represented by <i>pathname</i> exists and is a directory. If <i>nil</i> , it either does not exist, or it is not a directory. |
| Description | <code>file-directory-p</code> tests whether the pathname represents a directory.                     |                                                                                                                                                          |
| Example     | <pre>CL-USER 70 &gt; (file-directory-p "~") T  CL-USER 71 &gt; (file-directory-p ".login") NIL</pre> |                                                                                                                                                          |

|           |                                                                                                                                                                                                                                                                                                                                                               | <i>Function</i> |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Summary   | Matches a regular expression.                                                                                                                                                                                                                                                                                                                                 |                 |
| Package   | <code>lispworks</code>                                                                                                                                                                                                                                                                                                                                        |                 |
| Signature | <code>find-regexp-in-string pattern string &amp;key start end from-end<br/>   case-sensitive brackets-limits =&gt; pos, len</code><br><code>find-regexp-in-string pattern string &amp;key start end from-end<br/>   case-sensitive brackets-limits =&gt; pos, len, brackets-limits-vector</code>                                                              |                 |
| Arguments | <p><i>pattern</i>      A string or a precompiled regular expression object.</p> <p><i>string</i>      A string.</p> <p><i>start, end</i>    Bounding index designators of <i>string</i>.</p> <p><i>from-end</i>     A generalized boolean.</p> <p><i>case-sensitive</i>    A generalized boolean.</p> <p><i>brackets-limits</i>    A generalized boolean.</p> |                 |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                              |  |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|--|
| Values      | <i>pos</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | A non-negative integer or <code>nil</code> . |  |
|             | <i>len</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | A non-negative integer or <code>nil</code> . |  |
|             | <i>brackets-limits-vector</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | A vector.                                    |  |
| Description | <p>The function <code>find-regexp-in-string</code> searches the string <i>string</i> for a match for the regular expression <i>pattern</i>. The index in <i>string</i> of the start of the first match is returned in <i>pos</i>, and the length of the match is <i>len</i>.</p> <p>If <i>from-end</i> is <code>nil</code> (the default value) then the search starts at index <i>start</i> and ends at index <i>end</i>. <i>start</i> defaults to 0 and <i>end</i> defaults to <code>nil</code>. If <i>from-end</i> is true, then the search direction is reversed.</p> <p><i>pattern</i> should be a precompiled regular expression object or a string. If <i>pattern</i> is a string then <code>find-regexp-in-string</code> first makes a precompiled regular expression object. This operation allocates, therefore if you need to repeatedly call <code>find-regexp-in-string</code> with the same pattern, it is better to call <code>precompile-regexp</code> once and pass its result, a pre-compiled regular expression object, as <i>pattern</i>.</p> <p><i>case-sensitive</i> controls whether a string <i>pattern</i> is precompiled as a case sensitive or case insensitive search. A non-nil value means a case sensitive search. The value <code>nil</code> (the default) means a case insensitive search. <i>case-sensitive</i> is ignored if <i>pattern</i> is not a string.</p> <p>When <i>brackets-limits</i> is non-nil, a successful call to <code>find-regexp-in-string</code> returns a third value which is a vector specifying the limits of matches of any pair of <code>\(</code> and <code>\)</code> in the search pattern. The length of the vector is twice the number of pairs, and the elements are offsets from the beginning of the match of the whole pattern. Each pair of <code>\(</code> and <code>\)</code> is assigned a number in the order of the appearance of the <code>\(</code> in the pattern. This number multiplied by two is the index into the vector where the match for this pair starts, and the next</p> |                                              |  |

element specifies the end of the match. The default value of *brackets-limits* is `nil`.

The regular expression syntax used by `find-regexp-in-string` is similar to that used by Emacs, as described in the "Regular expression syntax" section of the *LispWorks Editor User Guide*. (If you use **Help > Search** to locate this section, select the **Contents** radio button.)

**Example**

This form allocates several regular expression objects:

```
(loop with pos = 0
      with len = 0
      while pos
      do (multiple-value-setq (pos len)
                               (find-regexp-in-string "[0,2,4,6,8]"
   "0123456789"
   :start (+ pos len)))
         when pos
         do (format t "~&Match at pos ~D len ~D~%" pos len))
```

This form does the same matching but allocates just one pre-compiled regular expression object:

```
(loop with pattern = (precompile-regexp "[0,2,4,6,8]")
      with pos = 0
      with len = 0
      while pos
      do (multiple-value-setq (pos len)
                               (find-regexp-in-string pattern "0123456789"
   :start (+ pos len)))
         when pos do (format t "~&Match at pos ~D len ~D~%" pos len))
```

**See also**

`precompile-regexp`  
`regexp-find-symbols`  
`count-regexp-occurrences`

## function-lambda-list

## *Function*

**Summary**

Returns the argument list of the given function.

|             |                                                                                                                                                                                                                                                                                                                                            |                             |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|
| Package     | <code>lispworks</code>                                                                                                                                                                                                                                                                                                                     |                             |
| Signature   | <code>function-lambda-list <i>function</i> &amp;optional <i>error-p</i> =&gt; <i>args</i></code>                                                                                                                                                                                                                                           |                             |
| Arguments   | <i>function</i>                                                                                                                                                                                                                                                                                                                            | A symbol or a function.     |
|             | <i>error-p</i>                                                                                                                                                                                                                                                                                                                             | A boolean.                  |
| Values      | <i>args</i>                                                                                                                                                                                                                                                                                                                                | A list, or the symbol :none |
| Description | <p><i>function</i> is the function whose arguments are required</p> <p>If <i>error-p</i> is nil, then <code>function-lambda-list</code> returns :none if <i>function</i> is not defined, and does not start the debugger. The default value of <i>error-p</i> is t, meaning that an error is signaled if <i>function</i> is undefined.</p> |                             |
| Example     | <pre>TEST 2 &gt; (function-lambda-list 'editor:create-buffer-command) (EDITOR::P &amp;OPTIONAL EDITOR:BUFFER-NAME)</pre>                                                                                                                                                                                                                   |                             |

## get-inspector-values sort-inspector-p

### Generic Functions

|           |                                                                                                               |                             |
|-----------|---------------------------------------------------------------------------------------------------------------|-----------------------------|
| Summary   | Customizes the information displayed and sort order of attributes/values in the LispWorks IDE Inspector tool. |                             |
| Package   | <code>lispworks</code>                                                                                        |                             |
| Signature | <code>get-inspector-values <i>object mode</i> =&gt; <i>names, values, getter, setter, type</i></code>         |                             |
| Signature | <code>sort-inspector-p <i>object mode</i> =&gt; <i>result</i></code>                                          |                             |
| Arguments | <i>object</i>                                                                                                 | The object to be inspected. |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                  |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
|             | <i>mode</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Name of a mode, or <code>nil</code> . <code>nil</code> defines the default inspection format for <i>object</i> . |
| Values      | <i>names, values</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | The two lists displayed in columns in the Inspector window.                                                      |
|             | <i>getter</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Ignored.                                                                                                         |
|             | <i>setter</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | A function used to update slot values.                                                                           |
|             | <i>type</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Displayed in the Inspector window.                                                                               |
|             | <i>result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | A boolean.                                                                                                       |
| Description | <p>The generic functions <code>get-inspector-values</code> and <code>sort-inspector-p</code> allow you to customize the LispWorks IDE Inspector tool by adding new ways to display class instances and control sorting of the attributes and values.</p> <p><code>get-inspector-values</code> allows you to add new formats (corresponding to different values of mode) in which instances of a particular class can be inspected. Mode <code>nil</code> is the default mode, which is always present (it can be overwritten).</p> <p>LispWorks includes methods for:</p> <pre>(get-inspector-values (object nil)) (get-inspector-values (standard-object nil)) (get-inspector-values (structured-object nil)) (get-inspector-values (sequence nil)) (get-inspector-values cons nil))</pre> <p>and so on.</p> <p><code>sort-inspector-p</code> determines whether to sort the list of displayed attributes/values.</p> <p>The Inspector tool calls <code>sort-inspector-p</code> with the current object and mode the first time it displays this object in this mode to determine whether to sort the list of attributes/values. If it returns non-nil, it sorts by item, otherwise it does not sort.</p> |                                                                                                                  |

There are various methods on system-defined types to get the most useful behavior. You can add methods for your own types.

- Notes      The sort type can be changed interactively in the Inspector tool by using the the **Preferences...** dialog.
- Example    This example allows inspection of a CLOS object, displaying only direct slots from a chosen class in its class precedence list. This can be useful when an object inherits many slots from superclasses, and the inherited slots are of no interest.

```

(defmethod lispworks:get-inspector-values
  ((object standard-object)
   (mode (eql 'direct-as)))
  (declare (ignore mode))
  (loop with object-class =
        (class-of object)
        with precedence-list =
        (class-precedence-list object-class)
        with items =
        (loop for super in precedence-list
              collecting (list*
                           (format nil "~a"
                                   (class-name super))
                           super)))
        with class =
        (or (capi:prompt-with-list items
                                    "Direct slots as ...")
            object-class)
            ;; default if no selection
        with slots =
        (class-direct-slots class)
        for slot in slots
        for name =
        (clos::slot-definition-name slot)
        collect name into names
        collect (if (slot-boundp object name)
                   (slot-value object name)
                   :slot-unbound)
        into values
        finally
        (return
         (values
          names
          values
          nil
          #'(lambda
              (x slot-name index new-value)
              (declare (ignore index))
              (setf (slot-value x slot-name)
                    new-value))
          (format nil "~a - direct slots as ~a"
                  (class-name object-class)
                  (class-name class)))))))

```

| <b>get-unix-error</b> | <i>Function</i>                                                                                                                         |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| Summary               | Returns the text associated with a given error.                                                                                         |
| Package               | <code>lispworks</code>                                                                                                                  |
| Signature             | <code>get-unix-error number =&gt; error</code>                                                                                          |
| Arguments             | <code>number</code> The <code>errno</code> value whose text is required.                                                                |
| Values                | <code>error</code> The text associated with the error.                                                                                  |
| Description           | The function <code>get-unix-error</code> returns the text associated with the specified value of the UNIX variable <code>errno</code> . |
| Notes                 | <code>get-unix-error</code> is implemented only on non-Windows platforms.                                                               |
| See also              | <code>errno-value</code>                                                                                                                |

| <b>*grep-command*</b> | <i>Variable</i>                                                                                                                                                                                     |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package               | <code>lispworks</code>                                                                                                                                                                              |
| Summary               | Determines the search utility used by <code>Grep</code> searches in the Search Files tool in the LispWorks IDE.                                                                                     |
| Initial value         | <code>"grep"</code> on non-Windows platforms.<br><code>nil</code> on Windows.                                                                                                                       |
| Description           | If the value is a string, it is the search utility to run in the Search Files tool.<br><br>If the value is <code>nil</code> , then the value of<br><br><code>(sys:lispworks-file "etc/grep")</code> |

is expected to be an executable, which is run. On Windows a suitable `grep.exe` is included with LispWorks in this location.

The search utility is passed arguments constructed using `*grep-command-format*` and `*grep-fixed-args*`.

See the *LispWorks IDE User Guide* for more information about the Search Files tool.

See also \*grep-command-format\*  
\*qgrep-fixed-args\*

**\*grep-command-format\*** *Variable*

## Package lispworks

**Summary** The format string used to construct the arguments passed to the Search Files tool to perform a **Grep** search.

Initial value "cd '~a'; ~a ~a ~a /dev/null" on non-Windows platforms.

"~a ~a ~a NUL" on Windows.

Description On non-Windows platforms, the first format argument is the current directory.

The remainder of the format arguments are:

- the value of `*grep-command*` or, if this is `nil`, the value of `(sys:lispworks-file "etc/grep")`.
  - the value of `*grep-fixed-args*`.
  - the arguments you specify.

See the *LispWorks IDE User Guide* for more information about the Search Files tool.

See also      **\*grep-command\***  
**\*grep-fixed-args\***

**\*grep-fixed-args\*** *Variable*

|               |                                                                                                                                                                                                                                                                                                              |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package       | <b>lispworks</b>                                                                                                                                                                                                                                                                                             |
| Summary       | Arguments added to the command string of a <b>Grep</b> search in the Search Files tool.                                                                                                                                                                                                                      |
| Initial value | " <b>-n</b> "                                                                                                                                                                                                                                                                                                |
| Description   | The variable <b>*grep-fixed-args*</b> provides arguments added to a <b>Grep</b> command string in the Search Files tool. The value should ensure that the line number is output at the start of each match.<br><br>See the <i>LispWorks IDE User Guide</i> for more information about the Search Files tool. |
| See also      | <b>*grep-command*</b><br><b>*grep-command-format*</b>                                                                                                                                                                                                                                                        |

**\*handle-existing-action-in-action-list\*** *Variable*

|               |                                                                                                                                                                                                                    |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary       | Contains keywords determining behavior on exceptions raised when an action definition already exists in a given action list.                                                                                       |
| Package       | <b>lispworks</b>                                                                                                                                                                                                   |
| Initial value | ( <b>:warn :redefine</b> )                                                                                                                                                                                         |
| Description   | The variable <b>*handle-existing-action-in-action-list*</b> is a list containing one of <b>:warn</b> , or <b>:silent</b> , determining whether to notify the user, and one of <b>:skip</b> , or <b>:redefine</b> , |

to determine what to do about an action definition when the action already exists in the given action list.

It is used by `define-action`.

See also      `define-action`

**\*handle-existing-action-list\***                                    *Variable*

Summary      Contains keywords determining what to do about a given action list operation when the action list already exists.

Package      `lispworks`

Initial value      `(:warn :skip)`

Description      A list containing either `:warn` or `:silent`, determining whether to notify the user, and either `:skip` or `:redefine` to determine what to do about an action list operation when the action list already exists. The initial value is `(:warn :skip)`.

It is used by the macro `define-action-list`.

See also      `define-action-list`

**\*handle-missing-action-list\***                                    *Variable*

Summary      Defines how to handle an operation on a missing action list.

Package      `lispworks`

Signature      `*handle-missing-action-list*`

Initial value      `:error`

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The variable <code>*handle-missing-action-list*</code> is a keyword; one of <code>:warn</code>, <code>:error</code>, or <code>:ignore</code>, denoting how to handle an operation on a missing action-list. The default value is <code>:error</code>.</p> <p><code>*handle-missing-action-list*</code> is used by <code>undefined-action-list</code>, <code>print-actions</code>, <code>execute-actions</code>, <code>define-action</code> and <code>undefined-action</code>.</p> |
| See also    | <code>define-action</code><br><code>execute-actions</code><br><code>print-actions</code><br><code>undefined-action</code><br><code>undefined-action-list</code>                                                                                                                                                                                                                                                                                                                      |

### **\*handle-missing-action-in-action-list\*** *Variable*

|               |                                                                                                                                                                                                                                                                                                           |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary       | Denotes how to handle an operation on a missing action.                                                                                                                                                                                                                                                   |
| Package       | <code>lispworks</code>                                                                                                                                                                                                                                                                                    |
| Initial value | <code>:warn</code>                                                                                                                                                                                                                                                                                        |
| Description   | The variable <code>*handle-missing-action-in-action-list*</code> is a keyword; one of <code>:warn</code> , <code>:error</code> or <code>:ignore</code> , denoting how to handle an operation on a missing action. Its initial value is <code>:warn</code> . It is used by <code>undefined-action</code> . |
| See also      | <code>undefined-action</code>                                                                                                                                                                                                                                                                             |

### **\*handle-warn-on-redefinition\*** *Variable*

|         |                                                                |
|---------|----------------------------------------------------------------|
| Summary | Specifies the action on defining a symbol in certain packages. |
| Package | <code>lispworks</code>                                         |

|               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Initial value | <code>:error</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Description   | <p>The variable <code>*handle-warn-on-redefinition*</code> specifies what action should be taken on defining external symbols in certain packages. It is designed to protect against (re)definition of symbols in implementation packages.</p> <p>The protected packages are those specified in the variable <code>*packages-for-warn-on-redefinition*</code>.</p> <p>If <code>*handle-warn-on-redefinition*</code> is set to <code>:warn</code> then you are warned. If it is set to <code>:quiet</code> or <code>nil</code>, the definition is done quietly. If, however, it is set to <code>:error</code>, then LispWorks signals an error.</p> |
| Notes         | <p>The checking is useful because it is relatively easy to redefine an external symbol by mistake, and it leads to undefined behavior which is difficult to debug. It is therefore a bad idea to change the value of <code>*handle-warn-on-redefinition*</code> to something else. If required, do this by rebinding <code>*handle-warn-on-redefinition*</code> rather than setting its global value.</p>                                                                                                                                                                                                                                          |
| See also      | <ul style="list-style-type: none"> <li><code>*packages-for-warn-on-redefinition*</code></li> <li><code>*redefinition-action*</code></li> <li>“Protecting packages” on page 88</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

| <b>hardcopy-system</b> |                                                                              | <i>Function</i>                                                                                                         |
|------------------------|------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| Summary                | Print each file of a system to a printer.                                    |                                                                                                                         |
| Package                | <code>lispworks</code>                                                       |                                                                                                                         |
| Signature              | <code>hardcopy-system system-name &amp;key command simulate =&gt; nil</code> |                                                                                                                         |
| Arguments              | <code>system-name</code>                                                     | A symbol representing the name of the system. The system must have been defined using the <code>defsystem</code> macro. |

**simulate** If `nil` or not present then `hardcopy-system` works silently. Otherwise a plan of the actions which `hardcopy-system` intends to carry out is printed. What happens next depends on the value of *simulate*:

`t` — do nothing.

`:ask` — you are asked, using `y-or-n-p`, if you want the plan to be carried out.

`:each` — `hardcopy-system` displays each action in the plan one at a time, and asks you if you want to carry out this particular action. The answer executes the rest of the plan without further prompting, `e` returns from `hardcopy-system` without further processing, and `y` and `n` work as expected.

Values      `hardcopy-system` returns `nil`.

Examples     

```
(hardcopy-system 'blackboard)
(hardcopy-system 'tms :simulate :ask :command "lpr")
```

Notes        By default, `hardcopy-system` uses `*print-command*` as the command sent to the shell.

See also     `defsystem`  
`*print-command*`

### **\*init-file-name\*** *Variable*

Summary      The default user initialization file.

Package      `lispworks`

Initial value    `"~/.lispworks"`

Description      The variable `*init-file-name*` is the name of the default user initialization file.  
However, if the user initialization file is specified by either:

- the command line argument `-init`, or
- user preferences (as set via the Preferences dialog in the LispWorks IDE)

then the value of `*init-file-name*` is not used.

### **\*inspect-through-gui\*** *Variable*

Summary      Controls what `inspect` does in the development environment.  
Package      `lispworks`  
Initial value      `nil`  
Description      The variable `*inspect-through-gui*` controls what `inspect` does in the development environment.  
When the value is `nil`, `inspect` uses a command line interface in the REPL.  
When the value is true, `inspect` invokes an Inspector tool in the LispWorks IDE.

### **lisp-image-name** *Function*

Summary      Returns the name of the running image.  
Package      `lispworks`  
Signature      `lisp-image-name => name`

|             |                                                                                                                                                                                                                                                                                                                                          |           |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Arguments   | None.                                                                                                                                                                                                                                                                                                                                    |           |
| Values      | <i>name</i>                                                                                                                                                                                                                                                                                                                              | A string. |
| Description | The function <code>lisp-image-name</code> returns a string representing the full path to the running LispWorks image. The example below is in typical LispWorks for Windows and LispWorks for Linux installations. In resaved and delivered images (including dynamic libraries such as Windows DLLs), the appropriate path is returned. |           |
| Example     | <p>On Windows:</p> <pre>CL-USER 1 &gt; (lisp-image-name) "C:\\Program Files\\LispWorks\\lispworks-7-1-0-x86- win32.exe"</pre> <p>On Linux:</p> <pre>CL-USER 1 &gt; (lisp-image-name) "/usr/bin/lispworks-7-1-0-x86-linux"</pre>                                                                                                          |           |
| See also    | <code>*line-arguments-list*</code>                                                                                                                                                                                                                                                                                                       |           |

## **\*lispworks-directory\*** *Variable*

|               |                                                                                                                                                                                                                                                                                                      |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary       | The main LispWorks installation directory.                                                                                                                                                                                                                                                           |
| Package       | <code>lispworks</code>                                                                                                                                                                                                                                                                               |
| Initial value | <p>Some examples of the initial value are:</p> <pre>#P"/usr/lib/lispworks/" on SPARC Solaris.</pre> <pre>#P"/usr/local/lib/LispWorks/" on Linux (for an installation from the tar archive) x86/x64 Solaris or FreeBSD.</pre> <pre>#P"/usr/lib64/LispWorks/" on Linux (for an RPM installation)</pre> |

#P"C:\Program Files\LispWorks\" or #P"C:\Program Files (x86)\LispWorks\" on Microsoft Windows.  
#P"/Applications/LispWorks 7.1 (32-bit)/Library/"  
or #P"/Applications/LispWorks 7.1 (64-bit)/Library/" on Mac OS X.

Note however that the value can be set when configuring an image or on startup.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The variable <b>*lispworks-directory*</b> holds the name of the directory where various files important for the running of LispWorks are located.</p> <p>When LispWorks starts in a directory which contains an appropriate numbered subdirectory such as <code>lib/7-1-0-0/</code>, then it assumes this is the LispWorks installation directory and sets <b>*lispworks-directory*</b> accordingly. Additionally, LispWorks for Macintosh running on Cocoa looks for such a subdirectory in the <code>Library</code> folder alongside its application bundle, and if found it sets <b>*lispworks-directory*</b> accordingly.</p> <p>On non-Windows platforms, LispWorks then consults the Unix environment variable <code>LISPWORKS_DIRECTORY</code>. If this is set, then <b>*lispworks-directory*</b> is set accordingly.</p> <p>The <code>lib/7-1-0-0/</code> subdirectory of <b>*lispworks-directory*</b> should include these subdirectories:</p> <ul style="list-style-type: none"><li><code>config</code>, which contains the configuration files.</li><li><code>patches</code>, which contains any public (numbered) patches that are distributed by LispWorks Ltd.</li><li><code>private-patches</code>, which is the place to put private (named) patches that are sent to you by Lisp Support.</li><li><code>postscript</code>, which contains configuration files for printing using the CAPI printing library. See “Configuring the printer” on page 189 for more information on printer configuration.</li></ul> |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**examples**, which contains various files of example code.

Other directories are **etc**, **load-on-demand** and **manual**. There is also **app-defaults** for platforms where Motif is supported.

| <b>load-all-patches</b> | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary                 | Loads all patch files into the image.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Package                 | <b>lispworks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Signature               | <b>load-all-patches =&gt; nil</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Arguments               | None.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Values                  | Returns <b>nil</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Description             | <p>Loads into the image all appropriate files from the directory <b>patches</b> in the directory determined by <b>*lispworks-directory*</b>, and then loads the file <b>private-patches/load.lisp</b> where load forms for any private patches may be placed. When the appropriate patches have successfully been loaded, the updated version of the image can be saved using <b>save-image</b>.</p> <p>You should call <b>load-all-patches</b> before starting the Lisp-Works IDE. Thus, you normally place the call to this function in your <b>.lispworks</b> file.</p> <p>The system expects all patches to be loaded sequentially. If a patch is missing, there is a warning message. In this situation, it is advisable to contact Lisp Support to obtain a copy of the missing patch.</p> |

|           | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary   | Load each file of a system into the Lisp image if either the file has not been loaded, or the file has been written since it was last loaded.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Package   | <code>lispworks</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Signature | <code>load-system <i>system-name</i> &amp;key <i>force</i> <i>simulate</i> <i>source-only</i> <i>target-directory</i> =&gt; nil</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Arguments | <p><b><i>system-name</i></b> A symbol representing the name of the system. The system must have been defined using the <code>defsystem</code> macro.</p> <p><b><i>force</i></b> If <code>t</code> then all the files in the system are loaded regardless. (This argument was formerly called <code>force-p</code>. The old name is currently still accepted for compatibility.)</p> <p><b><i>simulate</i></b> If <code>nil</code> or not present then <code>load-system</code> works silently. Otherwise a plan of the actions which <code>load-system</code> intends to carry out is printed. What happens next depends on the value of <code>simulate</code>:</p> <ul style="list-style-type: none"> <li><code>t</code> — do nothing.</li> <li><code>:ask</code> — you are asked, using <code>y-or-n-p</code>, if you want to carry out the plan.</li> <li><code>:each</code> — <code>load-system</code> displays each action in the plan one at a time, and asks you if you want to carry out this particular action. The answer executes the rest of the plan without further prompting, <code>e</code> returns from <code>load-system</code> without further processing, and <code>y</code> and <code>n</code> work as expected.</li> </ul> |

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>source-only</i>      | If t the source files of the system are loaded. This only applies to file types where it makes sense to load a source file.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <i>target-directory</i> | This is the directory to search for the object files. If the object file cannot be found here then the source file from the system's default directory are loaded.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Examples                | <pre>(load-system 'blackboard)  (load-system 'tms :simulate :ask :source-only t)</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Notes                   | <p>For Lisp files <code>load-system</code> loads the object file (if it exists) into the image, unless over-ridden by the <code>:source-only</code> keyword argument. This behavior can be changed so that the newest file (whether source or object) is loaded by setting the variable <code>*load-source-if-newer*</code> to t.</p> <p>C source files, for example <code>foo.c</code>, can be included in a system (see the use of <code>:default-type</code> and <code>:type</code> in <code>defsystem</code>). The corresponding object file name is <code>foon.so</code> on Linux, FreeBSD, AIX and x86/x64 Solaris, <code>foon.dylib</code> on Mac OS X and <code>foon.o</code> on SPARC Solaris, where <i>n</i> is a platform-specific integer. On Windows the object file name is <code>foo.dll</code>.</p> |
| See also                | <code>defsystem</code><br><code>compile-system</code><br><code>concatenate-system</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

## make-unregistered-action-list *Function*

|         |                                    |
|---------|------------------------------------|
| Summary | Makes an unregistered action list. |
| Package | <code>lispworks</code>             |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signature   | <code>make-unregistered-action-list &amp;key documentation sort-time dummy-actions default-order execution-function =&gt;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Arguments   | <p><i>documentation</i> A string.</p> <p><i>sort-time</i> One of <code>:execute</code> or <code>:define-action</code>.</p> <p><i>dummy-actions</i> A list.</p> <p><i>default-order</i> A list.</p> <p><i>execution-function</i>A function.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Description | <p>Return an action-list not registered in the global registry of lists. The keyword arguments are as for <code>define-action-list</code>.</p> <p>The <i>documentation</i> string allows you to provide documentation for the action list.</p> <p><i>sort-time</i> is a keyword specifying when added actions are sorted for the given list — either <code>:execute</code> or <code>:define-action</code> (see <code>*default-action-list-sort-time*</code>).</p> <p><i>dummy-actions</i> is a list of action-names that specify placeholder actions; they cannot be executed and are constrained to the order specified in this list, for example</p> <pre>'(:beginning :middle :end)</pre> <p><i>default-order</i> specifies default ordering constraints for subsequently defined action-items where no explicit ordering constraints are specified. An example is</p> <pre>'(:after :beginning :before :end)</pre> <p><i>execution-function</i> specifies a user-defined function accepting arguments of the form:</p> <pre>(the-action-list other-args-list &amp;rest keyword-value-pairs)</pre> <p>where the two required arguments are the action-list and a list of additional arguments passed to <code>execute-actions</code>, respectively. The remaining arguments are any number of keyword-value pairs that may be specified in the call to</p> |

**execute-actions.** If no execution function is specified, then the default execution function will be used to execute the action-list.

## See also

`define-action-list`  
`*handle-warn-on-redefinition*`

**make-*mt-random-state*** *Function*

Summary      Creates an object of type `mt-random-state`.

Package      `lispworks`

Signature      `make-mt-random-state &optional state => new-state`

Arguments      `state`      `nil`, `t` or an object of type `mt-random-state`. The default is `nil`.

Values      `new-state`      A new object of type `mt-random-state`.

Description      The function `make-mt-random-state` creates a new object of type `mt-random-state` which is suitable for use as the value of `*mt-random-state*`.

If `state` is an object of type `mt-random-state`, then `new-state` is a copy of `state`. If `state` is `nil`, then `new-state` is a copy of the value of `*mt-random-state*`. If `state` is `t` then `new-state` is an object of type `mt-random-state` initialized using a call to `get-universal-time`.

`make-mt-random-state` is analogous to  
`cl:make-random-state`.

## See also

`mt-random`  
`*mt-random-state*`  
`mt-random-state`

| <b>mt-random</b> | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary          | Returns a pseudo-random number using the Mersenne Twister algorithm.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Package          | <code>lispworks</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Signature        | <code>mt-random arg &amp;optional state =&gt; random-number</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Arguments        | <p><code>arg</code> A positive <code>integer</code> or a positive <code>float</code>.</p> <p><code>state</code> An object of type <code>mt-random-state</code>. The default is the value of <code>*mt-random-state*</code>.</p>                                                                                                                                                                                                                                                                                                                                                              |
| Values           | <p><code>random-number</code> A non-negative number less than <code>arg</code> and of the same type as <code>arg</code>.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Description      | <p>The function <code>mt-random</code> returns a pseudo-random number which is non-negative, less than <code>arg</code> and is of the same type as <code>arg</code>.</p> <p><code>random-number</code> is generated using the Mersenne Twister algorithm published by Makoto Matsumoto and Takuji Nishimura at<br/> <code><a href="http://www.math.keio.ac.jp/~matumoto/emt.html">http://www.math.keio.ac.jp/~matumoto/emt.html</a></code>.</p> <p>We thank the authors for making the algorithm freely available.</p> <p><code>mt-random</code> is analogous to <code>cl:random</code>.</p> |
| See also         | <code>make-mt-random-state</code><br><code>*mt-random-state*</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

| <b>*mt-random-state*</b> | <i>Variable</i>                                           |
|--------------------------|-----------------------------------------------------------|
| Summary                  | The default random state used by <code>mt-random</code> . |

|             |                                                                                                                                                                                                                                                                                  |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>lispworks</code>                                                                                                                                                                                                                                                           |
| Description | The variable <code>*mt-random-state*</code> contains an object of type <code>mt-random-state</code> which is the default state used by <code>mt-random</code> if a state is not supplied.<br><br><code>*mt-random-state*</code> is analogous to <code>cl:*random-state*</code> . |
| See also    | <code>make-mt-random-state</code><br><code>mt-random</code><br><code>mt-random-state</code>                                                                                                                                                                                      |

## **mt-random-state** *Type*

|             |                                                                                                                                                                                                                     |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | The type of objects containing state information used by <code>mt-random</code> .                                                                                                                                   |
| Package     | <code>lispworks</code>                                                                                                                                                                                              |
| Description | The Mersenne Twister pseudo-random number generator uses state data contained in a object of type <code>mt-random-state</code> .<br><br><code>mt-random-state</code> is analogous to <code>cl:random-state</code> . |
| See also    | <code>*mt-random-state*</code><br><code>mt-random</code><br><code>mt-random-state-p</code>                                                                                                                          |

## **mt-random-state-p** *Function*

|           |                                                                  |
|-----------|------------------------------------------------------------------|
| Summary   | The predicate for objects of type <code>mt-random-state</code> . |
| Package   | <code>lispworks</code>                                           |
| Signature | <code>mt-random-state-p arg =&gt; result</code>                  |

|             |               |                                                                                                                                                                                                                                                             |
|-------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arguments   | <i>arg</i>    | An object.                                                                                                                                                                                                                                                  |
| Values      | <i>result</i> | A boolean.                                                                                                                                                                                                                                                  |
| Description |               | The function <code>mt-random-state-p</code> returns <code>t</code> if <i>arg</i> is an object of type <code>mt-random-state</code> , and <code>nil</code> otherwise.<br><br><code>mt-random-state-p</code> is analogous to <code>cl:random-state-p</code> . |
| See also    |               | <code>mt-random-state</code>                                                                                                                                                                                                                                |

## pathname-location

*Function*

|             |                                                                                                                                                                                                                                              |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Returns the location of a file.                                                                                                                                                                                                              |
| Signature   | <code>pathname-location pathname =&gt; location</code>                                                                                                                                                                                       |
| Arguments   | <i>pathname</i> A pathname designator.                                                                                                                                                                                                       |
| Values      | <i>location</i> A pathname.                                                                                                                                                                                                                  |
| Description | The function <code>pathname-location</code> returns a pathname <i>location</i> that represents the directory where the file <i>pathname</i> resides. Each of the name, type and version components of <i>location</i> are <code>nil</code> . |

|         |                                                                                                                                                       |
|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| Example | Due to the ANSI Common Lisp definition of the <code>directory</code> function and the fact that LispWorks returns fully specified truenames, the form |
|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------|

```
(directory (truename "/tmp/"))
```

will always signal an error or return the list `(#P"/tmp/")`. To obtain the contents of the `/tmp` directory, use the form

```
(directory (pathname-location (truename "/tmp/")))
```

See also [current-pathname](#)  
[directory](#)

| precompile-regexp |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Function                                                                      |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| Summary           | Precompiles a regular expression object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                               |
| Package           | <code>lispworks</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                               |
| Signature         | <code>precompile-regexp string &amp;key case-sensitive error-function =&gt; pattern, condition-designators</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                               |
| Arguments         | <code>string</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | A string.                                                                     |
|                   | <code>case-sensitive</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | A generalized boolean.                                                        |
|                   | <code>error-function</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <code>nil</code> or a function that takes arguments like <code>error</code> . |
| Values            | <code>pattern</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | A precompiled regular expression object.                                      |
|                   | <code>condition-designators</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | - A list.                                                                     |
| Description       | <p>The function <code>precompile-regexp</code> returns a precompiled regular expression object suitable for passing as <code>pattern</code> to functions like <code>find-regexp-in-string</code>.</p> <p><code>case-sensitive</code> controls whether <code>string</code> is precompiled as a case sensitive or case insensitive search. A non-<code>nil</code> value means a case sensitive pattern. The value <code>nil</code> (the default) means a case insensitive pattern.</p> <p><code>error-function</code> is used when the string is not a legal regular expression. In this case, if <code>error-function</code> is not <code>nil</code>, it is applied to a list of arguments which are designators for a condition like the arguments that <code>error</code> takes. If <code>error-function</code> is <code>nil</code>, <code>precompile-regexp</code> returns <code>nil</code> as the first argument and the list of arguments as a second return value, <code>condition-designators</code>. <code>error-function</code> defaults to <code>error</code>.</p> |                                                                               |

Notes For the regular expression syntax, see `find-regexp-in-string`.

See also `find-regexp-in-string`  
`regexp-find-symbols`  
`count-regexp-occurrences`  
`editor:regular-expression-search`

## **print-actions** *Function*

Summary Prints a listing of the action items on a given action list in order.

Package `lispworks`

Signature `print-actions name-or-list &optional stream`

Arguments `name-or-list` An action list.  
`stream` An output stream.

Description The function `print-actions` prints a listing of the action items on the action-list denoted by `name-or-list`, in order.

If the action-list specified by `name-or-list` does not exist, then this is handled according to the value of `*handle-missing-action-list*`.

The output is written to the stream `stream`. The default value of `stream` is the value of `*standard-output*`.

See also `print-action-lists`

## **print-action-lists** *Function*

Summary Prints a list of all the action lists in the global registry.

|             |                                                                                                                                                                                                                                                                                              |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <b>lispworks</b>                                                                                                                                                                                                                                                                             |
| Signature   | <b>print-action-lists &amp;optional stream</b>                                                                                                                                                                                                                                               |
| Arguments   | <b>stream</b> An output stream.                                                                                                                                                                                                                                                              |
| Description | The function <b>print-action-lists</b> prints a listing of all the action lists in the global registry. The ordering of the action lists is random.<br><br>The output is written to the stream <i>stream</i> . The default value of <i>stream</i> is the value of <b>*standard-output*</b> . |
| See also    | <b>print-actions</b>                                                                                                                                                                                                                                                                         |

### **\*print-command\*** *Variable*

|               |                                                                                                 |
|---------------|-------------------------------------------------------------------------------------------------|
| Summary       | A command used for some printing operations.                                                    |
| Package       | <b>lispworks</b>                                                                                |
| Initial value | " <b>print</b> " on Windows.<br><br>" <b>lpr</b> " on Mac OS X and all Unix-like systems.       |
| Description   | This variable is used as the command sent by LispWorks to the shell in <b>hardcopy-system</b> . |
| See also      | <b>hardcopy-system</b>                                                                          |

### **\*print-nickname\*** *Variable*

|         |                                                            |
|---------|------------------------------------------------------------|
| Summary | Controls the package prefix used when a symbol is printed. |
| Package | <b>lispworks</b>                                           |

|               |                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Initial value | <code>nil</code>                                                                                                                                                                                                                                                                                                                                                                                                                |
| Description   | <p>The variable <code>*print-nickname*</code> controls which package prefix is used when a symbol is printed and the symbol's package needs to be output.</p> <p>If <code>*print-nickname*</code> is true and the package has at least one nickname, then the first of the nicknames (that is, the first nickname in the list returned by <code>package-nicknames</code>) is output. Otherwise, the package name is output.</p> |

| <b>*prompt*</b> |                                                                                                                                 | <i>Variable</i> |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Summary         | Defines the LispWorks listener prompt.                                                                                          |                 |
| Package         | <code>lispworks</code>                                                                                                          |                 |
| Initial value   | <code>"~%~A ~D~ [~:;~:~* : ~D~] &gt; "</code>                                                                                   |                 |
| Description     | <p>The variable <code>*prompt*</code> defines the LispWorks listener prompt. Its value can be a:</p> <p>Function designator</p> |                 |
|                 | <p>A function of zero arguments which should return the prompt as a string.</p>                                                 |                 |
| String          | <p>A format string with processing three arguments: the current package name, the next history number, and the debug level.</p> |                 |
| A form          | <p>The form is passed to <code>eval</code> and should return a format string, which is used as for the string case above.</p>   |                 |

|         |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Example | <pre> CL-USER 1 &gt; (defvar *default-prompt* *prompt*) *DEFAULT-PROMPT*  CL-USER 2 &gt; (progn                 (setf *prompt*                       ' (string-append "~&amp;"                                       (sys:get-user-name)                                       #\Space                                       (subseq *default-                                           prompt* 2)))                 nil) NIL dunya CL-USER 3 &gt; </pre> |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**push-end****push-end-new***Macros*

|              |                                                                                                                                                                                                                                                                                                                                                                       |             |           |              |                                                                                                                                              |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-----------|--------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| Summary      | Append an item to a list stored in a place.                                                                                                                                                                                                                                                                                                                           |             |           |              |                                                                                                                                              |
| Package      | <b>lispworks</b>                                                                                                                                                                                                                                                                                                                                                      |             |           |              |                                                                                                                                              |
| Signature    | <b>push-end item place =&gt; new-place-value</b><br><b>push-end-new item place &amp;key key test test-not =&gt; new-place-value</b>                                                                                                                                                                                                                                   |             |           |              |                                                                                                                                              |
| Arguments    | <table border="0"> <tr> <td style="vertical-align: top; padding-right: 20px;"><i>item</i></td><td>Anything.</td></tr> <tr> <td style="vertical-align: top; padding-right: 20px;"><i>place</i></td><td>A generalized reference form as described in section 5.1.1 <i>Overview of Places and Generalized Reference</i> of the Common Lisp HyperSpec.</td></tr> </table> | <i>item</i> | Anything. | <i>place</i> | A generalized reference form as described in section 5.1.1 <i>Overview of Places and Generalized Reference</i> of the Common Lisp HyperSpec. |
| <i>item</i>  | Anything.                                                                                                                                                                                                                                                                                                                                                             |             |           |              |                                                                                                                                              |
| <i>place</i> | A generalized reference form as described in section 5.1.1 <i>Overview of Places and Generalized Reference</i> of the Common Lisp HyperSpec.                                                                                                                                                                                                                          |             |           |              |                                                                                                                                              |
|              | <i>key, test, test-not</i><br>Function designators.                                                                                                                                                                                                                                                                                                                   |             |           |              |                                                                                                                                              |
| Values       | <i>new-place-value</i> A list which is the new value of <i>place</i> .                                                                                                                                                                                                                                                                                                |             |           |              |                                                                                                                                              |

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description            | <p>The macros <code>push-end</code> and <code>push-end-new</code> are analogs to <code>push</code> and <code>pushnew</code>, except that they append <i>item</i> to the end of the list rather than prepend it.</p> <p><i>place</i> must contain a proper list.</p> <p><code>push-end</code> sets <i>place</i> to a copy of this list with <i>item</i> appended in the end.</p> <p><code>push-end-new</code> does the same as <code>push-end</code>, except when <i>item</i> is already on the list, in which case <code>push-end-new</code> does nothing. The check is done using the values of <i>key</i>, <i>test</i> and <i>test-not</i> in the same way that <code>pushnew</code> does.</p> <p>The return value <i>new-place-value</i> is the value of <i>place</i> after the operation. Except when <i>item</i> is already in the list, it is always a new list.</p> |
| Notes: Multi-threading | <p><code>push-end</code> and <code>push-end-new</code> are not atomic.</p> <p>If <i>place</i> is globally accessible and may be read by another thread without synchronization (by a <code>lock</code> or other synchronization mechanism), then you need to wrap <i>place</i> by <code>globally-accessible</code>, for example:</p> <pre>(push-end my-item           (sys:globally-accessible            *a-global-symbol*))</pre> <p>See “Making an object's contents accessible to other threads” on page 268 for a discussion.</p> <p><code>push</code> and <code>pushnew</code> also have the same issues with Multi-threading.</p>                                                                                                                                                                                                                                   |

## quit

## *Function*

|         |                        |
|---------|------------------------|
| Summary | Quits LispWorks.       |
| Package | <code>lispworks</code> |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                        |  |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|--|
| Signature   | <code>quit &amp;key status confirm ignore-errors-p return</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                        |  |
| Arguments   | <code>status</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | An integer.            |  |
|             | <code>confirm</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | A generalized boolean. |  |
|             | <code>ignore-errors-p</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | A generalized boolean. |  |
|             | <code>return</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | A generalized boolean. |  |
| Values      | <code>quit</code> does not return, or returns <code>t</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                        |  |
| Description | <p>The function <code>quit</code> exits LispWorks unless the user cancels the operation.</p> <p>There are two stages which may allow the user the chance to cancel.</p> <ol style="list-style-type: none"> <li>1. First the action items of the action list "<code>Confirm when quitting image</code>" are run. If any action item returns <code>nil</code>, then LispWorks does not exit.</li> <li>2. Otherwise, if <code>confirm</code> is true (the default value is <code>nil</code>) then a question like<br/> <code>"Do you really want to exit LispWorks?"</code> is presented to the user. If the answer No is supplied, then LispWorks does not exit. Otherwise, the action items of the action list "<code>When quitting image</code>" are run, and then LispWorks exits, and the value <code>status</code> is returned to the Operating System as the exit value of the LispWorks process. The default value of <code>status</code> is 0.</li> </ol> <p>If <code>ignore-errors-p</code> is true, then any error signaled during the running of the action list items or the confirm prompt is ignored and <code>quit</code> proceeds to exit the image. If <code>ignore-errors-p</code> is <code>nil</code> and an error is signaled during the running of the action list items, then a restart is available allowing the user to choose to continue to exit the image. The default values of <code>ignore-errors-p</code> is <code>nil</code>.</p> <p>If <code>return</code> is true and LispWorks is going to exit, then <code>quit</code> returns <code>t</code>. This can be used if you want some other Lisp pro-</p> |                        |  |

cess to kill the current one later, rather than it self-destructing immediately. This can be useful to allow more precise control over process termination. If *return* is `nil` then `quit` does not return. The default value of *return* is `nil`.

|          |                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | On Cocoa, when you define your own application menu (by passing <code>:application-menu</code> when making the application interface), the <code>Quit</code> menu item needs to call <code>capi:destroy</code> on the application interface, rather than <code>quit</code> . See <code>capi:cocoa-default-application-interface</code> in the <i>CAPI User Guide and Reference Manual</i> for more information. |
| See also | <code>save-image</code>                                                                                                                                                                                                                                                                                                                                                                                         |

## rebinding *Macro*

|             |                                                                                                                                                                                                                                                                                                      |      |                              |      |                                                           |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------------------------------|------|-----------------------------------------------------------|
| Summary     | Ensures unique names for all the variables in a groups of forms.                                                                                                                                                                                                                                     |      |                              |      |                                                           |
| Package     | <code>lispworks</code>                                                                                                                                                                                                                                                                               |      |                              |      |                                                           |
| Signature   | <code>rebinding (&amp;rest vars) &amp;body body =&gt; form</code>                                                                                                                                                                                                                                    |      |                              |      |                                                           |
| Arguments   | <table><tr><td>vars</td><td>The variables to be rebound.</td></tr><tr><td>body</td><td>A body of forms, the variables in which should be unique.</td></tr></table>                                                                                                                                   | vars | The variables to be rebound. | body | A body of forms, the variables in which should be unique. |
| vars        | The variables to be rebound.                                                                                                                                                                                                                                                                         |      |                              |      |                                                           |
| body        | A body of forms, the variables in which should be unique.                                                                                                                                                                                                                                            |      |                              |      |                                                           |
| Values      | Returns the body wrapped in a form that creates unique names for each variable.                                                                                                                                                                                                                      |      |                              |      |                                                           |
| Description | Returns the <i>body</i> wrapped in a form which creates a unique name for each of the variables (compare with <code>gensym</code> ) and binds these names to the values of the variables. This ensures that the body can refer to the variables without name clashes with other variables elsewhere. |      |                              |      |                                                           |

Example      After defining

```
(defmacro lister (x y)
  (rebinding (x y)
    '(list ,x ,y)))
```

the form `(lister i j)` macroexpands to

```
(LET* ((#:X-77 I)
       (#:Y-78 J))
      (LIST #:X-77 #:Y-78))
```

See also      [with-unique-names](#)

## **regexp-find-symbols** *Function*

Summary      Returns a list of symbols that match a supplied regular expression.

Package      **lispworks**

Signature      **regexp-find-symbols** *regexp-string* &key *case-sensitive* *packages*  
*test external-only => symbols*

Arguments      *regexp-string*      A string.

*case-sensitive*      A boolean.

*packages*      A list of package designators, a single package designator, or the keyword :all.

*test*      A function of one argument returning a boolean result.

*external-only*      A generalized boolean.

Values      *symbols*      A list of symbols.

Description      The function **regexp-find-symbols** returns a list of symbols that match the regular expression in *regexp-string*.

*case-sensitive* determines whether the match is case sensitive. The default value of *case-sensitive* is `nil`.

*packages* specifies in which packages to search. The default value of *packages* is `:all`, meaning search in all packages.

*test*, if supplied, must be a function of one argument, which returns `t` if the argument should be returned, and `nil` otherwise. The function *test* is applied to each symbol that matches *regexp-string*, and if it returns `nil` the symbol is not included in the returned value *symbols*. If *test* is `nil` all matches are returned. The default value of *test* is `nil`.

*external-only*, if true, specifies that only external symbols should be checked, which makes the search much faster. The default value of *external-only* is `nil`.

The regular expression syntax used by `regexp-find-symbols` is similar to that used by Emacs, as described in the "Regular expression syntax" section of the *LispWorks Editor User Guide*.

Examples To find all exported symbols that start with DEF:

```
(lw:regexp-find-symbols "^def" :external-only t)
```

To find all symbols that contain lower case "slider":

```
(regexp-find-symbols "slider" :case-sensitive t)
```

See also `apropos`  
`find-regexp-in-string`

## remove-advice

## *Function*

Summary Remove a piece of advice.

Package `lispworks`

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signature   | <code>remove-advice function-dspec name =&gt; nil</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Arguments   | <p><code>function-dspec</code> A function-dspec Specifies the function definition to which the piece of advice belongs. See “Function dspecs” on page 84 for description of function-dspec.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|             | <p><code>name</code> A symbol naming the piece of advice to be removed. Since several pieces of advice may be attached to a single functional definition, the name is necessary to indicate which one is to be removed.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Values      | <code>remove-advice</code> returns <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Description | <p><code>remove-advice</code> is the function used to remove a piece of advice. Advice is a way of altering the behavior of functions. Pieces of advice are associated with a function using <code>defadvice</code>. They define additional actions to be performed when the function is invoked, or alternative code to be performed instead of the function, which may or may not access the original definition. As well as being attached to ordinary functions, advice may be attached to methods and to macros (in this case it is in fact associated with the macro’s expansion function).</p> <p><code>hcl:delete-advice</code> is a macro, identical in effect to <code>remove-advice</code>, except that you do not need to quote the arguments.</p> |
| Notes       | <code>remove-advice</code> is an extension to Common Lisp.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| See also    | <code>defadvice</code><br><code>delete-advice</code><br>Chapter 6, “The Advice Facility”                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

|             |                                                                                                                                                                                                                                                                                            |              |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
|             |                                                                                                                                                                                                                                                                                            | <i>Macro</i> |
| Summary     | Removes an item from a sequence.                                                                                                                                                                                                                                                           |              |
| Package     | <code>lispworks</code>                                                                                                                                                                                                                                                                     |              |
| Signature   | <code>removef place item &amp;key test test-not start end key =&gt; result</code>                                                                                                                                                                                                          |              |
| Arguments   | <p><i>place</i>      A place.</p> <p><i>item</i>      An object.</p> <p><i>test</i>      A test function.</p> <p><i>test-not</i>    A test function.</p> <p><i>start</i>     An integer.</p> <p><i>end</i>      An integer or <code>nil</code>.</p> <p><i>key</i>      A key function.</p> |              |
| Values      | <i>result</i> A sequence.                                                                                                                                                                                                                                                                  |              |
| Description | The modifying macro <code>removef</code> removes an item from a sequence using <code>remove</code> . See <code>remove</code> for more details.                                                                                                                                             |              |
| See also    | <code>appendf</code>                                                                                                                                                                                                                                                                       |              |

|               |                                                                                                                                                                     |                 |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
|               |                                                                                                                                                                     | <i>Variable</i> |
| Summary       | Controls the output of <code>require</code> .                                                                                                                       |                 |
| Package       | <code>lispworks</code>                                                                                                                                              |                 |
| Initial value | <code>t</code>                                                                                                                                                      |                 |
| Description   | The variable <code>*require-verbose*</code> is a generalized boolean controlling whether <code>require</code> prints the names of the files which are being loaded. |                 |

| <b>rotate-byte</b> | <i>Function</i>                                                                                                                                                                                                                                               |              |             |                 |                   |                |             |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------|-----------------|-------------------|----------------|-------------|
| Summary            | Rotates specified bits within an integer.                                                                                                                                                                                                                     |              |             |                 |                   |                |             |
| Package            | <code>lispworks</code>                                                                                                                                                                                                                                        |              |             |                 |                   |                |             |
| Signature          | <code>rotate-byte count byte-spec integer =&gt; result-integer</code>                                                                                                                                                                                         |              |             |                 |                   |                |             |
| Arguments          | <table> <tr> <td><i>count</i></td> <td>An integer.</td> </tr> <tr> <td><i>bytespec</i></td> <td>A byte specifier.</td> </tr> <tr> <td><i>integer</i></td> <td>An integer.</td> </tr> </table>                                                                 | <i>count</i> | An integer. | <i>bytespec</i> | A byte specifier. | <i>integer</i> | An integer. |
| <i>count</i>       | An integer.                                                                                                                                                                                                                                                   |              |             |                 |                   |                |             |
| <i>bytespec</i>    | A byte specifier.                                                                                                                                                                                                                                             |              |             |                 |                   |                |             |
| <i>integer</i>     | An integer.                                                                                                                                                                                                                                                   |              |             |                 |                   |                |             |
| Values             | <i>result-integer</i> An integer.                                                                                                                                                                                                                             |              |             |                 |                   |                |             |
| Description        | The function <code>rotate-byte</code> returns <i>integer</i> with the bits specified by <i>bytespec</i> rotated left by <i>count</i> bits. Other bits remain the same as in <i>integer</i> . If <i>count</i> is negative, then the effect is to rotate right. |              |             |                 |                   |                |             |
| See also           | <a href="http://www.cliki.net/rotate-byte">http://www.cliki.net/rotate-byte</a>                                                                                                                                                                               |              |             |                 |                   |                |             |
| Examples           | <pre>(rotate-byte 2 (byte 3 1) 99) =&gt; 105 (rotate-byte -2 (byte 3 1) 99) =&gt; 101</pre>                                                                                                                                                                   |              |             |                 |                   |                |             |

| <b>round-to-single-precision</b> | <i>Function</i>                                                                                                      |              |         |
|----------------------------------|----------------------------------------------------------------------------------------------------------------------|--------------|---------|
| Summary                          | Rounds the given float to single-precision format (32 bits) and returns it as a <code>double-float</code> (64 bits). |              |         |
| Package                          | <code>lispworks</code>                                                                                               |              |         |
| Signature                        | <code>round-to-single-precision float =&gt; double-float</code>                                                      |              |         |
| Arguments                        | <table> <tr> <td><i>float</i></td> <td>A float</td> </tr> </table>                                                   | <i>float</i> | A float |
| <i>float</i>                     | A float                                                                                                              |              |         |

|                     |                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Values              | <i>double-float</i>                                                                                                                                                                                                                                  | A <b>double-float</b> with <b>single-float</b> precision.                                                                                                                                                                                                                                                                                                               |
| Description         | The argument is rounded to single-precision format (32 bits) and returned as a <b>double-float</b> (64 bits). This function allows you to model the rounding behavior of a machine or implementation that performs 32-bit floating point arithmetic. | LispWorks supports multiple floating point formats: <b>short-float</b> (only on 32-bit LispWorks), <b>single-float</b> and <b>double-float</b> . If this function is called with a <b>single-float</b> or a <b>short-float</b> , it returns the equivalent <b>double-float</b> , that is, it is the same as evaluating<br><br><code>(coerce float 'double-float)</code> |
| Compatibility notes | LispWorks 4.4 and previous on Windows and Linux platforms supports just one floating point format. In LispWorks 5.0 and later, at least two floating point formats are supported on all platforms.                                                   |                                                                                                                                                                                                                                                                                                                                                                         |
| Example             | <br><code>CL-USER 197 &gt; pi</code><br><code>3.141592653589793D0</code><br><br><code>CL-USER 198 &gt; round-to-single-precision pi</code><br><code>3.1415927410125732D0</code>                                                                      |                                                                                                                                                                                                                                                                                                                                                                         |

|           |                                              | <i>Function</i>               |
|-----------|----------------------------------------------|-------------------------------|
| Summary   | The accessor for simple base strings.        |                               |
| Package   | <code>lispworks</code>                       |                               |
| Signature | <code>sbchar string index =&gt; value</code> |                               |
| Arguments | <i>string</i>                                | A <b>simple-base-string</b> . |
|           | <i>index</i>                                 | An index.                     |

|             |                                                                       |                                                  |
|-------------|-----------------------------------------------------------------------|--------------------------------------------------|
| Values      | <i>value</i>                                                          | The character in <i>string</i> at <i>index</i> . |
| Description | This is the accessor for simple base strings. <b>setf</b> is allowed. |                                                  |
| See also    | <b>simple-base-string</b>                                             |                                                  |

## **sequencep** *Function*

|             |                                                                                                             |                        |
|-------------|-------------------------------------------------------------------------------------------------------------|------------------------|
| Summary     | A predicate to check for sequences.                                                                         |                        |
| Package     | <b>lispworks</b>                                                                                            |                        |
| Signature   | <b>sequencep</b> <i>object</i> => <i>result</i>                                                             |                        |
| Arguments   | <i>object</i>                                                                                               | A Lisp object.         |
| Values      | <i>result</i>                                                                                               | A generalized boolean. |
| Description | The function <b>sequencep</b> returns true if <i>object</i> is of type <b>sequence</b> and false otherwise. |                        |
| Examples    | <pre>(sequencep '(1 2 3)) =&gt; t (sequencep #(1 2 3)) =&gt; t (sequencep 123) =&gt; nil</pre>              |                        |

## **set-default-character-element-type** *Function*

|           |                                                                               |  |
|-----------|-------------------------------------------------------------------------------|--|
| Summary   | Configures the value of <b>lw:*default-character-element-type*</b> .          |  |
| Package   | <b>lispworks</b>                                                              |  |
| Signature | <b>set-default-character-element-type</b> <i>type</i> => <i>type-defaults</i> |  |

|                     |                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arguments           | <code>type</code>          | A character type. This can take any of the values <code>cl:base-char</code> , <code>bmp-char</code> and <code>cl:character</code> . For backwards compatibility, <code>simple-char</code> is also allowed, and is treated as if <code>cl:character</code> was passed.                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Values              | <code>type-defaults</code> | The new value of <code>lw:*default-character-element-type*</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Description         |                            | <p>The function <code>set-default-character-element-type</code> sets the value of <code>lw:*default-character-element-type*</code>, ensuring that the system's internal state is also updated accordingly.</p> <p>If you are running an existing 8-bit application you will only need to have this in your site or user configuration file:</p> <pre>(lw:set-default-character-element-type 'base-char)</pre> <p>It would be a mistake to call this function in a loadable package and it is not intended to be called while running code. In particular, it is global, not thread-specific.</p> <p>Hence we consider <code>lw:*default-character-element-type*</code> a parameter.</p> |
| Compatibility note: |                            | <code>simple-char</code> is deprecated. Its meaning has changed between LispWorks 6 and 7.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| See also            |                            | <code>string</code><br><code>simple-string</code><br><code>make-string</code><br><code>open</code><br><code>*default-character-element-type*</code><br><code>with-output-to-string</code><br>“Unicode support” on page 435<br>“Controlling string construction” on page 442                                                                                                                                                                                                                                                                                                                                                                                                             |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <i>Function</i>                                                      |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| Summary     | Overrides the <code>:quit-when-no-windows</code> keyword argument to <code>deliver</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                      |
| Signature   | <code>set-quit-when-no-windows on</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                      |
| Arguments   | <code>on</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <code>nil</code> , <code>t</code> or the keyword <code>:check</code> |
| Description | <p>The function <code>set-quit-when-no-windows</code> can be used at run time in a delivered application to override the value of the <code>:quit-when-no-windows</code> keyword to <code>deliver</code>. This can be useful if the application runs in various modes, some with windows and some without. It has no effect in a non-delivered application.</p> <p>If <code>on</code> is <code>nil</code>, then the application will not quit merely because there are no remaining open windows.</p> <p>If <code>on</code> is <code>t</code>, then the application will quit when there are no remaining open windows after the application has opened at least one CAPI window.</p> <p>If <code>on</code> is <code>:check</code>, then the application will quit immediately if there are no open windows at the current time. Unlike with <code>:quit-when-no-windows t</code>, this occurs even if the application has not opened any CAPI windows so far. If there are open windows currently, then it turns on quitting like when <code>on</code> is <code>t</code>.</p> |                                                                      |
| See also    | <p><code>:quit-when-no-windows</code> in the <i>LispWorks Delivery User Guide</i></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                      |

|         |                                                                    | <i>Type</i> |
|---------|--------------------------------------------------------------------|-------------|
| Summary | The simple character type. <code>simple-char</code> is deprecated. |             |
| Package | <code>lispworks</code>                                             |             |

|             |                                                                                                                                                                                                                              |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signature   | <code>simple-char</code>                                                                                                                                                                                                     |
| Description | <p>The type of simple characters (standard term for chars with null implementation-defined attributes, that is, no bits).</p> <p><code>simple-char</code> is a synonym for <code>cl:character</code>, and is deprecated.</p> |
| Notes       | 16-bit characters and 16-bit strings are implemented by the types <code>bmp-char</code> and <code>bmp-string</code> and <code>simple-bmp-string</code> .                                                                     |

## **simple-char-p** *Function*

|             |                                                                                                                                                                                                                   |                          |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| Summary     | The predicate for simple characters. <code>simple-char-p</code> is deprecated.                                                                                                                                    |                          |
| Package     | <code>lispworks</code>                                                                                                                                                                                            |                          |
| Signature   | <code>simple-char-p object =&gt; result</code>                                                                                                                                                                    |                          |
| Arguments   | <code>object</code>                                                                                                                                                                                               | The object to be tested. |
| Values      | <code>result</code>                                                                                                                                                                                               | A boolean.               |
| Description | <p>The function <code>simple-char-p</code> is the predicate for simple characters.</p> <p><code>result</code> is <code>t</code> if <code>object</code> is a simple character, and <code>nil</code> otherwise.</p> |                          |
| See also    | <code>simple-char</code>                                                                                                                                                                                          |                          |

## **split-sequence** *Function*

|         |                                                                                      |
|---------|--------------------------------------------------------------------------------------|
| Summary | Returns a list of subsequences of a sequence, split at specified separator elements. |
|---------|--------------------------------------------------------------------------------------|

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                  |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|
| Package     | <b>lispworks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                  |
| Signature   | <b>split-sequence separator-bag sequence &amp;key start end test key coalesce-separators =&gt; sequences</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                  |
| Arguments   | <i>separator-bag</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | A sequence.                                      |
|             | <i>sequence</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | A sequence.                                      |
|             | <i>start, end</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Bounding index designators for <i>sequence</i> . |
|             | <i>test</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | A function designator.                           |
|             | <i>key</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | A function designator or <code>nil</code> .      |
|             | <i>coalesce-separators</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | A generalized boolean.                           |
| Values      | <i>sequences</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | A list of sequences.                             |
| Description | <p>The function <b>split-sequence</b> returns a list of subsequences of <i>sequence</i> (between <i>start</i> and <i>end</i>), split when an element in the sequence <i>separator-bag</i> is found. The structure of <i>sequence</i> is not changed and the elements matching <i>separator-bag</i> are not included in the resulting sequences.</p> <p>The function <i>test</i>, which defaults to <code>eq1</code>, is used to compare the elements of <i>sequence</i> and the elements of <i>separator-bag</i>.</p> <p>If true, the function <i>key</i>, is applied to the elements of <i>sequence</i> before <i>test</i> is called.</p> <p>If <i>coalesce-separators</i> is true, then empty sequences are removed.</p> |                                                  |
| See also    | <b>split-sequence-if</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                  |

|         | <b>split-sequence-if</b>                                                                            | <i>Function</i> |
|---------|-----------------------------------------------------------------------------------------------------|-----------------|
| Summary | Returns a list of subsequences of a sequence, split at elements for which a predicate returns true. |                 |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                  |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|
| Package     | <code>lispworks</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                  |
| Signature   | <code>split-sequence-if predicate sequence &amp;key start end key</code><br><code>coalesce-separators =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                  |
| Arguments   | <i>predicate</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | A function designator.                           |
|             | <i>sequence</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | A sequence.                                      |
|             | <i>start, end</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Bounding index designators for <i>sequence</i> . |
|             | <i>key</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | A function designator or <code>nil</code> .      |
|             | <i>coalesce-separators</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | A generalized boolean.                           |
| Values      | <i>result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A list of sequences.                             |
| Description | <p>The function <code>split-sequence-if</code> returns a list of subsequences of <i>sequence</i> (between <i>start</i> and <i>end</i>), split by where the function <i>predicate</i> returns true for an element. The structure of <i>sequence</i> is not changed and the elements identified by the predicate are not included in the resulting sequences.</p> <p>If non-nil, the function <i>key</i> is applied to the elements of <i>sequence</i> before <i>predicate</i> is called.</p> <p>If <i>coalesce-separators</i> is true, then empty sequences are omitted from <i>result</i>.</p> |                                                  |
| See also    | <code>split-sequence</code><br><code>split-sequence-if-not</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                  |

## **split-sequence-if-not** *Function*

|         |                                                                                                      |
|---------|------------------------------------------------------------------------------------------------------|
| Summary | Returns a list of subsequences of a sequence, split at elements for which a predicate returns false. |
| Package | <code>lispworks</code>                                                                               |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                  |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|
| Signature   | <code>split-sequence-if-not <i>predicate sequence &amp;key start end key coalesce-separators =&gt; sequences</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                  |
| Arguments   | <i>predicate</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | A function designator.                           |
|             | <i>sequence</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | A sequence.                                      |
|             | <i>start, end</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Bounding index designators for <i>sequence</i> . |
|             | <i>key</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | A function designator or <code>nil</code> .      |
|             | <i>coalesce-separators</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | A generalized boolean.                           |
| Values      | <i>result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | A list of sequences.                             |
| Description | <p>The function <code>split-sequence-if-not</code> returns a list of sub-sequences of <i>sequence</i> (between start and end), split by where the function <i>predicate</i> returns false for an element. The structure of <i>sequence</i> is not changed and the elements identified by the predicate are not included in the resulting sequences.</p> <p>If non-nil, the function <i>key</i> is applied to the elements of <i>sequence</i> before <i>predicate</i> is called.</p> <p>If <i>coalesce-separators</i> is true, then empty sequences are omitted from <i>result</i>.</p> |                                                  |
| See also    | <a href="#"><code>split-sequence</code></a><br><a href="#"><code>split-sequence-if</code></a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                  |

|                           |                                                            | <i>Function</i> |
|---------------------------|------------------------------------------------------------|-----------------|
| <b>start-tty-listener</b> |                                                            |                 |
| Summary                   | Starts a listener in the startup shell.                    |                 |
| Package                   | <code>lispworks</code>                                     |                 |
| Signature                 | <code>start-tty-listener <i>force =&gt; process</i></code> |                 |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                           |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| Arguments   | <i>force</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | A generalized boolean.                    |
| Values      | <i>process</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | A listener process, or <code>nil</code> . |
| Description | <p>The function <code>start-tty-listener</code> returns a process that runs a listener read-eval-print loop connected to <code>*terminal-io*</code>. If <i>force</i> is <code>nil</code>, then <code>start-tty-listener</code> checks whether the default listener process is alive or if there is a live process with name "TTY Listener". If such a process exists, <code>start-tty-listener</code> simply returns <code>nil</code> and does not start a new process. If no such process exists, or if <i>force</i> was <code>t</code>, then <code>start-tty-listener</code> starts a new listener process named "TTY Listener", and returns it.</p> <p>If a REPL with I/O through <code>*terminal-io*</code> (such as a REPL started by <code>start-tty-listener</code>) is in the debugger, then by default it blocks multiprocessing. This behavior is controlled by the value of <code>*terminal-debugger-block-multiprocessing*</code>.</p> |                                           |
| See also    | <code>*terminal-debugger-block-multiprocessing*</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                           |

| <b>stchar</b> |                                              | <i>Function</i>                                  |
|---------------|----------------------------------------------|--------------------------------------------------|
| Summary       | The accessor for simple text strings.        |                                                  |
| Package       | <code>lispworks</code>                       |                                                  |
| Signature     | <code>stchar string index =&gt; value</code> |                                                  |
| Arguments     | <i>string</i>                                | A <code>simple-text-string</code> .              |
|               | <i>index</i>                                 | An index.                                        |
| Values        | <i>value</i>                                 | The character in <i>string</i> at <i>index</i> . |

Description This is the accessor for simple text strings. `setf` is allowed.

See also `simple-text-string`

## **string-append** *Function*

Summary Constructs a single string from a number of strings.

Package `lispworks`

Signature `string-append &rest strings => string`

Arguments `strings` Any number of string designators.

Values `string` A string.

Description The function `string-append` takes any number of string designators and constructs a single string from them.

Each of the elements of the `strings` argument is first coerced into a string using the `string` function if it is not already a string.

`string` is a string of the "widest" type amongst `strings`. That is, the constructed string is of the same type as the argument with the largest element type.

Example      `(readtable-case *readtable*)`

`=>`  
`:UPCASE`

`(string-append "foo" 'bar)`  
`=>`  
`"fooBAR"`

`(type-of`  
  `(string-append`  
    `(coerce "A" 'simple-base-string)`  
    `(coerce "A" 'simple-text-string)`  
  `))`  
`=>`  
`SIMPLE-TEXT-STRING`

See also     `string-append*`

## **string-append\***

*Function*

Summary     Constructs a single string from a list of strings.

Package     `lispworks`

Signature    `string-append* strings => string`

Arguments    `strings`       A list of string designators.

Values       `string`       A string.

Description    The function `string-append*` takes a list of string designators and constructs a single string from them.

Each of the elements of the `strings` argument is first coerced into a string using the function `string` if it is not already a string.

`string` is a string of the "widest" type amongst `strings`. That is, the constructed string is of the same type as the string with

the largest element type amongst those supplied in the argument.

|          |                                                                                                                                                                                                                                                            |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Example  | <pre>(readtable-case *readtable*) =&gt; :UPCASE  (string-append* '("foo" bar)) =&gt; "fooBAR"  (type-of   (string-append*     (list (coerce "A" 'simple-base-string)           (coerce "A" 'simple-text-string)         ))) =&gt; SIMPLE-TEXT-STRING</pre> |
| See also | <code>string-append</code>                                                                                                                                                                                                                                 |

## **structurep** *Function*

|             |                                                                                                                                  |
|-------------|----------------------------------------------------------------------------------------------------------------------------------|
| Summary     | A predicate to check for structure objects.                                                                                      |
| Package     | <code>lispworks</code>                                                                                                           |
| Signature   | <code>structurep object =&gt; result</code>                                                                                      |
| Arguments   | <code>object</code> A Lisp object.                                                                                               |
| Values      | <code>result</code> A generalized boolean.                                                                                       |
| Description | The function <code>structurep</code> returns true if <i>object</i> is of type <code>structure-object</code> and false otherwise. |
| Examples    | <code>(structurep #(1 2 3)) =&gt; nil</code><br>Given the definition:<br>                                                        |

```
(defstruct my-struct a)
```

then

```
(structurep (make-my-struct)) => t
```

but metaclasses are not structures so:

```
(structurep (find-class 'my-struct)) => nil
```

## **text-string**

### **simple-text-string**

*Types*

Summary      The text string types.

Package      **lispworks**

Signature      **text-string length**

**simple-text-string length**

Arguments      *length*      The length of the string (or \*, meaning any).

Description      **text-string** is the type of strings that can hold any character, that is, `(vector cl:character length)`. This is the string type that is guaranteed to always hold any character used in writing text (program text or natural language).

**simple-text-string** is the simple version of **text-string**, that is, the string itself is simple. Equivalent to:

```
(simple-vector cl:character length)
```

Notes      **text-string** uses 32 bits per character. Applications that use many strings and are very large, when they know they do not use the full Unicode range, can consider using **base-string** (up to 8 bits) or **bmp-string** (up to 16 bits) to reduce memory usage.

|                    |                                                                                                                               |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------|
| Compatibility note | In LispWorks 6.1 and earlier versions, <code>text-string</code> uses 16 bits per character.                                   |
| See also           | <code>bmp-string</code><br><code>base-string</code><br><code>text-string-p</code><br>“Character and String types” on page 436 |

**text-string-p****simple-text-string-p***Functions*

|             |                                                                                                                                                                                                                                                                                                                                         |                |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| Summary     | The predicates for text strings.                                                                                                                                                                                                                                                                                                        |                |
| Package     | <code>lispworks</code>                                                                                                                                                                                                                                                                                                                  |                |
| Signature   | <code>text-string-p object =&gt; result</code><br><code>simple-text-string-p object =&gt; result</code>                                                                                                                                                                                                                                 |                |
| Arguments   | <code>object</code>                                                                                                                                                                                                                                                                                                                     | A Lisp object. |
| Values      | <code>result</code>                                                                                                                                                                                                                                                                                                                     | A boolean.     |
| Description | <p>The functions <code>text-string-p</code> and <code>simple-text-string-p</code> are the predicates for text strings and simple text strings respectively.</p> <p><code>result</code> is <code>t</code> if <code>object</code> is a <code>text-string</code> (or <code>simple-text-string</code>), and <code>nil</code> otherwise.</p> |                |
| See also    | <code>text-string</code><br><code>simple-text-string</code>                                                                                                                                                                                                                                                                             |                |

**true***Function*

|         |                                                    |
|---------|----------------------------------------------------|
| Summary | Ignores its arguments and returns <code>t</code> . |
|---------|----------------------------------------------------|

|             |                                                                                                                              |
|-------------|------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>lispworks</code>                                                                                                       |
| Signature   | <code>true &amp;rest ignore =&gt; t</code>                                                                                   |
| Arguments   | <code>ignore</code> All arguments are ignored.                                                                               |
| Values      | <code>t</code>                                                                                                               |
| Description | The function <code>true</code> ignores all its arguments and returns <code>t</code> . It is useful as a functional argument. |
| See also    | <code>do-nothing</code><br><code>false</code>                                                                                |

## **undefine-action** *Macro*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Removes an action from a specified list.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Package     | <code>lispworks</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Signature   | <code>undefine-action name-or-list action-name =&gt;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Arguments   | <code>name-or-list</code> A list or action list object.<br><code>action-name</code> A general lisp object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Description | <p>The macro <code>undefine-action</code> removes the action specified by <code>action-name</code> from the action list specified by <code>name-or-list</code>. If the action specified by <code>action-name</code> does not exist, then this is handled according to the value of <code>*handle-missing-action-in-action-list*</code>.</p> <p><code>name-or-list</code> is evaluated to give either a list UID (to be looked up in the global registry of lists) or an action list object. <code>action-name</code> is a UID (general lisp object, to be compared by <code>equalp</code>). It uniquely identifies this action within its list (as opposed to among all lists).</p> |

See also      **define-action**

## **undefine-action-list** *Macro*

Summary      Removes a given defined action list.

Package      **lispworks**

Signature      **undefine-action-list *uid* =>**

Arguments      ***uid***                  A lisp object.

Values      None.

Description      The macro **undefine-action-list** flushes the specified list (and all its action-items). If the action-list specified by ***uid*** does not exist, then handling is controlled by the value of the variable **\*handle-missing-action-list\***.

See also      **define-action-list**

## **unicode-alpha-char-p** *Function*

Summary      Returns a value like **c1:alpha-char-p**, but using specified Unicode rules.

Package      **lispworks**

Signature      **unicode-alpha-char-p *char* &key *style* => *flag***

Arguments      ***char***                  A character

***style***                  A keyword

Values      ***flag***                  A generalized boolean

|             |                                                                                                                                                                                                                                                                                  |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | The function <code>unicode-alpha-char-p</code> returns <i>flag</i> as true if <i>char</i> is an alphabetic character according to the Unicode rules specified by <i>style</i> .<br><br>The current implementation only supports one style:<br><br><code>:general-category</code> |
| See also    | <code>unicode-alphanumeric-p</code><br><code>unicode-both-case-p</code>                                                                                                                                                                                                          |

|              | <i>Function</i>                                                                                                                                                                                                                                                        |             |             |              |           |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------------|--------------|-----------|
| Summary      | Returns a value like <code>cl:alphanumericp</code> , but using specified Unicode rules.                                                                                                                                                                                |             |             |              |           |
| Package      | <code>lispworks</code>                                                                                                                                                                                                                                                 |             |             |              |           |
| Signature    | <code>unicode-alphanumericp <i>char</i> &amp;key <i>style</i> =&gt; <i>flag</i></code>                                                                                                                                                                                 |             |             |              |           |
| Arguments    | <table> <tr> <td><i>char</i></td> <td>A character</td> </tr> <tr> <td><i>style</i></td> <td>A keyword</td> </tr> </table>                                                                                                                                              | <i>char</i> | A character | <i>style</i> | A keyword |
| <i>char</i>  | A character                                                                                                                                                                                                                                                            |             |             |              |           |
| <i>style</i> | A keyword                                                                                                                                                                                                                                                              |             |             |              |           |
| Values       | <i>flag</i> A generalized boolean                                                                                                                                                                                                                                      |             |             |              |           |
| Description  | The function <code>unicode-alphanumericp</code> returns <i>flag</i> as true if <i>char</i> is alphanumeric according to the Unicode rules specified by <i>style</i> .<br><br>The current implementation only supports one style:<br><br><code>:general-category</code> |             |             |              |           |
|              | Use the "general category" for <i>char</i> in Unicode 6.3.0.                                                                                                                                                                                                           |             |             |              |           |

See also      **unicode-alpha-char-p**  
**unicode-both-case-p**

## **unicode-both-case-p** *Function*

Summary      Returns a value like `c1:both-case-p`, but using specified Unicode rules.

Package      **lispworks**

Signature      **unicode-both-case-p** *char* &**key** *style* => *flag*

Arguments      *char*      A character

*style*      A keyword

Values      *flag*      A generalized boolean

Description      The function `unicode-both-case-p` returns *flag* as true if *char* has case according to the Unicode rules specified by *style*.

The current implementation only supports one style:

**:general-category**

Use the "general category" for *char* in Unicode 6.3.0.

Notes      The name of `unicode-both-case-p` is slightly confusing, because it matches the ANSI Common Lisp definition "a character with case" whereas there is no guarantee that both cases actually exist. Note also that there are some "alpha" chars which are not lower or upper case.

See also      **unicode-alpha-char-p**  
**unicode-lower-case-p**  
**unicode-upper-case-p**

## **unicode-char-equal**

## **unicode-char-not-equal**

## *Functions*

Summary      Compares two characters, ignoring case using specified Unicode rules.

Package      **lispworks**

Signatures    **unicode-char-equal *char1* *char2* &key *style* => *flag***  
**unicode-char-not-equal *char1* *char2* &key *style* => *flag***

Arguments    *char1*      A character

*char2*      A character

*style*      A keyword

Values        *flag*      A generalized boolean

Description    The function **unicode-char-equal** returns true if the characters *char1* and *char2* are equal, and the function **unicode-char-not-equal** returns true if the characters *char1* and *char2* are not equal. Both functions ignore case using Unicode rules specified by *style*.

The current implementation only supports one style of comparison:

**:simple-case-fold**

                Compares characters using the simple case folding rules in Unicode 6.3.0.

See also     **unicode-char-greaterp**

**unicode-char-greaterp****unicode-char-lessp***Functions*

**Summary**      Compares two characters, ignoring case using specified Unicode rules.

**Package**      **lispworks**

**Signatures**      **unicode-char-greaterp *char1* *char2* &key *style* => *flag***  
**unicode-char-lessp *char1* *char2* &key *style* => *flag***

**Arguments**      ***char1***      A character

***char2***      A character

***style***      A keyword

**Values**      ***flag***      A generalized boolean

**Description**      The functions **unicode-char-greaterp** and **unicode-char-lessp** return true if the character *char1* is greater than (or for **unicode-char-lessp**, less than) the character *char2*, similarly to **cl:char-greaterp** and **cl:char-lessp** but ignoring case using Unicode rules specified by *style*.

The current implementation only supports one style of comparison:

**:simple-case-fold**

                  Compares characters using the simple lowercase folding rules in Unicode 6.3.0.

**See also**      **unicode-char-equal**

**unicode-char-not-greaterp**

*Function*

**unicode-char-not-greaterp**

**unicode-char-not-lessp**

*Functions*

Summary      Compares two characters, ignoring case using specified Unicode rules.

Package      **lispworks**

Signatures    **unicode-char-not-greaterp *char1 char2 &key style => flag***  
**unicode-char-not-lessp *char1 char2 &key style => flag***

Arguments     *char1*      A character

*char2*      A character

*style*      A keyword

Values        *flag*      A generalized boolean

Description     The functions **unicode-char-not-greaterp** and **unicode-char-not-lessp** return true if the character *char1* is not greater (or for **unicode-char-not-lessp**, not less) than the character *char2*, similarly to **c1:char-not-greaterp** and **c1:char-not-lessp** but ignoring case using Unicode rules specified by *style*.

The current implementation only supports one style of comparison:

**:simple-case-fold**

Compares characters using the simple lowercase folding rules in Unicode 6.3.0.

See also      **unicode-char-equal**

**unicode-char-greaterp**

| <b>unicode-lower-case-p</b> | <i>Function</i>                                                                                                                                                                                                                                                                                                                        |             |             |              |           |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------------|--------------|-----------|
| Summary                     | Returns a value like <code>c1:lower-case-p</code> , but using specified Unicode rules.                                                                                                                                                                                                                                                 |             |             |              |           |
| Package                     | <code>lispworks</code>                                                                                                                                                                                                                                                                                                                 |             |             |              |           |
| Signature                   | <code>unicode-lower-case-p char &amp;key style =&gt; flag</code>                                                                                                                                                                                                                                                                       |             |             |              |           |
| Arguments                   | <table> <tr> <td><i>char</i></td><td>A character</td></tr> <tr> <td><i>style</i></td><td>A keyword</td></tr> </table>                                                                                                                                                                                                                  | <i>char</i> | A character | <i>style</i> | A keyword |
| <i>char</i>                 | A character                                                                                                                                                                                                                                                                                                                            |             |             |              |           |
| <i>style</i>                | A keyword                                                                                                                                                                                                                                                                                                                              |             |             |              |           |
| Values                      | <i>flag</i> A generalized boolean                                                                                                                                                                                                                                                                                                      |             |             |              |           |
| Description                 | The function <code>unicode-lower-case-p</code> returns <i>flag</i> as true if <i>char</i> is lowercase according to the Unicode rules specified by <i>style</i> .<br><br>The current implementation only supports one style:<br><br><code>:general-category</code><br><br>Use the "general category" for <i>char</i> in Unicode 6.3.0. |             |             |              |           |
| See also                    | <code>unicode-both-case-p</code><br><code>unicode-upper-case-p</code>                                                                                                                                                                                                                                                                  |             |             |              |           |

**unicode-string-equal**  
**unicode-string-not-equal**

## *Functions*

|            |                                                                                                                                                             |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary    | Compares two strings, ignoring case using specified Unicode rules.                                                                                          |
| Package    | <b>lispworks</b>                                                                                                                                            |
| Signatures | <code>unicode-string-equal <i>string1</i> <i>string2</i> &amp;key <i>start1</i> <i>start2</i> <i>end1</i> <i>end2</i> <i>style</i> =&gt; <i>flag</i></code> |

**unicode-string-not-equal** *string1 string2 &key start1 start2 end1 end2 style => mismatch-index*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                  |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|
| Arguments   | <i>string1</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | A string designator                              |
|             | <i>string2</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | A string designator                              |
|             | <i>start1, end1</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Bounding index designators of <i>string1</i>     |
|             | <i>start2, end2</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Bounding index designators of <i>string2</i>     |
|             | <i>style</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | A keyword                                        |
| Values      | <i>flag</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A generalized boolean                            |
| Values      | <i>mismatch-index</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | A bounding index of <i>string1</i> or <b>nil</b> |
| Description | <p>The functions <b>unicode-string-equal</b> and <b>unicode-string-not-equal</b> compare the designated substrings of <i>string1</i> and <i>string2</i>, ignoring case using Unicode rules specified by <i>style</i>. The values of <i>start1</i> and <i>start2</i> default to 0, while the values of <i>end1</i> and <i>end2</i> default to <b>nil</b>.</p> <p>The returned value <i>flag</i> of <b>unicode-string-equal</b> is true if the strings are equal and false otherwise.</p> <p>The returned value <i>mismatch-index</i> of <b>unicode-string-not-equal</b> is the index where the strings mismatch (as an offset from the beginning of <i>string1</i>) or <b>nil</b> otherwise.</p> <p>The current implementation only supports one style of comparison:</p> <p><b>:simple-case-fold</b></p> <p>Compares each character of the strings using the simple case folding rules in Unicode 6.3.0.</p> |                                                  |
| See also    | <p><b>choose-unicode-string-hash-function</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                  |

## **unicode-string-greaterp**

## **unicode-string-lessp**

### *Functions*

**Summary**      Compares two strings, ignoring case using specified Unicode rules.

**Package**      **lispworks**

**Signatures**      **unicode-string-greaterp** *string1 string2 &key start1 start2 end1 end2 style => mismatch-index*

**unicode-string-lessp** *string1 string2 &key start1 start2 end1 end2 style => mismatch-index*

**Arguments**

|                     |                                              |
|---------------------|----------------------------------------------|
| <i>string1</i>      | A string designator                          |
| <i>string2</i>      | A string designator                          |
| <i>start1, end1</i> | Bounding index designators of <i>string1</i> |
| <i>start2, end2</i> | Bounding index designators of <i>string2</i> |
| <i>style</i>        | A keyword                                    |

**Values**      *mismatch-index* A bounding index of *string1* or **nil**

**Description**      The functions **unicode-string-greaterp** and **unicode-string-lessp** compare the designated substrings of *string1* and *string2*, similarly to **c1:string-greaterp** and **c1:string-greaterp** but ignoring case using Unicode rules specified by *style*. The values of *start1* and *start2* default to 0, while the values of *end1* and *end2* default to **nil**.

The value of *mismatch-index* is the index where the strings mismatch (as an offset from the beginning of *string1*) if *substring1* is greater (or for **unicode-string-lessp**, less) than *substring2*, or **nil** otherwise.

The current implementation only supports one style of comparison:

**:simple-case-fold**

Compares each character of the string using the simple lowercase folding rules in Unicode 6.3.0.

See also      `unicode-string-equal`  
                 `unicode-string-not-greaterp`

## `unicode-string-not-greaterp` `unicode-string-not-lessp`

### *Functions*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                     |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| Summary     | Compares two strings, ignoring case using specified Unicode rules.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                     |
| Package     | <code>lispworks</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                     |
| Signatures  | <code>unicode-string-not-greaterp <i>string1</i> <i>string2</i> &amp;key <i>start1</i> <i>start2</i> <i>end1</i> <i>end2</i> <i>style</i> =&gt; <i>mismatch-index</i></code>                                                                                                                                                                                                                                                                                                                                                                                           |                                                                     |
|             | <code>unicode-string-not-lessp <i>string1</i> <i>string2</i> &amp;key <i>start1</i> <i>start2</i> <i>end1</i> <i>end2</i> <i>style</i> =&gt; <i>mismatch-index</i></code>                                                                                                                                                                                                                                                                                                                                                                                              |                                                                     |
| Arguments   | <code><i>string1</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | A string designator                                                 |
|             | <code><i>string2</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | A string designator                                                 |
|             | <code><i>start1</i>, <i>end1</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Bounding index designators of <code><i>string1</i></code>           |
|             | <code><i>start2</i>, <i>end2</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Bounding index designators of <code><i>string2</i></code>           |
|             | <code><i>style</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | A keyword                                                           |
| Values      | <code><i>mismatch-index</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | A bounding index of <code><i>string1</i></code> or <code>nil</code> |
| Description | The functions <code>unicode-string-not-greaterp</code> and <code>unicode-string-not-lessp</code> compare the designated substrings of <code><i>string1</i></code> and <code><i>string2</i></code> , similarly to <code>cl:string-not-greaterp</code> and <code>cl:string-not-lessp</code> but ignoring case using Unicode rules specified by <code><i>style</i></code> . The values of <code><i>start1</i></code> and <code><i>start2</i></code> default to 0, while the values of <code><i>end1</i></code> and <code><i>end2</i></code> default to <code>nil</code> . |                                                                     |

The value of *mismatch-index* is the index where the strings mismatch (as an offset from the beginning of *string1*) if *substring1* is not greater (or for `unicode-string-not-lessp`, not less) than *substring2*, or `nil` otherwise.

The current implementation only supports one style of comparison:

**:simple-case-fold**

Compares each character of the string using the simple lowercase folding rules in Unicode 6.3.0.

See also      `unicode-string-equal`  
                  `unicode-string-greaterp`

## **unicode-upper-case-p** *Function*

Summary      Returns a value like `c1:upper-case-p`, but using specified Unicode rules.

Package      `lispworks`

Signature      `unicode-upper-case-p char &key style => flag`

Arguments      `char`      A character  
                  `style`      A keyword

Values      `flag`      A generalized boolean

Description      The function `unicode-upper-case-p` returns *flag* as true if *char* is uppercase according to the Unicode rules specified by *style*.

The current implementation only supports one style:

**:general-category**

Use the "general category" for *char* in Unicode 6.3.0.

See also      **unicode-both-case-p**  
                 **unicode-lower-case-p**

## **user-preference** *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| Summary     | Gets or sets a persistent value in the user's registry.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                |
| Package     | <b>lispworks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                |
| Signature   | <b>user-preference</b> <i>path</i> <i>value-name</i> &key <i>product</i> => <i>value</i> ,<br><i>valuep</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                |
| Signature   | <b>(setf user-preference)</b> <i>value</i> <i>path</i> <i>value-name</i> &key <i>product</i><br>=> <i>value</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                |
| Arguments   | <i>path</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | A string or a list of strings. |
|             | <i>value-name</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | A string.                      |
|             | <i>product</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | A keyword.                     |
| Values      | <i>value</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | A Lisp object.                 |
|             | <i>valuep</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | A boolean.                     |
| Description | <p>The function <b>user-preference</b> reads the value of the registry entry <i>value-name</i> under <i>path</i> under the registry path defined for <i>product</i> by <b>(setf product-registry-path)</b>. If the registry entry was found a second value <i>t</i> is returned. If the registry entry was not found, then <i>value</i> is <b>nil</b>.</p> <p>The function <b>(setf user-preference)</b> sets the value of that registry entry to <i>value</i>.</p> <p>If <i>path</i> is a list of strings, then it is interpreted like the directory component of a pathname. If <i>path</i> is a string, then any directory separators should be appropriate for the platform -</p> |                                |

that is, use backslash on Windows, and forward slash on non-Windows systems.

Notes

1. When *value* is a string, `user-preference` stores a print-escaped string in the registry and reads it back with `read-from-string`. Therefore it may not work with string values stored by other software.
2. While *product* can in principle be any Lisp object, values of *product* are compared by `eq`, so you should use keywords.
3. The CAPI provides a way to store window geometry - see the reference entry for `capi:top-level-interface-save-geometry-p` in the *CAPI User Guide and Reference Manual*.

Example

This example is on Microsoft Windows. Note the use of backslashes as directory separators in the *path* argument:

```
(setf (user-preference "My Stuff\\FAQ"
                      "Ultimate Answer"
                      :product :deep-thought)
      42)
=>
42
```

This is equivalent to the previous example, and is portable because we avoid the explicit directory separators in the *path* argument:

```
(setf (user-preference (list "My Stuff" "FAQ")
                      "Ultimate Answer"
                      :product :deep-thought)
      42)
=>
42
```

We can retrieve values on Windows like this:

```
(user-preference "My Stuff\\FAQ"
                 "Ultimate Answer"
                 :product :deep-thought)
=>
42
t
```

We can retrieve values on any platform like this:

```
(user-preference (list "My Stuff" "FAQ")
                 "Ultimate Question"
                 :product :deep-thought)
=>
nil
nil
```

See also [copy-preferences-from-older-version](#)  
[product-registry-path](#)

## when-let

*Macro*

|           |                                                                                                                      |                                                                             |
|-----------|----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| Summary   | Executes a body of code if a form evaluates to non-nil, propagating the result of the form through the body of code. |                                                                             |
| Package   | <code>lispworks</code>                                                                                               |                                                                             |
| Signature | <code>when-let (var form) &amp;body body =&gt; result</code>                                                         |                                                                             |
| Arguments | <code>var</code>                                                                                                     | A variable whose value is used in the evaluation of <i>body</i> .           |
|           | <code>form</code>                                                                                                    | A form, which must evaluate to non-nil.                                     |
|           | <code>body</code>                                                                                                    | A body of code to be evaluated conditionally on the result of <i>form</i> . |
| Values    | <code>result</code>                                                                                                  | The result of evaluating <i>body</i> using the value <i>var</i> .           |

|             |                                                                                                                                                                                                                                   |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | This macro executes the body of code if the form evaluates to a non-nil result. Within the body, the variable <i>var</i> is bound to the result of the <i>form</i> .                                                              |
| Example     | <p>The form</p> <pre>(when-let (position (search string1 string2))             (print position))</pre> <p>macroexpands to</p> <pre>(let ((position (search string1 string2)))     (when position         (print position)))</pre> |
| See also    | <a href="#">when-let*</a>                                                                                                                                                                                                         |

| <b>when-let*</b> |                                                                                                                                                                                                                                                                                                                                | <i>Macro</i>                                                      |                                                                   |             |                                         |             |                                                                             |  |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|-------------------------------------------------------------------|-------------|-----------------------------------------|-------------|-----------------------------------------------------------------------------|--|
| Summary          | Executes a body of code if a series of forms evaluates to non-nil, propagating the results of the forms through the body of code.                                                                                                                                                                                              |                                                                   |                                                                   |             |                                         |             |                                                                             |  |
| Package          | <code>lispworks</code>                                                                                                                                                                                                                                                                                                         |                                                                   |                                                                   |             |                                         |             |                                                                             |  |
| Signature        | $\text{when-let}^* \text{ } \textit{bindings} \& \textit{body} \text{ } \textit{body} \Rightarrow \textit{result}$<br>$\textit{bindings} ::= ((\textit{var} \textit{form})*)$                                                                                                                                                  |                                                                   |                                                                   |             |                                         |             |                                                                             |  |
| Arguments        | <table> <tr> <td><i>var</i></td> <td>A variable whose value is used in the evaluation of <i>body</i>.</td> </tr> <tr> <td><i>form</i></td> <td>A form, which must evaluate to non-nil.</td> </tr> <tr> <td><i>body</i></td> <td>A body of code to be evaluated conditionally on the result of <i>form</i>.</td> </tr> </table> | <i>var</i>                                                        | A variable whose value is used in the evaluation of <i>body</i> . | <i>form</i> | A form, which must evaluate to non-nil. | <i>body</i> | A body of code to be evaluated conditionally on the result of <i>form</i> . |  |
| <i>var</i>       | A variable whose value is used in the evaluation of <i>body</i> .                                                                                                                                                                                                                                                              |                                                                   |                                                                   |             |                                         |             |                                                                             |  |
| <i>form</i>      | A form, which must evaluate to non-nil.                                                                                                                                                                                                                                                                                        |                                                                   |                                                                   |             |                                         |             |                                                                             |  |
| <i>body</i>      | A body of code to be evaluated conditionally on the result of <i>form</i> .                                                                                                                                                                                                                                                    |                                                                   |                                                                   |             |                                         |             |                                                                             |  |
| Values           | <i>result</i>                                                                                                                                                                                                                                                                                                                  | The result of evaluating <i>body</i> using the value <i>var</i> . |                                                                   |             |                                         |             |                                                                             |  |

|             |                                                                                                                                                                                                                                                                                                                                                                        |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | The macro <code>when-let*</code> expands into nested <code>when-let</code> forms. The bindings are evaluated in turn as long as each returns non-nil. If the last binding evaluates to non-nil, <code>body</code> is executed. Within the code <code>body</code> , each variable <code>var</code> is bound to the result of the corresponding form <code>form</code> . |
| Example     | <pre>(defmacro divisible (n &amp;rest divisors)   `(~(when-let* , (loop for div in divisors                          collect (list (gensym)                                        (zerop (mod n div))))))     t))</pre>                                                                                                                                               |
| See also    | <code>when-let</code>                                                                                                                                                                                                                                                                                                                                                  |

## whitespace-char-p *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Summary     | Tests whether a character represents white space.                                                                                                                                                                                                                                                                                                                                                                                                               |  |
| Package     | <code>lispworks</code>                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |
| Signature   | <code>whitespace-char-p char =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                |  |
| Arguments   | <code>char</code> A character.                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |
| Values      | <code>result</code> A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |
| Description | <p>The function <code>whitespace-char-p</code> is a predicate for [whitespace], as described in the standard:</p> <p>“Space and non-graphic characters that only moved the print position.”</p> <p><code>result</code> is <code>t</code> if <code>char</code> represents white space, and <code>nil</code> otherwise.</p> <p>If the value of <code>*extended-spaces*</code> is <code>t</code>, then U+3000 Ideographic Space is also considered whitespace.</p> |  |
| See also    | <code>*extended-spaces*</code>                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |

| with-action-item-error-handling | Macro                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary                         | Executes a body of code across action lists and items, signaling errors and then continuing to the next action item.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Package                         | <code>lispworks</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Signature                       | <code>with-action-item-error-handling <i>action-list-var</i> <i>action-item-var</i> <i>ignore-errors-p</i> &amp;body <i>body</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Arguments                       | <p><i>action-list-var</i> A variable.</p> <p><i>action-item-var</i> A variable.</p> <p><i>ignore-errors-p</i> A boolean.</p> <p><i>body</i> A body of Lisp code.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Description                     | The macro <code>with-action-item-error-handling</code> executes the <i>body</i> with <i>action-list-var</i> and <i>action-item-var</i> are bound to the action list and item respectively. If <i>ignore-errors-p</i> is set to <code>t</code> then errors are handled. The behavior of the handler is to signal a warning in which the action-list, item and original error are all reported; execution then continues with the next action-item.                                                                                                                                                                                                                                                                                                                             |
| Example                         | <pre>(defun my-execution-function (the-action-list                                other-args                                &amp;key ignore-errors-p                                &amp;allow-other-keys)   (with-action-list-mapping (the-action-list                             an-action-item                             action-item-data)     (with-action-item-error-handling (the-action-list                                       an-action-item                                       ignore-errors-p)       (do-something-interesting-first)       (apply (car action-item-data) other-args (cdr action-item-data)))))</pre> <p>If this function was invoked with the keyword argument <code>:ignore-errors-p t</code>, and an error was signaled while exe-</p> |

cuting the body-form(s) for one of the action-items, then a warning such as:

```
Warning: Got an error 'The variable *PREV-STATE* is  
unbound.' while executing action "Initialize State" in  
list "Startup Inits".
```

would be signaled and execution would continue with the next action-item.

See also [\\*handle-missing-action-in-action-list\\*](#)

## **with-action-list-mapping** *Macro*

**Summary** Maps over an action list's actions with given variables bound to the executing action and its data.

**Package** `lispworks`

**Signature** `with-action-list-mapping action-list item-var data-var  
&optional post-process &body body`

**Arguments** `action-list` An action list.

`item-var` A Lisp symbol.

`data-var` A Lisp symbol.

`post-process` A keyword.

`body` A body of Lisp code.

**Description** The macro `with-action-list-mapping` maps over an action-list's action-items. During execution, the symbols specified for `item-var` and `data-var` are bound to the executing action-item and its data respectively. See `execute-actions` for more on post-processing.

If this function is invoked with the keyword argument `:post-process :collect`, a list the values returned by each action-item's setf operation are returned.

**Examples**

```
(defun my-execution-function
  (the-action-list other-args
    &key (post-process nil)
    &allow-other-keys)
  (declare (ignore other-args))
  (with-action-list-mapping (the-action-list
    an-action-item
    action-item-data
    post-process)
    (do-something-interesting-first)
    (setf (symbol-value (car action-item-data))
      (apply (cadr action-item-data)
        (cddr action-item-data)))))
```

**See also****execute-actions****with-unique-names***Macro*

**Summary** Returns a body of code with each specified name bound to a similar name.

**Package** **lispworks**

**Signature** **with-unique-names (&rest names) &body body => result**

**Arguments** **names** The names to be rebound in *body*.

**body** The body of code within which *names* are rebound.

**Values** **result** The result of evaluating *body*.

**Description** Returns the body with each *name* bound to a symbol of a similar name (compare **gensym**).

**Example** After defining

```
(defmacro lister (p q)
  (with-unique-names (x y)
    `(let ((,x (x-function))
          (,y (y-function)))
      (list ,p ,q ,x ,y))))
```

the form (**lister i j**) macroexpands to

```
(LET* ((#:X-88 (X-FUNCTION))
       (#:Y-89 (Y-FUNCTION)))
  (LIST i j #:X-88 #:Y-89))
```

See also      **rebinding**



# 41

---

## The LW-JI Package

This chapter describes symbols available in the `LW-JI` package, the LispWorks Java interface.

The uses of these symbols are discussed in Chapter 15, “Java interface”.

|             |                                                                                                                                                                                                                                 | <i>Function</i> |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Summary     | Call a Java method.                                                                                                                                                                                                             |                 |
| Package     | <code>lw-ji</code>                                                                                                                                                                                                              |                 |
| Signature   | <code>call-java-method <i>method-name</i> &amp;rest <i>args</i></code>                                                                                                                                                          |                 |
| Arguments   | <i>method-name</i>                                                                                                                                                                                                              | A string.       |
|             | <i>args</i>                                                                                                                                                                                                                     | Lisp objects.   |
| Description | The function <code>call-java-method</code> calls a Java method on the supplied <i>args</i> .<br><br><i>method-name</i> must specify the full name of the Java method to call, including the package, class and method name, for |                 |

`example "java.io.File.exists".call-java-method` first uses the string to lookup a caller, and if that fails it produces a caller in the same way that `define-java-caller` and `setup-java-caller` do and caches it. It then uses the caller to call the Java method with `args`, and return the result.

The process of actual calling is the same as in ordinary Java callers defined by `define-java-caller`. See the entry for `define-java-caller` for details.

If *method-name* is incorrect (does not have class and method name, class cannot be found or method cannot be found), `call-java-method` signals an error of type `call-java-method-error`, which reports the actual failure.

|          |                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | <code>call-java-method</code> needs to lookup the caller using the string, so the call is slightly slower than calls for ordinary Java callers, but the difference is not significant. There is also no way to verify that the string is correct. It also has to keep some extra code that can be shaken out if only <code>define-java-caller</code> is used, but not much. If you find it convenient, there is no reason not to use it. |
| See also | <a href="#">define-java-caller</a><br><a href="#">call-java-method-error</a><br><a href="#">“Defining specific callers” on page 202</a>                                                                                                                                                                                                                                                                                                  |

|              | <i>Condition</i>                                         |
|--------------|----------------------------------------------------------|
| Summary      | <code>call-java-method</code> failed to find the method. |
| Package      | <code>lw-ji</code>                                       |
| Superclasses | <code>java-interface-error</code>                        |
| Subclasses   | None.                                                    |

Description      The condition class `call-java-method-error` is signaled when `call-java-method` failed to find the method.

See also      `call-java-method`

## **catching-java-exceptions**

### **catching-exceptions-bind**

*Macros*

Summary      Execute Lisp code with a catch for Java exceptions.

Package      `lw-ji`

Signature      `catching-java-exceptions &body body`

Signature      `catching-exceptions-bind (result exception) form &body body`

Arguments      `result`      A variable.

`exception`      A variable.

`form`      A Lisp form.

`body`      Lisp code.

Description      The macro `catching-java-exceptions` executes `body` with a catch for Java exceptions. The code of `body` is executed normally, and if no Java exception is signaled through the execution, returns whatever `body` returns. If there is an exception, instead of signaling an error of class `java-exception`, `catching-java-exceptions` returns two values: `nil` and the Java exception object (analogous to `cl:ignore-errors`).

The macro `catching-exceptions-bind` executes the `form` and binds `result` and `exception` to the first two return values if there was no exception. If there was an exception they are bound to `nil` and the exception. It then executes the code of `body` within the scope of the bind. `catching-exceptions-bind` is equivalent to

```
(multiple-value-bind (result exception)
  (catching-java-exceptions form)
    body)
```

- Notes
1. `jobject-string`, `jobject-class-name` and `jobject-of-class-p` are useful general utilities for deciding what to do with the exception. For find-grained handling, you will need to access the exception using your own callers or `call-java-method` when applicable.
  2. These macros have no effect on signaling and handling of other errors in Lisp, except that they prevent Java exceptions from being signaled as errors.
  3. Some exceptions can happen during normal execution and handled by the system in a user-invisible way (analogous to the way that `try` in Java code does). These macros do not affect the behavior for these cases, so even though when running under a Java debugger you may see an exception, it will not necessarily be visible with these macros.
  4. In general, these macros are less useful in high-level code, because they cause exceptions to throw out, preventing them from being signaled as Lisp errors and handled by error handler in the scope of `body` (for `catching-java-exceptions`) or `form` (for `catching-exceptions-bind`). They should normally be used in low-level code that actually does Java calls, with any Lisp error handlers wrapped around them.
  5. For simple handling of exceptions you can use standard handlers (`c1:handler-case`, `c1:handler-bind`), for `java-exception` and its subclasses.

## See also

`jobject-string`  
`jobject-class-name`  
`jobject-of-class-p`

|             |                                                                                                                                                                                      | <i>Function</i>                                                                                                                                                                                                                                                                |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Tests whether calls from Java into Lisp can work.                                                                                                                                    |                                                                                                                                                                                                                                                                                |
| Package     | <code>lw-ji</code>                                                                                                                                                                   |                                                                                                                                                                                                                                                                                |
| Signature   | <code>check-lisp-calls-initialized =&gt; result</code>                                                                                                                               |                                                                                                                                                                                                                                                                                |
| Arguments   | None.                                                                                                                                                                                |                                                                                                                                                                                                                                                                                |
| Values      | <i>result</i>                                                                                                                                                                        | A boolean.                                                                                                                                                                                                                                                                     |
| Description | The function <code>check-lisp-calls-initialized</code> returns <code>t</code> if Lisp calls have been initialized successfully, which means that calls from Java into Lisp can work. | The main factor that may affect successful initialization of Lisp calls is the availability of the class <code>com.lisp-works.LispCalls</code> , which comes from LispWorks and will not be available if you do not make it available to the Java Virtual Machine in some way. |
| Notes       | On Android the <code>LispCalls</code> class is available because it is in the <code>lispworks.jar</code> file that must be included in the application.                              |                                                                                                                                                                                                                                                                                |
| See also    | “Calling from Java to Lisp” on page 206                                                                                                                                              |                                                                                                                                                                                                                                                                                |

|           |                                                                                       | <i>Function</i> |
|-----------|---------------------------------------------------------------------------------------|-----------------|
| Summary   | Create a CLOS instance based on a <code>jobject</code> .                              |                 |
| Package   | <code>lw-ji</code>                                                                    |                 |
| Signature | <code>create-instance-from-jobject jobject &amp;optional errorp =&gt; instance</code> |                 |

|             |                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arguments   | <i>jobject</i>  | A <i>jobject</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|             | <i>errorp</i>   | A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Values      | <i>instance</i> | A CLOS object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Description |                 | <p>The function <code>create-instance-from-jobject</code> creates a CLOS instance based on the <i>jobject</i> <i>jobject</i>.</p> <p><i>jobject</i> must be a <i>jobject</i>. Its class name (that is, the result of <code>jobject-class-name</code>) must have been associated with the name of a CLOS subclass of <code>standard-java-object</code> using <code>record-java-class-lisp-symbol</code> (the importing interface, when defining a class, does it automatically).</p> <p><code>create-instance-from-jobject</code> uses the record to find the class, and makes the CLOS instance by calling <code>make-instance</code>, passing it <i>jobject</i>.</p> <p>The result is an instance of the CLOS class, which can be passed to Java interface functions and Java methods.</p> <p>If <code>create-instance-from-jobject</code> fails to find the CLOS class it signals an error if <i>errorp</i> is non-nil, otherwise it returns <code>nil</code>. The default value of <i>errorp</i> is true.</p> |
| See also    |                 | <p><code>record-java-class-lisp-symbol</code><br/> “CLOS partial integration” on page 218</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

**create-instance-jobject-list****create-instance-jobject***Functions*

|           |                                                                                                                                       |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------|
| Summary   | Construct a <i>jobject</i> for a CLOS instance.                                                                                       |
| Package   | <code>lw-ji</code>                                                                                                                    |
| Signature | <code>create-instance-jobject-list instance args =&gt; jobject</code><br><code>create-instance-jobject instance &amp;rest args</code> |

|             |                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arguments   | <i>instance</i> | An instance of a subclass of <b>standard-java-object</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|             | <i>args</i>     | A list or t.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Values      | <i>jobject</i>  | A jobject.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Description |                 | <p>The functions <code>create-instance-jobject-list</code> and <code>create-instance-jobject</code> construct a jobject for the CLOS instance <i>instance</i> and set its slot to that <i>jobject</i>.</p> <p>The type of <i>instance</i> (that is, the class name of its class) must have been associated with a Java constructor by passing it as the <i>class-symbol</i> argument to <code>define-java-constructor</code> or <code>setup-java-constructor</code></p> <p><code>create-instance-jobject</code> just calls <code>create-instance-jobject-list</code> with <i>instance</i> and <i>args</i>.</p> <p><code>create-instance-jobject-list</code> constructs the <i>jobject</i> using the <i>args</i>. <i>args</i> can be either the list of arguments for the constructor (the list may be <code>nil</code>), or t, in which case <code>create-instance-jobject-list</code> uses <code>default-constructor-arguments</code> to create a list of arguments and uses it instead. The Java constructor is called in the same way that it would be called by the caller that is defined by <code>define-java-constructor</code>. See <code>define-java-constructor</code> for details of calling. The result of the construction is stored in <i>instance</i> and is returned.</p> |
| Notes       |                 | <ol style="list-style-type: none"> <li>1. The importing interface, when defining a class, automatically generates the <code>define-java-constructor</code> form passing it the <i>class-symbol</i> argument. <code>define-java-constructor</code> also defines a caller for the constructor, which can be used independently. <code>create-instance-jobject-list</code> and <code>create-instance-jobject</code> do not actually call it, but share information with it.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

2. `create-instance-jobject-list` and `create-instance-jobject` ignore the current `jobject` in `instance`, if there is one. There is no problem calling `create-instance-jobject-list` and `create-instance-jobject` repeatedly on the same instance.

See also      `define-java-constructor`

## `create-java-object` *Function*

Summary      Invoke the Java constructor.

Package      `lw-ji`

Signature      `create-java-object class-name &rest args => result`

Arguments      `class-name`      A string.

`args`      Lisp objects.

Values      `result`      A Java object.

Description      The function `create-java-object` invokes the Java constructor for the class `class-name` with the supplied `args`.

`class-name` must specify a Java class. `create-java-object` first uses `class-name` to lookup a caller, and if that fails it produces a caller in the same way that `define-java-constructor` and `setup-java-constructor` do and caches it. It then uses the caller to call the constructor with `args`, and returns the result.

The process of actual calling is the same as in ordinary Java callers defined by `define-java-constructor`. See the entry for `define-java-constructor` for details.

If the string is incorrect (that is, it does not look like a Java class name or the class cannot be found), `create-java-`

`object` signals an error of type `create-java-object-error`, which reports the actual failure.

|          |                                                                                                                                                                                                                                                                                                                                                                                          |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | <code>create-java-object</code> needs to lookup the caller using the string, so the call is slightly slower than calls for ordinary Java constructors, but the different is not significant. It also has to keep some extra code that can be shaken out if only <code>define-java-constructor</code> is used, but not much. If you find it convenient, there is no reason not to use it. |
| See also | <code>define-java-constructor</code>                                                                                                                                                                                                                                                                                                                                                     |

## **create-java-object-error** *Condition*

|              |                                                                                                                                         |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| Summary      | <code>create-java-object</code> failed to find constructors.                                                                            |
| Package      | <code>lw-ji</code>                                                                                                                      |
| Superclasses | <code>java-interface-error</code>                                                                                                       |
| Subclasses   | None.                                                                                                                                   |
| Description  | The condition class <code>create-java-object-error</code> is signaled when <code>create-java-object</code> failed to find constructors. |
| See also     | <code>create-java-object</code>                                                                                                         |

## **default-constructor-arguments** *Generic Function*

|           |                                                                 |
|-----------|-----------------------------------------------------------------|
| Summary   | Returns a default list of arguments to pass to the constructor. |
| Package   | <code>lw-ji</code>                                              |
| Signature | <code>default-constructor-arguments instance =&gt; list</code>  |

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Method signatures | <code>default-constructor-arguments (instance standard-java-object) =&gt; nil</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Arguments         | <i>instance</i> An instance of a subclass of <code>standard-java-object</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Values            | <i>list</i> A list.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Description       | <p>The generic function <code>default-constructor-arguments</code> returns a default list of arguments to pass to the constructor.</p> <p>It is used by <code>create-instance-jobject-list</code> when its <code>args</code> argument is <code>t</code>. <code>default-constructor-arguments</code> is also used by the <code>c1:initialize-instance</code> method of <code>standard-java-object</code> when <code>:construct</code> is passed with value <code>t</code>. It is intended for you to specialize on your own classes.</p> <p>The default method returns <code>nil</code>, which is sometimes useful, but in most cases you probably need to pass something.</p> |
| See also          | <code>create-instance-jobject-list</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

|           | <i>Function</i>                                                                     |
|-----------|-------------------------------------------------------------------------------------|
| Summary   | The default <i>name-constructor</i> used by the importing interface.                |
| Package   | <code>lw-ji</code>                                                                  |
| Signature | <code>default-name-constructor prefix method-or-field-name =&gt; symbol-name</code> |
| Arguments | <i>prefix</i> A string.<br><i>method-or-field-name</i><br>A string.                 |
| Values    | <i>symbol-name</i> A string.                                                        |

|             |                                                                                                                                                                                                                |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | The function <code>default-name-constructor</code> is the default <i>name-constructor</i> used by the importing interface. See <code>generate-java-class-definitions</code> for a description of what it does. |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## define-field-accessor *Macro*

Summary      Defines a Java field accessor.

Package      `lw-ji`

Signature      `define-field-accessor name class-name field-name static-p &optional is-final => name`

|           |                   |            |
|-----------|-------------------|------------|
| Arguments | <i>name</i>       | A symbol.  |
|           | <i>class-name</i> | A string.  |
|           | <i>field-name</i> | A string.  |
|           | <i>static-p</i>   | A boolean. |
|           | <i>is-final</i>   | A boolean. |

Values      *name*

Description      The macro `define-field-accessor` defines a field accessor for a field in a Java class.

The arguments are interpreted as by `setup-field-accessor`.

Unlike `setup-field-accessor`, `define-field-accessor` does not look up anything. The accessor does the look up first time it is called, and signals an error if something failed. This error should be of type:

`java-class-error`

Failed to find the class.

`java-field-error`

Failed to find the field, or found the field but wrong *static-p* value.

**field-access-exception**

Got an exception trying to access the field.

Notes

1. In general, accessing fields should be avoided, because they are typically a less well-defined and implemented interface than methods, but sometimes it is necessary.
2. The importing interface generates appropriate **define-field-accessor** forms for public fields.

See also

**setup-field-accessor**

## define-java-caller

## define-java-constructor

*Macros*

Summary

Define a Java caller, which is a function that calls a Java method or a constructor.

Package

**lw-ji**

Signature

**define-java-caller** *name class-name method-name &key signatures => result*

Signature

**define-java-constructor** *name class-name &key class-symbol signatures => result*

Arguments

*name* A symbol.

*class-name* A string.

*method-name* A string.

*signatures* A list of strings.

*class-symbol* A symbol.

Values

*result* *name* or **nil**.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The macros <code>define-java-caller</code> and <code>define-java-constructor</code> define a Java caller, which is a function that calls a Java method or a constructor. Once this the caller is defined, calls to <i>name</i> ultimately invoke the Java method or constructor.</p> <p><i>class-name</i> must be the full name of a Java class, in the correct case. The '.' in the name may be replaced by '/'.</p> <p><i>method-name</i> must be a public method name of the class, with the correct case.</p> <p><i>class-symbol</i>, when it is non-nil, must name a class. It creates a mapping from the class to the constructor info, which allow functions like <code>make-java-instance</code> and <code>create-instance-object</code> to construct a <code>jobject</code> for an instance of the class named by <i>class-symbol</i>.</p> <p>The effect of these macros is to set the symbol function of <i>name</i> to a function that calls the method in the class or the constructor of the class. When there is more than one method with the same name or more than one constructor (that is, it is overloaded), the function decides dynamically which of these to call, based on the arguments it gets.</p> <p>For a successful call to <i>name</i>, it needs to be called with the correct arguments for the Java method. For an ordinary method, this must include the object on which the method should be applied, followed by the arguments of the method. For static methods and constructors, the arguments to <i>name</i> are just the arguments to the method/constructor.</p> <p>For arguments of primitive type or a matching Java class (for example <code>Integer</code>), the Lisp argument must be either a Lisp object of matching type (see “Types and conversion between Lisp and Java” on page 198), or a <code>jobject</code> of the corresponding Java class. For strings (that is argument type <code>java.lang.String</code>) the argument must be a <code>string</code>, <code>nil</code>, or a <code>jobject</code> of type <code>java.lang.String</code>. For other non-primitive</p> |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

types, the argument must be a `jobject` of the correct class or `nil`. `nil` is passed as Java `null` for non-primitive types.

If the return value type is a primitive type or `String`, the function converts the result of the method to the matching Lisp type before returning it. For other return types, the function returns a `jobject` representing the Java object, or `nil` if the method returned `null`. Constructors always return `jobjects`.

When the method is an ordinary method (not static and not constructor), the invocation is virtual (normal Java behavior), which means that if the object is of a subclass of the `classname` argument, it may invoke a method that is defined in a subclass of `classname`.

Unlike the functions `setup-java-caller` and `setup-java-constructor`, the macros `define-java-caller` and `define-java-constructor` do not do any actual lookup, they just set up the symbol function and therefore they do not require running Java to perform the definition. They are also recognized by the Editor as definer forms, so source finders like the Editor command `Find Source` can locate them. These macros are intended as the main method of defining callers. They are produced by the importing interface to actually define the callers.

For callers defined by these macros, the actual lookup happens the first time the function is invoked, or for `define-java-caller` by `verify-java-caller` or `verify-java-callers`. If the lookup fails during the function call, an error is signaled of type `java-class-error` (when the class cannot be found) or `java-method-error` (when the method cannot be found).

The macros (when successful) return `name`.

- Notes
1. There is no difference in performance between functions defined by these macros and functions defined by `setup-java-caller` and `setup-java-constructor`. If you use `setup-java-caller` and `setup-java-constructor` in a delivered application then extra machinery is retained.
  2. If you need several `define-java-caller` forms with the same class, consider using `define-java-callers`.
  3. If you need many `define-java-caller` forms with the same class, you may want to use the importing interface. Even if you want to define your own names for the callers, you can either pass `name-constructor` to the import function, or use `write-java-class-definitions-to-file` and edit the definitions that it generated (which saves typing the method names).
  4. For methods it is possible to use `verify-java-callers` or `verify-java-caller` at run time to check that the methods are found, which is a way of guarding against typing errors in entering the method name.
  5. There is no restriction on defining more than one caller for the same method or constructor.
  6. Unlike `setup-java-caller` and `setup-java-constructor`, the `name` argument is not evaluated.

See also

`setup-java-caller`  
`define-java-callers`  
`write-java-class-definitions-to-file`  
`import-java-class-definitions`  
`verify-java-callers`  
`verify-java-caller`  
“Defining specific callers” on page 202

## **define-java-callers**

*Macro*

Summary      Define multiple Java callers for methods in the same class.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |           |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Package     | <code>lw-ji</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |           |
| Signature   | <code>define-java-callers class-name &amp;body method-specs =&gt; class-name</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |           |
| Arguments   | <code>class-name</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A string. |
|             | <code>method-specs</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Lists.    |
| Values      | <code>class-name</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A string. |
| Description | <p>The macro <code>define-java-callers</code> defines multiple Java callers for methods in the same class.</p> <p><code>class-name</code> must specify a Java class by its full name.</p> <p>Each item of <code>method-specs</code> must be a list where the first element is a symbol (the Java caller name), the second element is a string (the method name) and optionally followed by keyword/value pairs for <code>define-java-caller</code>. <code>define-javacallers</code> processes each item by inserting the <code>class-name</code> after the Java caller name, and then using the result as the arguments to <code>define-java-caller</code>:</p> <pre>(define-java-callers class-name   (caller-name1 method-name1)   (caller-name2 method-name2)) =&gt; (progn   (define-java-caller caller-name1 class-name method- name1)   (define-java-caller caller-name2 class-name method- name2)   class-name)</pre> <p><code>define-javacallers</code> is a more compact way to write several methods for the same class, but functionally it is identical to using <code>define-java-caller</code> explicitly.</p> <p><code>define-javacallers</code> returns the <code>class-name</code>.</p> |           |
| See also    | <code>define-java-caller</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |           |

## **define-lisp-proxy** *Macro*

|                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                   |                   |                                   |  |  |                      |
|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------------|-----------------------------------|--|--|----------------------|
| Summary                           | Defines a Lisp proxy.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                   |                   |                                   |  |  |                      |
| Package                           | <code>lw-ji</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                   |                   |                                   |  |  |                      |
| Signature                         | <code>define-lisp-proxy name &amp;body interface-and-method-descs =&gt; name</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                   |                   |                                   |  |  |                      |
| Arguments                         | <table><tr><td><code>name</code></td><td>A non-nil symbol.</td></tr><tr><td><i>interface-and-method-descs</i></td><td></td></tr><tr><td></td><td>A body of Lisp code.</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <code>name</code> | A non-nil symbol. | <i>interface-and-method-descs</i> |  |  | A body of Lisp code. |
| <code>name</code>                 | A non-nil symbol.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                   |                   |                                   |  |  |                      |
| <i>interface-and-method-descs</i> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                   |                   |                                   |  |  |                      |
|                                   | A body of Lisp code.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                   |                   |                                   |  |  |                      |
| Values                            | <code>name</code> A non-nil symbol.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                   |                   |                                   |  |  |                      |
| Description                       | <p>The macro <code>define-lisp-proxy</code> defines a Lisp proxy, which means creating a Lisp proxy definition and attaching it to <code>name</code>, which can then be used to create Lisp proxies, which are Java proxies where methods invocation ends up calling Lisp functions.</p> <p><code>define-lisp-proxy</code> parses <i>interface-and-method-descs</i> to a proxy definition, and attaches it to <code>name</code>. This operation is a "load-time" operation: it does not require running Java, and does not create any proxy. The name can then be used at run time as argument to <code>make-lisp-proxy</code> or <code>make-lisp-proxy-with-overrides</code>, or to the Java method <code>com.lisp-works.LispCalls.createLispProxy</code>. The result of any these calls is a proxy that implements the interfaces listed in <i>interface-and-method-descs</i>, and can be used in Java whenever an object that implements any of these interfaces is required.</p> <p><i>interface-and-method-descs</i> describes the Java interfaces to implement and the Lisp functions to call. It is parsed as a body of Lisp forms.</p> <p>Each element in the list must be either a string which is the Java interface name, or a list where the <code>c1:car</code> is the Java interface name. Each item specifies a Java interface to imple-</p> |                   |                   |                                   |  |  |                      |

ment, except that one item (at most) may specify options relating to the whole proxy definition, by using a list starting with the keyword `:options` instead of giving an interface name.

When the item is a list starting with an interface name, the rest of the list are method specifications. Note that you do not need to have a method specification for each method of the interface.

Each method specification must be a list, where the first element is a string with the name of the Java method, and the second element is the symbol specifying what Lisp function to call for this method. The symbol specifies the function to call except when it is overridden (see below about "Overriding"). In some cases, you will want to always override the function to call (typically when you want to use a closure as the function), in which case the symbol can be and should be a keyword (which is ignored by the verifying functions), but does not have to be. See below for how the calling of the Lisp function is done.

The rest of the method specification can contain keyword/value pairs. Currently, the only supported keyword is `:with-user-data`, which takes a boolean value, overrides the default value of `:with-user-data` of the proxy definition. The default of `:with-user-data` of the definition defaults to `nil`, and can be changed in the `:options`. The value of `:with-user-data` specifies whether to pass the `user-data` of a proxy to the Lisp function.

The `:options` item is specified by an item in *interface-and-method-descs* where the `c1:car` is the keyword `:options`. The rest of the item is keyword/value pairs. The keywords currently supported are:

**`:default-function`**

Specifies the default function to call for methods which do not have a Lisp function. This function is applied to the arguments of

the method preceded by the *method-name*, and if `:default-function-with-user-data` is non-nil also with *user-data* preceding the *method-name*.

The default function can be overridden by `make-lisp-proxy` and `make-lisp-proxy-with-overrides`.

**`:default-function-with-user-data`**

A boolean specifying whether the *user-data* of a proxy should be passed when the default function is called. When it is non-nil, the *user-data* is passed as the first argument to the *default-function* (or the function that overrides it). The default value of

`:default-function-with-user-data` is `nil`.

**`:with-user-data`**

A boolean specifying whether the default for calling functions in the proxy definition is with *user-data* or not. Each method description can override it as described above. The default value of `:with-user-data` is `nil`.

**`:print-name`**

Must be a string or a symbol. Specifies the first part of the *print-name* of each proxy.

**`:jobject-scope`**

One of `:global`, `:local` or `nil`. This controls the scope of `jobject` arguments (that is, arguments that are not of primitive type or string). With the default value `:global`, `jobjects` are passed as global `jobjects` and can be used indefinitely. When `:jobject-scope` is `:local`, `jobjects` are passed as a local `jobject`, which means that they must

not be used outside the scope of the function that is invoked by the proxy. Using a local `:object` out of scope can cause the system to crash (rather than call `c1:error`). When `:object-scope` is `nil`, `objects` are not passed at all to the functions. Note that means that the number of arguments that the functions in the proxy receive is different when `:object-scope` is `nil`, because only arguments of primitive type or strings are passed.

If you use `:object-scope :local`, the function can convert it to global using `object-ensure-global`, and then it can be used out of scope.

The default value of `:object-scope` is `:global`.

## user-data

The `user-data` is set up for each individual proxy object by `make-lisp-proxy` or `make-lisp-proxy-with-overrides`, and thus allows you to associate each individual proxy with an arbitrary Lisp object. The proxy definition determines whether to use it when calling the Lisp functions in the proxy definition. The default value of `user-data` is `nil`, so if you want to use it you need to specify it by using `:with-user-data`, either in the `:options` which would give the default value for all calls in the definition, or in individual method specifications. When `user-data` is passed, it is always passed to the Lisp function as the first argument. Another way to individualize proxies is to use overriding, which also allows you to use closures.

## Overriding

When `make-lisp-proxy` or `make-lisp-proxy-with-overrides` make a proxy, they can specify overriding of some of the symbols in the proxy definition. Overriding here means mapping one symbol to another symbol or a function object. When a symbol is supposed to be called and it is overridden, the target of the mapping is called rather than the symbol. Note that the overriding is specific to each individual proxy rather to the proxy definition, and therefore you can have different proxies using the same proxy definition (and hence implementing the same interface(s)), but calling different Lisp functions. An advantage of overriding is that it allows you to use closures created at run time instead of symbols.

See the entry for `make-lisp-proxy` for how the overriding is created.

## Calling the Lisp function

After a proxy is created from a proxy definition, any invocation of a Java method on it (except the Object methods `toString`, `equals` and `hashCode`) enters Lisp.

When a method is invoked on a proxy (normally from Java, but can be done from Lisp too), the steps for invoking your Lisp function are:

1. Check whether the item in the *interface-and-method-descs* for the interface of the method contains a method specification with the *method-name* of the method.
2. Convert the Java method arguments to Lisp arguments where possible. See “Types and conversion between Lisp and Java” on page 198.

Note that if the first step above found a method specification, and it contains the keyword `:object-scope`, it affects the way non-primitive arguments are processed as described above.

**3. Calling the user code:**

- (i) If a method specification was found in the first step above:
  - a) Take the symbol from the method specification, then
  - b) Check whether the symbol is overridden, and if it is use the target as a function to call. Otherwise, check whether the symbol is fbound, and if it is use it as a function to call, then
  - c) If as a result of (b) there is a function to call, check whether it should be called with the *user-data*. If `:with-user-data` was used in the method specification then use its value, otherwise if `:with-user-data` was used in `:options` item use this value, otherwise default to `nil`, then
  - d) Apply the function: if using *user-data*, apply the function to the *user-data* followed by the Lisp arguments, otherwise apply the function to the Lisp arguments only.
- (ii) If the method-specific call in (i) did not happen (no method specification found, or the symbol is not fbound and not overridden), try to apply the default function:
  - a) If there is a default function, check whether it is overridden and if so use the target as the function to call. Otherwise use the *default-function* itself as the function to call, then
  - b) Check whether need to pass *user-data*, which is specified by the `:default-function-with-user-data` in the `:options` item, then
  - c) Apply the function: if *user-data* needs to be used, apply the function to the *user-data*, *method-name* and the Lisp arguments. Otherwise apply the function to the *method-name* and Lisp arguments.
- (iii) If the calls in (i) and (ii) did not happen, an error is signaled. See handling of errors below.

4. Return a value: currently, if the user function returned a Java object (a `jobject` or an instance of `standard-java-object`), it is returned without checking. Otherwise, try to convert it to the appropriate Java object and return it. Otherwise, report it by calling the `java-to-lisp-debugger-hook` (see `init-java-interface`) with a `cl:simple-error` condition and return a default value from the Java method invocation, which is 0 for primitive types or `null` for other types.

## Throwing out and error handling

The call to the Lisp function is wrapped dynamically such that any throw from it is blocked, and the default value as in the last step above is returned.

In addition, there is a debugger wrapper (using `with-debugger-wrapper`) which calls the `java-to-lisp-debugger-hook` (see `init-java-interface`) with the condition and then calls `cl:abort`. If this abort is not caught by your `cl:abort` restart, it is handled by the "throwing blocker" from the previous paragraph, that is the Java method returns 0 or `null`.

## Verification

The verification functions `verify-lisp-proxies` and `verify-lisp-proxy` are provided to allow you to do some checking of the correctness of your proxy definition. Two things can be verified:

- That the symbols to be called in the proxy definition are fbound. In principle this check could happen at load-time, but that would enforce defining the functions before the proxy. The verification allows you to define the proxies and functions in any order, and then verify all the definitions, for example just before delivery.

- Check that all methods that are declared in the Java interfaces have a *method-desc*, and report those that do not. This requires running Java.

Note that neither of these issues is actually an error, because the default function can handle them. However it is useful to check them in case you did miss something.

## Performance issues

There is a little overhead associated with using `setup-lisp-proxy` as opposed to `define-lisp-proxy`, both in the size of the delivered application (very small) and in run time, but the difference is not large enough to prevent using `setup-lisp-proxy` when it is appropriate.

There is an overhead associated with initializing a proxy definition. It is therefore a bad idea to use `setup-lisp-proxy` many times.

Overrides and using multiple interfaces add a negligible overhead.

`:object-scope` with `nil` or `:local` are useful optimizations. In proxies that are invoked infrequently, say less than 10 times each second, the difference is probably insignificant, but it is useful for proxies that are called repeatedly by Java code. For example, if you implement the interface

`"java.io.FilenameFilter"` to pass to  
`"java.io.File.list"` on large directories, using `:object-scope :local` or `nil` will reduce the overhead significantly.

Examples      `(example-edit-file "android/android-othello-user")`

See also      `make-lisp-proxy`  
`make-lisp-proxy-with-overrides`  
`verify-lisp-proxy`  
`verify-lisp-proxies`  
`check-lisp-calls-initialized`

“Using proxies” on page 207  
“Direct calls” on page 206

|                        | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                  |                     |                        |         |                |                        |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|---------------------|------------------------|---------|----------------|------------------------|
| Summary                | Creates a Lisp class, and potentially some or all the super-classes as needed based on the tree.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                  |                     |                        |         |                |                        |
| Package                | <code>lw-ji</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                  |                     |                        |         |                |                        |
| Signature              | <code>ensure-lisp-classes-from-tree <i>lisp-name</i> <i>java-class-tree</i> <i>force-p</i> =&gt; <i>class</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                  |                     |                        |         |                |                        |
| Arguments              | <table><tr><td><i>lisp-name</i></td><td>A symbol.</td></tr><tr><td><i>java-class-tree</i></td><td>A tree.</td></tr><tr><td><i>force-p</i></td><td>A generalized boolean.</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <i>lisp-name</i> | A symbol.           | <i>java-class-tree</i> | A tree. | <i>force-p</i> | A generalized boolean. |
| <i>lisp-name</i>       | A symbol.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                  |                     |                        |         |                |                        |
| <i>java-class-tree</i> | A tree.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                  |                     |                        |         |                |                        |
| <i>force-p</i>         | A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                  |                     |                        |         |                |                        |
| Values                 | <table><tr><td><i>class</i></td><td>A class metaobject.</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <i>class</i>     | A class metaobject. |                        |         |                |                        |
| <i>class</i>           | A class metaobject.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                  |                     |                        |         |                |                        |
| Description            | <p>The function <code>ensure-lisp-classes-from-tree</code> creates a class for <i>lisp-name</i>, and potentially some or all the super-classes as needed based on the tree. Note that all references to “class” here are to Lisp classes. <code>ensure-lisp-classes-from-tree</code> does not actually know anything about Java.</p> <p><code>ensure-lisp-classes-from-tree</code> appears the output of the importing interface functions, where it is called with the output of <code>get-superclass-and-interfaces-tree</code>. Users can use it as well, but normally using plain <code>defclass</code> is much more appropriate.</p> <p><i>java-class-tree</i> is a tree representing the hierarchy of the Java classes. The structure of the tree is described in the entry for <code>get-superclass-and-interfaces-tree</code>. In general it is assumed that this tree was generated by <code>get-superclass-and-interfaces-tree</code>, but you can generate it yourself if</p> |                  |                     |                        |         |                |                        |

you find it useful, but normally simply using `defclass` to define the classes you want is better.

`force-p` controls whether to force classes to exist or not.

The processing of a node in the tree when `force-p` is `nil` is as follows (note that the `java-class-tree` argument is the first node):

1. Find the symbol corresponding to the class. For the first node, this is the `lisp-name` argument. For other nodes, it first checks whether `record-java-class-lisp-symbol` recorded the `java-class-name` to `lisp-name` mapping, and use it if it did. If not, `ensure-lisp-classes-from-tree` skips this node and use instead the superclass node.
2. Once the symbol is found, `ensure-lisp-classes-from-tree` processes the nodes of the superclass and the nodes of the interfaces, each one of which returns a class, and construct the superclasses list from the result. It remove duplicates from the list, which can happen because interfaces can be implemented by more than one route.
3. Once it got the superclasses, except for the first node, `ensure-lisp-classes-from-tree` checks whether the symbol has got a class definition, and if this class definition inherit from all the superclasses. If it does, it returns this class as the result. If a class is found but is not inheriting all the superclasses, `ensure-lisp-classes-from-tree` redefine it to inherit all the superclasses (ignoring the existing definition), and return it. If the class is not found, `ensure-lisp-classes-from-tree` skips this node and use instead the superclass node.

For the first node, `ensure-lisp-classes-from-tree` always creates the class.

If `force-p` is true, then `ensure-lisp-classes-from-tree` never fails for any node. Instead, in step 1.) when it does not find the symbol it generates a symbol in the same way that

`generate-javascript-definitions` does by default, and in step 3.) if there is no class it creates it.

- Notes
1. `ensure-lisp-classes-from-tree` does not need running Java.
  2. The main purpose of `ensure-lisp-classes-from-tree` is to create the needed class(es) at load-time without a need for running Java. It is not intended to be used at run time.
  3. `ensure-lisp-classes-from-tree` uses `clos:ensure-class` to create or redefine classes, so requires keeping CLOS in a delivered image (as described in the *LispWorks Delivery User Guide*).
  4. When the `java-class-tree` argument matches the Java hierarchy, as it is when it is the result of `get-superclass-and-interfaces-tree`, if `force-p` is true `ensure-lisp-classes-from-tree` generates a full hierarchy with a CLOS class matching each Java class. with `force-p nil`, at least `standard-java-object` will always be in the hierarchy, plus any classes that were define by the importing interface or recorded by the user using `record-javaclass-lisp-symbol`.

See also  
`get-superclass-and-interfaces-tree`  
`generate-javascript-definitions`

|           |                                                     | <i>Function</i>                                                                       |
|-----------|-----------------------------------------------------|---------------------------------------------------------------------------------------|
| Summary   | <code>ensure-supers-contain-java.lang.object</code> |                                                                                       |
| Package   |                                                     | <code>lw-ji</code>                                                                    |
| Signature |                                                     | <code>ensure-supers-contain-java.lang.object super-symbols lisp-name =&gt; nil</code> |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                    |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| Arguments   | <i>super-symbols</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | A list of symbols. |
|             | <i>lisp-name</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | A symbol.          |
| Values      | <code>ensure-supers-contain-java.lang.object</code> returns <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                    |
| Description | <p>The function <code>ensure-supers-contain-java.lang.object</code> checks that at least one of the symbols in <i>super-symbols</i> names a subclass of <code>standard-java-object</code> (or <code>standard-java-object</code> itself), otherwise it signals an error reporting that the superclasses for <i>lisp-name</i> do not have a subclass of <code>standard-java-object</code>.</p> <p><code>intern-and-export-list</code> is a utility function that is used by the importing interface when <i>lisp-supers</i> is passed to ensure at load-time that the supers contain a subclass of <code>standard-java-object</code>.</p> |                    |
| See also    | <code>generate-java-class-definitions</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                    |

|              | <i>Condition</i>                                                                                                                                                                                                                                     |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary      | Conditions signaled when accessing a field gets an exception.                                                                                                                                                                                        |
| Package      | <code>lw-ji</code>                                                                                                                                                                                                                                   |
| Superclasses | <code>field-exception</code>                                                                                                                                                                                                                         |
| Subclasses   | None.                                                                                                                                                                                                                                                |
| Readers      | <code>field-access-exception-set-p</code>                                                                                                                                                                                                            |
| Description  | <p>The condition class <code>field-access-exception</code> is a subclass of <code>field-exception</code>.</p> <p><code>field-access-exception</code> is signaled when an attempt to access a field gets an exception. This can occur for various</p> |

reasons, for example the new value that was passed for setting is not an acceptable value.

The reader **field-access-exception-set-p** indicates whether the attempted access was setting or reading.

|          |                                                                                                                                                                               |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | You can use the <b>field-exception</b> readers <b>field-exception-class-name</b> and <b>field-exception-field-name</b> on conditions of class <b>field-access-exception</b> . |
| See also | <b>field-exception</b>                                                                                                                                                        |

## **field-exception** *Condition*

|              |                                                                                                                                                                                                                                                                                                                                                                                                                               |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary      | An abstract class, meaning that it is not signaled. Its readers can be used to access the subclasses.                                                                                                                                                                                                                                                                                                                         |
| Package      | <b>lw-ji</b>                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Superclasses | <b>java-normal-exception</b>                                                                                                                                                                                                                                                                                                                                                                                                  |
| Subclasses   | <b>field-access-exception</b>                                                                                                                                                                                                                                                                                                                                                                                                 |
| Readers      | <b>field-exception-class-name</b><br><b>field-exception-field-name</b>                                                                                                                                                                                                                                                                                                                                                        |
| Description  | The condition class <b>field-exception</b> is a subclass of <b>java-normal-exception</b> . <b>field-exception</b> is an abstract class, meaning that it is not signaled. Its subclass <b>field-access-exception</b> is signaled however and its readers can be used to access those conditions.<br><br><b>field-exception-class-name</b> returns the class name and <b>field-exception-field-name</b> returns the field name. |
| See also     | <b>field-access-exception</b>                                                                                                                                                                                                                                                                                                                                                                                                 |

|                        | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>find-java-class</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Summary                | Finds a Java class and returns a <code>jobject</code> representing it                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Package                | <code>lw-ji</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Signature              | <code>find-java-class class-sym-or-string &amp;optional errorp =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Arguments              | <code>class-sym-or-string</code> A symbol or a string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Values                 | <code>result</code> A <code>jobject</code> or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Description            | <p>The function <code>find-java-class</code> finds a Java class and returns a <code>jobject</code> representing it.</p> <p>If <code>class-sym-or-string</code> is a string, it should be the full name of class. <code>find-java-class</code> allows the '.' in the names to be replaced by '/' (which is how the class is actually looked up). <code>find-java-class</code> also recognizes class names of primitives (for example, "int"), and can also find classes for arrays, using the internal syntax with leading '[' character(s).</p> <p>If <code>class-sym-or-string</code> is a symbol, it can be a keyword specifying a primitive class (see the table in “Types and conversion between Lisp and Java” on page 198), one of <code>:object</code> or <code>t</code> to specify <code>java.lang.Object</code>, <code>:string</code> to specify <code>java.lang.String</code>, or a symbol which is set to a string, in which case the value is used to search for a class.</p> <p>If <code>find-java-class</code> finds the Java class, it returns a <code>jobject</code> representing it.</p> <p>Otherwise, if <code>errorp</code> is non-nil it signals an error, otherwise it returns <code>nil</code>. The default value of <code>errorp</code> is <code>t</code>.</p> |
| Notes                  | For most of the Java interface, you do not actually need to find the class.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

|             |                      | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     |                      | Formats a string and sends it to the Java host.                                                                                                                                                                                                                                                                                                                                                               |
| Package     |                      | <code>lw-ji</code>                                                                                                                                                                                                                                                                                                                                                                                            |
| Signature   |                      | <code>format-to-java-host <i>format-string</i> <i>args</i> =&gt; <i>result</i></code>                                                                                                                                                                                                                                                                                                                         |
| Arguments   | <i>format-string</i> | A format control string.                                                                                                                                                                                                                                                                                                                                                                                      |
|             | <i>args</i>          | Arguments for <i>format-string</i> .                                                                                                                                                                                                                                                                                                                                                                          |
| Values      | <i>result</i>        | A boolean.                                                                                                                                                                                                                                                                                                                                                                                                    |
| Description |                      | <p>The function <code>format-to-java-host</code> sends a message to the Java host.</p> <p>It creates a message by applying <code>cl:format</code> with <i>destination nil</i> to <i>format-string</i> and <i>args</i>, and sends it using <code>send-message-to-java-host</code> with <i>where-keyword :append</i>.</p> <p><i>result</i> is the value returned by <code>send-message-to-java-host</code>.</p> |
| See also    |                      | <code>send-message-to-java-host</code>                                                                                                                                                                                                                                                                                                                                                                        |

|           |  | <i>Function</i>                                                                                                                                                                                                                                                |
|-----------|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary   |  | Returns a list of forms which are definitions of Java callers that call the public methods (including constructors) of the supplied class, and accessors for public fields.                                                                                    |
| Package   |  | <code>lw-ji</code>                                                                                                                                                                                                                                             |
| Signature |  | <code>generate-java-class-definitions <i>java-class-name</i> &amp;key <i>lisp-name package-name prefix name-constructor export-p create-defpackage lisp-class-p lisp-supers</i> =&gt; <i>list-of-definitions, lisp-name-symbol, package-name-string</i></code> |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arguments   | <p><i>java-class-name</i> A string.</p> <p><i>lisp-name</i> A symbol.</p> <p><i>package-name</i> A string.</p> <p><i>prefix</i> A string or <code>nil</code>.</p> <p><i>name-constructor</i> A function designator.</p> <p><i>export-p</i> A generalized boolean.</p> <p><i>create-defpackage</i> A generalized boolean.</p> <p><i>lisp-class-p</i> A generalized boolean.</p> <p><i>lisp-supers</i> A list of symbols.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Values      | <p><i>list-of-definitions</i> A list.</p> <p><i>lisp-name-symbol</i> A symbol.</p> <p><i>package-name-string</i><br/>A package name.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Description | <p>The function <code>generate-java-class-definitions</code> returns a list of forms which are definitions of Java callers that call the public methods (including constructors) of the class specified by <i>java-class-name</i>, and accessors for public fields. These include inherited methods and fields.</p> <p><code>generate-java-class-definitions</code> is normally used indirectly by using <code>import-java-class-definitions</code>, but can also be used directly. <code>write-java-class-definitions-to-file</code> and <code>write-java-class-definitions-to-stream</code> do the same processing as <code>generate-java-class-definitions</code>, and then generate output based on the result.</p> <p><i>java-class-name</i> must name a Java class, and it must be the precise full name, for example "<code>java.io.File</code>", "<code>android.view.View</code>".</p> <p>If <i>lisp-name</i> is supplied it must be a Lisp symbol. In this case it specifies the package to intern the names of definitions in,</p> |

and if a CLOS class is defined, the name of this class. It is also automatically defined as a constant with a value the *java-class-name*. *lisp-name* can also be `nil`.

If *lisp-name* is not supplied, the system creates a Lisp symbol based on the *java-class-name*. Note that this is different from passing `nil`, because in the latter case *lisp-name* stays `nil`.

*package-name* is used only if *lisp-name* is supplied as `nil`, to specify the package where the names of the definitions are interned. It must be a string containing the package name (in the desired case). The package is created if it does not exist already. If *lisp-name* is `nil` and *package-name* is `nil` or not supplied, the current package is used.

*prefix*, if supplied, specifies a prefix to use for the names of the definitions. If *prefix* is not supplied or is `nil`, the name of the Java class without the package part is uppercased and used as the *prefix* (for example for "java.io.File" the *prefix* is "FILE"). The *prefix* is passed to the *name-constructor* to construct names for the Java callers.

If *name-constructor* is supplied, it must be a function taking two string arguments: the *prefix* and the name of the Java method or field that the Java caller is going to call or access (for constructors, the string "new" is passed as the method name). It must return a string which is then interned (without changing the case) in the package to create the symbol that is used as the name of the caller. The *name-constructor* defaults to a function (`default-name-constructor`) that concatenates the *prefix* as it is, a dot and uppercase of the method/field name. For example, for the method "exists" in the Java class "java.io.File", the default name constructor with the default *prefix* would generate "FILE.EXISTS".

*export-p* controls whether all the Java callers are exported from the package. If it is `t` all the Java callers are exported, otherwise they are not. The default of *export-p* is `t`.

`create-defpackage` controls what form to generate to do the package manipulation. With the default, `generate-java-class-definitions` generates a form that checks that the package exists, otherwise creates it, and if `export-p` is `t`, a form that exports all the symbols. If `create-defpackage` is non-nil, `generate-java-class-definitions` generates a `defpackage` form instead. The default value of `create-defpackage` is `nil`.

**Note:** the reason the `create-defpackage` defaults to `nil` is that the `defpackage` form would contain only the symbols that were defined by the importing, which would be wrong if the package needs to export other symbols too, which is quite likely with the default settings (because other classes in the same Java package will default to use the same Lisp package). `create-defpackage` is useful when you want to create a package that exports only the definitions for a single Java class.

`lisp-supers` and `lisp-class-p` control whether a CLOS class is defined for the Java class. By default, no CLOS class is defined. See in “Creating CLOS class” on page 1244.

The generation of the Java callers and accessors by `generate-java-class-definitions` is as follows:

1. Based on the arguments as described above, it determines the package, `prefix` and `name-constructor` to use, and whether it has a `lisp-name` and needs to define a CLOS class. It then finds the definition of the Java class.
2. It uses Java methods to find the names of all the public methods, constructors and fields of the class (including inherited ordinary methods and fields).
3. For each name, it calls the `name-constructor` with the `prefix` and the name to generate a symbol name which is then interned in the package to generate a symbol. It then generates a form where the operator is one of the macros

`define-javascript-caller`, `define-javascript-constructor`, or `define-field-accessor`, as appropriate, using the symbol as the name.

For example, with the defaults generating for `"java.io.File"`, the constructor would be defined by

```
(define-javascript-constructor FILE.NEW  
"java/io/File")
```

The caller for the method `"exists"` would be defined by:

```
(define-javascript FILE.EXISTS "java/io/File"  
"exists")
```

the accessor for the field `"separator"` would be defined by:

```
(define-field-accessor file.separator  
"java/io/File" "separator" t t)
```

Note that `generate-javascript-class-definitions` uses `'/'` rather than `'.'` as separator between the components. The definer macros accept both `'/'` and `'.'` as separators. The actual generated forms may contain additional keywords. Currently methods and constructors have the signatures.

4. `generate-javascript-class-definitions` also identifies pairs of methods where one has the name `set<something>` and the other has the name `get<something>` or `is<something>`, which are assumed to be setter and getter for the same field. It then generates a `c1:setf` definition to allow using `c1:setf` on the symbol corresponding to `get<something>` or `is<something>` name to call the `set<something>` method.
5. For fields, `generate-javascript-class-definitions` also generates a symbol macro with a name that is the symbol name preceded and followed by the `*` character, and allows getting and the setting the field using this symbol.

The first return value of `generate-java-class-definitions` is a list of forms. The list contains the following forms in this order:

- Package manipulation forms (ensuring the package exist and exporting if required) either as `defpackage` forms or forms that explicitly ensure the existence of the package and do any exporting.
- If there is a *lisp-name*, define it as constant with the class name as value, and record the relation between the Java class name and the symbol (this is used by `create-instance-from-jobject`).
- All the Java callers and accessors that were defined as described in the previous paragraph.
- If a CLOS class is needed, a form to create the class.

`generate-java-class-definitions` also returns the *lisp-name* (supplied or generated) as second return value, and the package name of the package that it used as third value.

## Creating CLOS class

**Note:** see the discussion “CLOS partial integration” on page 218.

The arguments *lisp-class-p*, *lisp-supers* and *lisp-name* control whether the importing also defines a class. *lisp-name* and either *lisp-supers* or *lisp-class-p* must be non-nil to generate a Lisp class.

*lisp-name*, when non-nil, defines the name of the class. Note that by default *lisp-name* is not `nil`, because `generate-java-class-definitions` generates a symbol if *lisp-name* is not supplied.

If *lisp-supers* is supplied and non-nil (and *lisp-name* is non-nil) a class is created, using a plain `defclass` form, and the value *lisp-class-p* is ignored. *lisp-supers* must be a list of symbols naming classes, of which at least one is `standard-java-`

`object` or a subclass of it. This list defines the superclasses of the class that is defined.

If `lisp-class-p` is non-nil and `lisp-supers` is `nil` (and `lisp-name` is non-nil) a class is created using `ensure-lisp-classes-from-tree`. If `lisp-class-p` is the keyword `:complete`, the `force-p` argument is passed is `t`, otherwise it is `nil`. See `ensure-lisp-classes-from-tree` for details.

`generate-java-class-definitions` returns three arguments: the list of definitions, the `lisp-name` and the package name.

|          |                                                                                                                                                                                           |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | <code>generate-java-class-definitions</code> require running Java Virtual Machine, and access to the class definition via the <code>java.lang.reflect</code> package functionality.       |
| See also | <code>write-java-class-definitions-to-stream</code><br><code>write-java-class-definitions-to-file</code><br><code>import-java-class-definitions</code><br>“Importing classes” on page 201 |

| get-host-java-virtual-machine |                  | <i>Function</i>                                                                                                                                                                                 |
|-------------------------------|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary                       |                  | Return the host Java virtual machine in a dynamic library loaded by Java.                                                                                                                       |
| Package                       |                  | <code>lw-ji</code>                                                                                                                                                                              |
| Signature                     |                  | <code>get-host-java-virtual-machine =&gt; jvm</code>                                                                                                                                            |
| Values                        | <code>jvm</code> | A <code>java-vm-poi</code> or <code>nil</code> .                                                                                                                                                |
| Description                   |                  | The function <code>get-host-java-virtual-machine</code> returns the host Java virtual machine when it is called in a dynamic library that was delivered with a call <code>setup-deliver-</code> |

`dynamic-library-for-java`, and the dynamic library was loaded by Java. In all other circumstances it returns `nil`.

If the initialization of the Java interface is synchronous, which is determined the `asynchronous` argument of `setup-deliver-dynamic-library-for-java` and is the default, then during the call to the deliver startup function (the first argument of `deliver`), `get-host-java-virtual-machine` still returns `nil`. It is guaranteed to return the correct value only when the `function` argument of `setup-deliver-dynamic-library-for-java` (if any) is called. In the asynchronous case, `get-host-java-virtual-machine` always returns the correct value.

The result `jvm`, when it is not `nil`, is an object of type `java-vm-poi`.

`get-host-java-virtual-machine` is useful as a predicate to determine if the library was loaded by Java or non-Java code.

#### Notes

`get-host-java-virtual-machine` can find the virtual machine because Java calls `JNI_OnLoad` with it. If a non-Java code calls `JNI_OnLoad` with something else, then `get-host-java-virtual-machine` will return that something else.

When `init-java-interface` is called without a specified Java virtual machine, it uses `get-host-java-virtual-machine` to try to find the current one.

#### See also

`setup-deliver-dynamic-library-for-java`  
`init-java-interface`  
 Chapter 15, “Java interface”

## get-java-virtual-machine

## *Function*

#### Summary

If a Java virtual machine has started, return it.

#### Package

`lw-ji`

|             |                                                                                                                                                                                                                                                                                    |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signature   | <code>get-java-virtual-machine =&gt; java-virtual-machine</code>                                                                                                                                                                                                                   |
| Arguments   | None.                                                                                                                                                                                                                                                                              |
| Values      | <code>java-virtual-machine</code> A <code>java-vm-poi</code> .                                                                                                                                                                                                                     |
| Description | The function <code>get-java-virtual-machine</code> returns the Java virtual machine if it has started. If LispWorks already knows what the virtual machine is, it just returns it. Otherwise, it tries to use the C function <code>JNI_GetCreatedJavaVMs</code> to try to find it. |
| See also    | <code>init-java-interface</code>                                                                                                                                                                                                                                                   |

## get-jobject

## ensure-is-jobject

## Functions

|             |                                                                                                                                                                                                                                                                                                                                                                                |                          |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| Summary     | Get the <code>jobject</code> of the argument.                                                                                                                                                                                                                                                                                                                                  |                          |
| Package     | <code>lw-ji</code>                                                                                                                                                                                                                                                                                                                                                             |                          |
| Signature   | <code>get-jobject object =&gt; jobject</code>                                                                                                                                                                                                                                                                                                                                  |                          |
| Signature   | <code>ensure-is-jobject object caller =&gt; jobject</code>                                                                                                                                                                                                                                                                                                                     |                          |
| Arguments   | <code>object</code>                                                                                                                                                                                                                                                                                                                                                            | A Lisp object.           |
|             | <code>caller</code>                                                                                                                                                                                                                                                                                                                                                            | A Lisp object.           |
| Values      | <code>jobject</code>                                                                                                                                                                                                                                                                                                                                                           | A <code>jobject</code> . |
| Description | The functions <code>get-jobject</code> and <code>ensure-is-jobject</code> both get the <code>jobject</code> of the <code>object</code> argument. If <code>object</code> is already a <code>jobject</code> it is simply returned. If it is an instance of <code>standard-java-object</code> and has an associated <code>jobject</code> , this <code>jobject</code> is returned. |                          |

Otherwise, `get-object` returns `nil` but `ensure-is-object` signals an error. `ensure-is-object` uses *caller* in the error message to identify where the error occurred.

|          |                                                                                                                                                        |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | <code>get-object</code> is the predicate to check whether an object is a Java object.                                                                  |
| See also | <code> jobject-p</code><br><code> jobject</code><br>“Types and conversion between Lisp and Java” on page 198<br>“CLOS partial integration” on page 218 |

## get-primitive-array-region set-primitive-array-region

### Functions

|           |                                                                                                                       |                                                                                                                                      |
|-----------|-----------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| Summary   | Copy between a Java array of primitive type and a buffer specified by a foreign pointer.                              |                                                                                                                                      |
| Package   | <code>lw-ji</code>                                                                                                    |                                                                                                                                      |
| Signature | <code>get-primitive-array-region array &amp;key start end buffer buffer-size =&gt; target-buffer, foreign-type</code> |                                                                                                                                      |
| Signature | <code>set-primitive-array-region array buffer &amp;key start end =&gt; t, foreign-type</code>                         |                                                                                                                                      |
| Arguments | <code>array</code><br><code>start, end</code><br><code>buffer</code><br><code>buffer-size</code>                      | A Java array of primitive type.<br>Bounding index designators for <code>array</code> .<br>An FLI pointer.<br>A non-negative integer. |
| Values    | <code>target-buffer</code><br><code>foreign-type</code>                                                               | <code>buffer</code> or a new buffer.<br>A foreign type.                                                                              |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The function <code>get-primitive-array-region</code> copies from a Java array of primitive type to a buffer specified by a foreign pointer.</p> <p>The function <code>set-primitive-array-region</code> copies from a buffer specified by a foreign pointer to a Java array of primitive type.</p> <p><i>buffer</i>, if supplied, must be a foreign pointer pointing to a suitable buffer, which means large enough to receive the data in <code>get-primitive-array-region</code>, or containing the desired data in <code>set-primitive-array-region</code>.</p> <p><i>start</i> and <i>end</i> are bounding index designators for <i>array</i>, specifying the region to copy in number of elements.</p> <p><i>buffer-size</i> is used only when <i>buffer</i> is also supplied. <i>buffer-size</i> specifies the number of bytes to copy into <i>buffer</i>. If copying the required number of elements requires more bytes, <code>get-primitive-array-region</code> signals an error. Note that <i>buffer-size</i> is specified in bytes, while <i>start</i> and <i>end</i> are specified in elements.</p> <p>If <i>buffer</i> is not supplied to <code>get-primitive-array-region</code> it creates a buffer of the correct size using <code>fli:allocate-foreign-object</code>. In this case you will need to free the buffer using <code>fli:free-foreign-object</code> when the program has finished with it.</p> <p><code>get-primitive-array-region</code> copies the required number of elements into the buffer, and returns two values: the target buffer (either the <i>buffer</i> argument or the new buffer) and the <i>foreign-type</i> corresponding to the Java primitive type (one of <code>jbyte</code>, <code>jshort</code>, <code>jint</code>, <code>jlong</code>, <code>jfloat</code>, <code>jdouble</code>, <code>jboolean</code> and <code>jchar</code>).</p> <p><code>set-primitive-array-region</code> copies the required number of elements from <i>buffer</i> to <i>array</i>, and returns two values: <i>t</i> and the foreign type.</p> |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|          |                                                                                                                                                                                                                |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | These functions are useful when you need to pass the data to foreign code. If you need the data in Lisp, use <code>lisp-array-to-primitive-array</code> or <code>primitive-array-to-lisp-array</code> instead. |
| See also | <code>lisp-array-to-primitive-array</code><br><code>primitive-array-to-lisp-array</code><br>“Working with Java arrays” on page 210                                                                             |

|                                           | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>get-superclass-and-interfaces-tree</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Summary                                   | Returns the superclasses and implemented interfaces of a supplied Java class.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Package                                   | <code>lw-ji</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Signature                                 | <code>get-superclass-and-interfaces-tree java-class =&gt; java-class-tree</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Arguments                                 | <code>java-class</code> A <code>jobject</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Values                                    | <code>java-class-tree</code> A tree.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Description                               | The function <code>get-superclass-and-interfaces-tree</code> takes a Java class and returns of its superclasses and implemented interfaces. It is used by the importing interface to generate a tree which is then output as argument to <code>ensure-lisp-classes-from-tree</code> . It may be useful on its own, as a quick way of finding the tree for a class.<br><br><code>java-class</code> must be a Java class, that is a <code>jobject</code> corresponding to a class. Typically that would be the result of <code>find-java-class</code> , but it can be the result of your calls to Java methods. Using the Java methods "getInterfaces", "getSuperclass" and "getName" in the Java class "java.lang.Class", <code>get-superclass-and-interfaces-tree</code> constructs a complete |

tree of the superclasses and implemented interfaces of the class and its superclasses.

Each node in the tree is a vector of three elements:

- 0) The full name of the class as a string
  - 1) A node for the superclass (in Java terminology, the one it extends), or `nil` if there is no superclass (for `java.lang.Object` and interfaces).
  - 2) A list of nodes corresponding to the interfaces that the class implements.

`get-superclass-and-interfaces-tree` returns the node for the class itself.

See also [ensure-lisp-classes-from-tree](#)  
[generate-java-class-definitions](#)

## **import-java-class-definitions** *Macro*

**Summary** Generates all the definitions for a Java class.

## Package **lw-ji**

**Signature** `import-javaclass-definitions java-class-name &key lisp-class-p lisp-name export-p package-name name-constructor lisp-supers => lisp-name-symbol`

Arguments      *java-class-name*    A string.

## *lisp-class-n* A generalized boolean

*lisp-name*      A symbol

export-*p* A generalized boolean

*package-name* A package designator

*name-constructor* A function designator

## *lisp-supers* A list of symbols

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Values      | <i>lisp-name-symbol</i> A symbol.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Description | <p>The macro <code>import-java-class-definitions</code> generates all the definitions for the class <code>java-class-name</code>, and wraps <code>c1:progn</code> around them, and returns this from the macroexpansion. Therefore evaluation of an <code>import-java-class-definitions</code> form defines all the callers for <code>java-class-name</code>. <code>java-class-name</code> name must name a Java Class, and it must be the precise full name.</p> <p>The generation of the definitions is done by <code>generate-java-class-definitions</code>, and all the keywords are passed to it. See the entry for <code>generate-java-class-definitions</code> for the effects of the keywords.</p> <p>During macroexpansion, <code>import-java-class-definitions</code> needs to be able to find the class definitions, for which it needs running Java, which means a Java Virtual Machine running and the class being accessible. The evaluation of the definitions does not require Java. Thus if you compile a file containing an <code>import-java-class-definitions</code> form, the binary file can be loaded without Java, but the compilation needs running Java, and loading the source file also requires running Java.</p> <p>The returned value <i>lisp-name-symbol</i> is the Lisp name (which is <i>lisp-name</i>, or is generated by <code>generate-java-class-definitions</code> if <i>lisp-name</i> was not supplied).</p> <p>See “Importing classes” on page 201 for discussion.</p> |
| Notes       | <ol style="list-style-type: none"><li>1. You can avoid the need for running Java during compilation by writing the definitions using the writers (<code>write-java-class-definitions-to-file</code> or <code>write-java-class-definitions-to-stream</code>) once, and incorporate the output into your sources.</li></ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

2. Even when you use `import-java-class-definitions`, it is probably useful to look at the output of the writers to have a better idea what is actually being generated.

Examples      (`import-java-class-definitions "java.io.File"`)

See also      `generate-java-class-definitions`  
`write-java-class-definitions-to-file`  
`write-java-class-definitions-to-stream`  
“Importing classes” on page 201

## init-java-interface

### setup-java-interface-callbacks

*Functions*

Summary      Initializes the Java interface.

Package      `lw-ji`

Signature      `init-java-interface &key jvm-library-path java-class-path  
option-strings jni-env-finder java-virtual-machine class-finder class-loader-finder java-to-lisp-debugger-hook report-error-to-java-host  
send-message-to-java-host => result`  
`setup-java-interface-callbacks &key class-finder java-to-lisp-debugger-hook report-error-to-java-host send-message-to-java-host => t`

Arguments      *jvm-library-path* A string, `t` or `nil`.

*java-class-path* A string or a list of strings.

*option-strings* A list.

*jni-env-finder* A function designator, or `nil`.

*java-virtual-machine*

A foreign pointer of type `java-vm-poi`, or `t`.

*class-finder* A function designator or `nil`.

*class-loader-finder* A function designator or `nil`.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                               |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|
|             | <i>java-to-lisp-debugger-hook</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | A function designator or <code>nil</code> .                   |
|             | <i>report-error-to-java-host</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | A function designator or <code>nil</code> .                   |
|             | <i>send-message-to-java-host</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | A function designator or <code>nil</code> .                   |
| Values      | <i>result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <code>t</code> or the keyword <code>:no-java-to-lisp</code> . |
| Description | <p>The function <code>init-java-interface</code> needs to be called before using any of the run time part of the Java interface. That includes the interface functions that are documented as requiring Java, and any of the user-defined callers. The definers in general do not need running Java, but the importing interface does.</p> <p><b>Note:</b> On Android and in dynamic libraries that were delivered with <code>setup-deliver-dynamic-library-for-java</code> with <code>init-java</code> true (the default), <code>init-java-interface</code> is called automatically by the system initialization, so you do not need to (and must not) call it.</p> <p><code>init-java-interface</code> may be used to first initialize the Java Virtual Machine (JVM) or can be called with the JVM already running.</p> |                                                               |

## Initializing the virtual machine

If `init-java-interface` needs to initialize the JVM, it must be called with `jvm-library-path` either `t` or the path of a dynamic library, and `jni-env-finder` must be `nil`. When `jvm-library-path` is `t`, `init-java-interface` uses a default JVM library path, which is currently `"/System/Library/Frameworks/JavaVM.framework/JavaVM"` on Mac OS X and `"-ljvm"` on other Unix variants. On Windows, `init-java-interface` checks the registry for the location of the JVM library, using the keys that Oracle document in *Java 2 Runtime*

*Environment for Microsoft Windows.* The library must implement the JVM, which means exporting the JNI functions, and to be able to find any supporting files that it may need. It loads this library by `fli:register-module`, and then initializes it using `JNI_CreateJavaVM`. The keyword arguments `java-class-path` and `option-strings` can be used to pass options to `JNI_CreateJavaVM`. Except on Mac OS X, passing `jvm-library-path` t can work only if the library path contains the JVM library.

`java-class-path` specifies the class path(s) for additional classes on top of the system ones. It is used to specify the `-Djava.class.path` option. If `java-class-path` is a string, it is passed as is, and may contain more than path separated by the appropriate separator (#\: on Unix, #\; on Windows), for example `"/myhomedir/myjavaclass;/systemdir/systemjavaclasses/"`. If it is a list, each string should be a path. Each path needs to specify either a directory containing JAR files, or a full path of a JAR file.

If you want to make calls from Java to Lisp, you will need to have the Java class `com.lispworks.LispCalls`. `com.lispworks.LispCalls` is defined in the JAR file `lispcalls.jar` which is part of the LispWorks distribution in the `etc` directory, that is (`lispworks-file "etc/lispcalls.jar"`), so this JAR file will have to be on the path. If you develop for Android and want to import Android classes, you will need the `android.jar` on the path too.

`option-strings` can be used to pass options to `JNI_CreateJavaVM`. Each element of `option-strings` is either a string or a cons of two strings. An element which is a string is passed as the option string (slot `optionString` of the `JavaVMOption` C struct). For a cons, the car is passed as the option string, and the cdr as the extra info (slot `extraInfo` in the `JavaVMOption`). Note that that you should not use the option `-Djava.class.path` when using the `java-class-path` argument.

*java-class-path* and *option-strings* are ignored when `init-java-interface` is called after the JVM started.

## Calling with JVM already running

If `init-java-interface` is called with the JVM already running, then *jvm-library-path* must be `nil`, and either *jni-env-finder* or *java-virtual-machine* must be supplied as non-`nil`, except when called inside a dynamic library delivered with `setup-deliver-dynamic-library-for-java`, when all arguments can be `nil`.

If *jni-env-finder* is non-`nil` then it must be a function of no arguments that returns a pointer to the JNI environment for the current thread. The result of the finder must be a foreign pointer of type *jni-env-poi*, corresponding to the C pointer `JNIEnv*`. The finder function needs to cope with being called on any thread and the result needs to be valid until that thread dies, at which point implementing code must deal with eliminating it. In general, this function needs to know how to find the Java virtual machine, and then use the JNI functions `AttachCurrentThread` OR `GetEnv`.

If *jni-env-finder* is `nil`, then *java-virtual-machine* is used. If *java-virtual-machine* is `t`, LispWorks tried to find the Java virtual machine by first calling `get-host-java-virtual-machine`, and if this returns `nil`, by calling `JNI_GetCreatedJavaVMs`. Otherwise, *java-virtual-machine* is used as the virtual machine and must be a foreign pointer of type *java-vm-poi*, corresponding to the C type `JavaVM*`.

When running in a dynamic library delivered with `setup-deliver-dynamic-library-for-java`, `init-java-interface` should be called with *jvm-library-path*, *jni-env-finder* and *java-virtual-machine* all `nil` because the Java virtual machine is obtained using `get-host-java-virtual-machine` in this case.

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes                  | <p>The simple option when the JVM is already running is just passing <code>java-virtual-machine t</code>. However, the function that the system uses, <code>JNI_GetCreatedJavaVMs</code>, is a relic from the time when Java allowed more than one Java VM in each process, which it no longer allows. So in principle some day it may be eliminated (Android already does not define it, but on Android the system calls <code>init-java-interface</code> with <code>jni-env-finder</code>, so this does not matter). On the other hand it is documented in the latest version (8) without any indication that it is deprecated.</p> |
|                        | <p>You may have a pointer to the Java VM to pass to <code>init-java-interface</code> either because you got it from code that started the Java VM (by <code>JNI_CreateJavaVM</code>), or by exporting <code>JNI_OnLoad</code> from a dynamic library. However, it is not a good idea to export <code>JNI_OnLoad</code> as a foreign callable from LispWorks when it is delivered as a dynamic library, because it will have to wait until LispWorks finished initialization. See “Loading a LispWorks dynamic library into Java” on page 217.</p>                                                                                     |
|                        | <p>By default, <code>setup-deliver-dynamic-library-for-java</code> sets up automatic initialization of the Java interface on startup. You need (and can call) <code>init-java-interface</code> in such a dynamic library only if you passed <code>nil</code> for the <code>init-java</code> argument to <code>setup-deliver-dynamic-library-for-java</code>.</p>                                                                                                                                                                                                                                                                      |
|                        | <p>If you call <code>init-java-interface</code> with <code>jvm-library-path</code>, <code>jni-env-finder</code> and <code>java-virtual-machine</code> all <code>nil</code> and <code>get-host-java-virtual-machine</code> returns <code>nil</code>, then <code>init-java-interface</code> returns <code>nil</code> rather than give an error.</p>                                                                                                                                                                                                                                                                                     |
| Description<br>(cont.) | <p><code>class-finder</code> specifies a class finder function to be used if the normal search fails. It must be a function taking a string argument, and return a <code>jobject</code> representing a class for this string (for example, a caller for the method <code>java.lang.Class.forName</code> does the right thing). It is useful when the application knows how to find classes which are not visible from the system class loader. On Android, <code>class-</code></p>                                                                                                                                                    |

*finder* is passed with a function that calls `java.lang.Class.forName` with the application Class loader, which will find all classes in the application.

*class-loader-finder* is used when initializing the LispCalls. If it is non-nil, it must be a function of no arguments that returns a ClassLoader `jobject`. It is called once during initialization, and the result is stored to be used to find the interfaces when initializing a proxy definition. On Android, it is passed with a function that returns the application class finder. You need to be a Java expert to use this option.

*java-to-lisp-debugger-hook*, when supplied, must be either a function of one argument or `nil`. When it is a function, it will be called when the debugger is invoked inside a call from Java to Lisp. The argument is a `c1:condition` object describing the problem. The function needs to do something to inform the user of the problem but not actually interactively, and return. The caller will then return a default value to Java. By default there is a hook that logs a bug form (by `log-bug-form`) and prints a message to the console. On Android, it is set to a function that logs the error and then invokes the user Java error reporters (set in Java by `com.lispworks.Manager.setErrorReporter` and `com.lispworks.Manager.setGuiErrorReporter`, see the entry for `setErrorReporter`).

*report-error-to-java-host*, when supplied, must be a function of two arguments, both of which are strings. When it is passed, if the function `report-error-to-java-host` is called it uses this function to actually do the report. The first argument is assumed to be the error string and the second a filename where there is a bug form, or `nil`. The function should report to the Java host, whatever that actually means. This keyword is used by the Android interface to set a function that calls into the Android Java code and invokes the same user Java error reporters that are used for the debugger hook above.

The system does not call `report-error-to-java-host` itself, so the context in which the function may be called is defined by your calls to it. However, it is intended to be used in error handlers, which means it should be able to cope with any context. The default function just prints to `cl:*terminal-io*`, which may be useful enough when just debugging.

`send-message-to-java-host`, when supplied, must be a function of two arguments: a string which is the message and a keyword, which tells it how to deal with it. The intent is to modify the "messages output" as described for the `where-keyword` in `send-message-to-java-host`. The meaning of "messages output" and the actual behavior is up to the function. On Android it is supplied a function that ends up calling the method `com.LispWorks.Manager.addMessage`. The default function checks the keyword and then writes the string to `cl:*terminal-io*`, which is probably good enough for testing purposes.

`init-java-interface` returns either `t` for success, or `:no-java-to-lisp` when it is successful but failed to initialize Java-to-Lisp calls, so you cannot call from Java to Lisp or use Lisp proxies. This failure would normally mean that it failed to find the class `com.lispworks.LispCalls`.

`setup-java-interface-callbacks` can be called after `init-java-interface` was called to change the values of `class-finder`, `java-to-lisp-debugger-hook`, `report-error-to-java-host` or `send-message-to-java-host`. This is useful in the situations where LispWorks performs the call to `init-java-interface`, which happens in Android and in a dynamic library delivered with `setup-deliver-dynamic-library-for-java`.

See also      Chapter 15, “Java interface”

|             | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                               |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Interns strings in a package and exports the resulting symbols.                                                                                                                                                                                                                                                                                                               |
| Package     | <code>lw-ji</code>                                                                                                                                                                                                                                                                                                                                                            |
| Signature   | <code>intern-and-export-list symbol-name-list package-name =&gt; nil</code>                                                                                                                                                                                                                                                                                                   |
| Arguments   | <code>symbol-name-list</code> A list of strings.<br><code>package-name</code> A package designator.                                                                                                                                                                                                                                                                           |
| Values      | <code>intern-and-export-list</code> returns <code>nil</code> .                                                                                                                                                                                                                                                                                                                |
| Description | <p>The function <code>intern-and-export-list</code> finds the package specified by <code>package-name</code>, interns all the strings in this package, and exports the resulting symbols.</p> <p><code>intern-and-export-list</code> is a utility function that is used by the importing interface to export symbols by default (when not using <code>defpackage</code>).</p> |
| See also    | <code>generate-java-class-definitions</code>                                                                                                                                                                                                                                                                                                                                  |

|           | <i>Function</i>                                                                                                                         |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------|
| Summary   | Read and set an element in a Java array.                                                                                                |
| Package   | <code>lw-ji</code>                                                                                                                      |
| Signature | <code>jaref array &amp;rest indices =&gt; element</code><br><code>(setf jaref) new-value array &amp;rest indices =&gt; new-value</code> |
| Arguments | <code>array</code> A Java array, of any type.<br><code>indices</code> Non-negative integers.                                            |

|             |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------------|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <i>new-value</i> | A valid element for <i>array</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Values      | <i>element</i>   | A Lisp object, a <code>jobject</code> or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Description |                  | <p>The function <code>jaref</code> reads and sets the value of an element in the Java array <i>array</i>.</p> <p>Each of the <i>indices</i> must be an integer in the right range, which means greater than or equal to 0, and less than than the length of the sub-array ("current array" below) for which they are used. There must be at least one index, and the number of indices must be smaller or equal to the array rank (that is, the number of dimensions) of <i>array</i>.</p> <p><i>new-value</i> must be a valid value to store in <i>array</i>. It has the same restrictions as <i>new-value</i> in <code>(setf jvref)</code>. See the discussion in <code>jvref</code> for details.</p> <p>The operation of <code>jaref</code> and <code>(setf jaref)</code> is as follows: For each index except the last, load the element from the "current array", which is the array itself for the first index or the element that was loaded for the previous index. When reaching the last index, <code>jaref</code> and <code>(setf jaref)</code> get or set the element in the "current array" the same way that <code>jvref</code> does. Note that this means that if there are less indices than number of the dimensions of the array, the access will be for a sub-array rather than actual element.</p> |
| Notes       |                  | <p>Because <code>jaref</code> needs to load the sub-srray for each index except the last, repeated calls to <code>jaref</code> for elements inside the same array are wasteful. It is much more efficient to get the sub-array and access it using <code>jvref</code>, or the multiple access functions.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| See also    |                  | <p><code>:jvref</code><br/> <code>map-java-object-array</code><br/> <code>primitive-array-to-lisp-array</code><br/> <code>lisp-array-to-primitive-array</code><br/> “Working with Java arrays” on page 210</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

|                                | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>java-array-element-type</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Summary                        | Returns the element type of a Java array.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Package                        | <code>lw-ji</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Signature                      | <code>java-array-element-type object =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Arguments                      | <code>object</code> A Java object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Values                         | <code>result</code> A keyword, <code>t</code> or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Description                    | <p>The function <code>java-array-element-type</code> returns the element type of <code>object</code> if <code>object</code> is a Java array:</p> <ul style="list-style-type: none"> <li>• For primitive types, <code>result</code> is a keyword from the table in “Types and conversion between Lisp and Java” on page 198.</li> <li>• If the array is multi-dimensional, <code>result</code> is <code>:array</code>.</li> <li>• If the array element type is <code>java.lang.Object</code>, <code>result</code> is <code>:object</code>.</li> <li>• If the array element type is <code>java.lang.String</code>, <code>result</code> is <code>:string</code>.</li> <li>• For other arrays <code>result</code> is <code>t</code>.</li> </ul> <p>If <code>object</code> is some other type of Java object, <code>java-array-element-type</code> returns <code>nil</code>. Otherwise it signals an error.</p> |
| Notes                          | <ol style="list-style-type: none"> <li>1. <code>java-array-element-type</code> is designed to be fast, so it can be used as a predicate to test whether a Java object is an array, and also to check whether some specific operations are applicable to it.</li> <li>2. If you want to check whether the array is primitive or not, use <code>java-primitive-array-element-type</code> or <code>java-object-array-element-type</code> instead.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

See also      [java-primitive-array-element-type](#)  
[java-object-array-element-type](#)  
“Working with Java arrays” on page 210

## **java-array-error** *Condition*

Summary      An abstract class, meaning that it is not signaled. Its readers can be used to access the subclasses.

Package      `lw-ji`

Superclasses      [java-interface-error](#)

Subclasses      [java-array-simple-error](#)  
[java-out-of-bounds-error](#)  
[java-storing-wrong-type-error](#)

Readers      [java-array-error-caller](#)  
[java-array-error-array](#)

Description      The condition class `java-array-error` is an abstract class, meaning that it is not signaled. Its readers can be used to access the subclasses.

## **java-array-indices-error** *Condition*

Summary      Conditions signaled by `jaref` or (`setf jaref`) when either too many indices are supplied for the array, or when a subarray is `null`.

Package      `lw-ji`

Superclasses      [java-array-simple-error](#)

Subclasses      None.

|             |                                                                                                                                                                                                                                    |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Readers     | <code>java-array-indices-error-rank</code><br><code>java-array-indices-error-indices</code>                                                                                                                                        |
| Description | Conditions of class <code>java-array-indices-error</code> are signaled when by <code>jaref</code> or <code>(setf jaref)</code> when either too many indices are supplied for the array, or when a sub-array is <code>null</code> . |
| Notes       | You can use the <code>java-array-error</code> readers <code>java-array-error-caller</code> and <code>java-array-error-array</code> on these conditions.                                                                            |
| See also    | <code>java-array-error</code><br><code>java-out-of-bounds-error</code>                                                                                                                                                             |

**java-array-length***Function*

|             |                                                                                                                                                                                                                                                                                                                                                 |  |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Summary     | Returns the length of a Java array.                                                                                                                                                                                                                                                                                                             |  |
| Package     | <code>lw-ji</code>                                                                                                                                                                                                                                                                                                                              |  |
| Signature   | <code>java-array-length object =&gt; result</code>                                                                                                                                                                                                                                                                                              |  |
| Arguments   | <i>object</i> A Java object.                                                                                                                                                                                                                                                                                                                    |  |
| Values      | <i>result</i> A non-negative integer or <code>nil</code> .                                                                                                                                                                                                                                                                                      |  |
| Description | The function <code>java-array-length</code> returns the length of <i>object</i> if this is a Java array. For multi-dimensional arrays, <code>java-array-length</code> returns the first dimension. If <i>object</i> is some other type of Java object, <code>java-array-length</code> returns <code>nil</code> . Otherwise it signals an error. |  |
| See also    | <code>java-array-element-type</code><br>“Working with Java arrays” on page 210                                                                                                                                                                                                                                                                  |  |

|              | <i>Condition</i>                                                                                                                                                                       |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary      | Conditions signaled in miscellaneous array errors.                                                                                                                                     |
| Package      | <code>lw-ji</code>                                                                                                                                                                     |
| Superclasses | <code>java-array-error</code>                                                                                                                                                          |
| Subclasses   | <code>java-array-indices-error</code>                                                                                                                                                  |
| Description  | The condition class <code>java-array-simple-error</code> is a subclass of <code>java-array-error</code> , signaled in miscellaneous array errors (those resulting from bad arguments). |
| Notes        | You can use the <code>java-array-error</code> readers <code>java-array-error-caller</code> and <code>java-array-error-array</code> on these conditions.                                |
| See also     | <code>java-array-error</code>                                                                                                                                                          |

|              | <i>Condition</i>                                                                                                                      |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------|
| Summary      | An abstract class, meaning that it is not signaled. Its readers can be used to access the subclasses.                                 |
| Package      | <code>lw-ji</code>                                                                                                                    |
| Superclasses | None.                                                                                                                                 |
| Subclasses   | <code>java-not-a-java-object-error</code><br><code>java-instance-without-jobject-error</code><br><code>java-not-an-array-error</code> |
| Readers      | <code>java-bad-jobject-caller</code><br><code>java-bad-jobject-object</code>                                                          |

Description      The condition class `java-bad-object` is an abstract class, meaning that it is never signaled. Its subclasses are signaled and its readers can be used to access those conditions.

See also      `java-not-a-java-object-error`  
`java-instance-without-jobject-error`  
`java-not-an-array-error`

**java-definition-error**  
**java-class-error**  
**java-method-error**  
**java-field-error**

*Conditions*

Summary      Conditions that are signaled when code defined by the Java interface fails to execute.

Package      `lw-ji`

Superclasses    `java-interface-error`

Subclasses    None.

Readers      `java-definition-error-class-name`  
`java-definition-error-name`

For `java-method-error` only:

`java-method-error-method-name`  
`java-method-error-args-num`

For `java-field-error` only:

`java-field-error-field-name`  
`java-field-error-static-p`

Description      The condition classes `java-class-error`, `java-method-error` and `java-field-error` are signaled when code that is defined by the Java interface (for example, `define-java-`

`caller, define-field-accessor)` fails to execute because the Java entity that it expects is not found.

They are subclasses of `java-definition-error`. `java-definition-error` is never signaled, and you should not signal these conditions.

The errors normally occur because the definition is wrong in some sense, but they can also happen if the Java virtual machine misses some of the classes or has a class definition that differs from what it should be.

`java-definition-error-name` returns the name of the Lisp function that fails, for example the `name` in the `define-javacaller` form.

`java-definition-error-class-name` returns the class name in the definition.

`java-method-error-method-name` returns the method name. If it is a constructor (`define-java-constructor`), `java-method-error-method-name` returns `nil`.

`java-method-error-args-num` returns the number of arguments that were passed to the call.

`java-field-error-field-name` returns the field name.

`java-field-error-static-p` queries whether the field was defined as static.

|          |                                                                                                               |
|----------|---------------------------------------------------------------------------------------------------------------|
| See also | <code>define-java-constructor</code><br><code>define-java-caller</code><br><code>define-field-accessor</code> |
|----------|---------------------------------------------------------------------------------------------------------------|

## **java-exception** *Condition*

|         |                                                                         |
|---------|-------------------------------------------------------------------------|
| Summary | The superclass of all conditions that are signaled for Java exceptions. |
|---------|-------------------------------------------------------------------------|

|              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package      | <code>lw-ji</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Superclasses | None                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Subclasses   | <code>java-normal-exception</code><br><code>java-serious-exception</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Readers      | <code>java-exception-string</code><br><code>java-exception-exception-name</code><br><code>java-exception-java-backtrace</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Description  | <p>The class <code>java-exception</code> is the superclass of all conditions that are signaled for Java exceptions.</p> <p>The reader <code>java-exception-string</code> returns a string specifying the reason for the exception (result of <code>jobject-string</code> on the Java exception).</p> <p>The reader <code>java-exception-exception-name</code> returns a string with the exception name (name of the exception class, the result of <code>jobject-class-name</code> on the Java exception).</p> <p>The reader <code>java-exception-java-backtrace</code> returns a list of strings specifying the Java backtrace for the exception. Each string shows one Java frame.</p> |

| <b>java-field-setting-error</b> | <i>Condition</i>                                                                                                             |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| Summary                         | Conditions signaled when setting a field is wrong, either because the field is final or because the value supplied is wrong. |
| Package                         | <code>lw-ji</code>                                                                                                           |
| Superclasses                    | None.                                                                                                                        |
| Subclasses                      | None.                                                                                                                        |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Readers     | <code>java-field-setting-error-field-name</code><br><code>java-field-setting-error-class-name</code><br><code>java-field-setting-error-class-name-for-setting</code><br><code>java-field-setting-error-new-value</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Description | <p>Conditions of class <code>java-field-setting-error</code> are signaled when setting a field is wrong, either because the field is final or because the value supplied is wrong. The setting can happen either by a call to <code>set-java-field</code> or by using <code>(setf name)</code> where <i>name</i> was defined by either <code>define-field-accessor</code> or <code>setup-field-accessor</code>.</p> <p>The new value returned by the accessor <code>java-field-setting-error-new-value</code> can be the keyword <code>:is-final</code>, which indicates that the error occurs because the field is final. Otherwise it is the new value, which is of an unacceptable type. The <i>class-name</i> of the field can be read using <code>java-field-setting-error-class-name-for-setting</code> (this is what <code>java-field-class-name-for-setting</code> would return for the same field).</p> |
| See also    | <code>set-java-field</code><br><code>define-field-accessor</code><br><code>setup-field-accessor</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

|              | <i>Condition</i>                                                           |
|--------------|----------------------------------------------------------------------------|
| Summary      | Conditions signaled if Lisp failed to find the ID for a method or a field. |
| Package      | <code>lw-ji</code>                                                         |
| Superclasses | <code>java-serious-exception</code>                                        |
| Subclasses   | None.                                                                      |

|             |                                                                                                                                                                               |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | Conditions of class <code>java-id-exception</code> are signaled if Lisp failed to find the ID for a method or a field. This is serious, so applications should save and exit. |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## **java-instance-without-jobject-error** *Condition*

|         |                                                                                                                                                                    |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary | Conditions signaled when an argument that need to be a Java object is an instance of <code>standard-java-object</code> that does not have a <code>jobject</code> . |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Package      `lw-ji`

Superclasses    `java-bad-jobject`

Subclasses     None.

|             |                                                                                                                                                                                                                                  |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | The condition class <code>java-instance-without-jobject-error</code> is signaled when an argument that needs to be a Java object is an instance of <code>standard-java-object</code> that does not have a <code>jobject</code> . |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|       |                                                                                                                                                          |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes | You can use the <code>java-bad-jobject</code> readers <code>java-bad-jobject-caller</code> and <code>java-bad-jobject-object</code> on these conditions. |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------|

See also      `java-bad-jobject`  
                   `java-not-a-java-object-error`  
                   `java-not-an-array-error`

## **java-interface-error** *Condition*

|         |                                                                              |
|---------|------------------------------------------------------------------------------|
| Summary | The superclass of the <code>*-error</code> conditions in the Java interface. |
|---------|------------------------------------------------------------------------------|

Package      `lw-ji`

|              |                                                                                                                                                                                                                               |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Superclasses | <code>cl:error</code>                                                                                                                                                                                                         |
| Subclasses   | <code>call-java-method-error</code><br><code>create-java-object-error</code><br><code>java-array-error</code><br><code>java-bad-jobject</code><br><code>java-definition-error</code><br><code>java-field-setting-error</code> |
| Description  | The condition class <code>java-interface-error</code> is the superclass of the <code>*-error</code> conditions in the Java interface.                                                                                         |

## **java-low-level-exception** *Condition*

|              |                                                                                                                                                               |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary      | Conditions signaled for failures in low level code.                                                                                                           |
| Package      | <code>lw-ji</code>                                                                                                                                            |
| Superclasses | <code>java-exception</code>                                                                                                                                   |
| Subclasses   | None.                                                                                                                                                         |
| Description  | Conditions of class <code>java-low-level-exception</code> are signaled for failures in low level code. This is serious, so applications should save and exit. |

## **java-method-exception** *Condition*

|              |                                                                                             |
|--------------|---------------------------------------------------------------------------------------------|
| Summary      | Conditions signaled when an exception occurs inside a call to a Java method or constructor. |
| Package      | <code>lw-ji</code>                                                                          |
| Superclasses | <code>java-normal-exception</code>                                                          |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Subclasses  | None.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Readers     | <pre>java-method-exception-name java-method-exception-class-name java-method-exception-method-name java-method-exception-args</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Description | <p>The condition class <code>java-method-exception</code> is signaled when an exception occurs inside a call to a Java method or a constructor. Such exceptions are normal behavior for Java, so these exceptions should in general be handled somehow.</p> <p>The <code>java-exception</code> accessors (<code>java-exception-exception-name</code>, <code>java-exception-string</code>) can be used on a <code>java-method-exception</code> and are useful for simple handling. For more complex handling, you can use <code>catching-java-exceptions</code> around pieces of your code, and then look at the actual Java exception.</p> <p>The reader <code>java-method-exception-name</code> returns the name of the Java caller (a Lisp symbol) that caused the exception.</p> <p>The reader <code>java-method-exception-class-name</code> returns the Java class name of the method or constructor.</p> <p>The reader <code>java-method-exception-method-name</code> returns the method name if the exception is inside a method, or <code>nil</code> if the exception is inside a constructor.</p> <p>The reader <code>java-method-exception-args</code> returns the arguments that were passed to the caller.</p> |
| See also    | <code>catching-java-exceptions</code><br><code>java-exception</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

**java-normal-exception***Condition*

|         |                                                      |
|---------|------------------------------------------------------|
| Summary | This condition is signaled for a "normal" exception. |
|---------|------------------------------------------------------|

|              |                                                                                                                                                              |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package      | <code>lw-ji</code>                                                                                                                                           |
| Superclasses | <code>java-exception</code>                                                                                                                                  |
| Subclasses   | <code>field-exception</code><br><code>java-method-exception</code>                                                                                           |
| Description  | Conditions of class <code>java-normal-exception</code> are signaled for exceptions that are "normal", that is they do not suggest that the system is broken. |

|              | <i>Condition</i>                                                                                                                                                                                              |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary      | Conditions signaled when an argument that needs to be a Java object is not a <code>jobject</code> or an instance of <code>standard-java-object</code> .                                                       |
| Package      | <code>lw-ji</code>                                                                                                                                                                                            |
| Superclasses | <code>java-bad-jobject</code>                                                                                                                                                                                 |
| Subclasses   | None.                                                                                                                                                                                                         |
| Description  | The condition class <code>java-not-a-java-object-error</code> is signaled when an argument that needs to be a Java object is not a <code>jobject</code> or an instance of <code>standard-java-object</code> . |
| Notes        | You can use the <code>java-bad-jobject</code> readers <code>java-bad-jobject-caller</code> and <code>java-bad-jobject-object</code> on these conditions.                                                      |
| See also     | <code>java-bad-jobject</code><br><code>java-instance-without-jobject-error</code><br><code>java-not-an-array-error</code>                                                                                     |

|              | <i>Condition</i>                                                                                                                                                                                                                                                                               |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary      | Conditions signaled when an argument that needs to be an array of some type is not an array of the expected type.                                                                                                                                                                              |
| Package      | <code>lw-ji</code>                                                                                                                                                                                                                                                                             |
| Superclasses | <code>java-bad-jobject</code>                                                                                                                                                                                                                                                                  |
| Subclasses   | None.                                                                                                                                                                                                                                                                                          |
| Description  | The condition class <code>java-not-an-array-error</code> is signaled when an argument that needs to be an array is not an array, or when an argument that needs to be a primitive array is not a primitive array, or when an argument that needs to be an object array is not an object array. |
| Notes        | You can use the <code>java-bad-jobject</code> readers <code>java-bad-jobject-caller</code> and <code>java-bad-jobject-object</code> on these conditions.                                                                                                                                       |
| See also     | <code>java-bad-jobject</code><br><code>java-not-a-java-object-error</code><br><code>java-instance-without-jobject-error</code>                                                                                                                                                                 |

|               | <i>Constant</i>                                                       |
|---------------|-----------------------------------------------------------------------|
| Summary       | A constant representing a Java null pointer.                          |
| Package       | <code>lw-ji</code>                                                    |
| Initial Value | A null Java value.                                                    |
| Description   | The constant <code>*java-null*</code> represents a Java null pointer. |
| See also      | “Java non-primitive objects” on page 200                              |

## **java-object-array-element-type** *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                        |  |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Summary     | Returns the element type of a Java array of a non-primitive element type.                                                                                                                                                                                                                                                                                                                              |  |
| Package     | <code>lw-ji</code>                                                                                                                                                                                                                                                                                                                                                                                     |  |
| Signature   | <code>java-object-array-element-type object =&gt; result</code>                                                                                                                                                                                                                                                                                                                                        |  |
| Arguments   | <i>object</i> A Java object.                                                                                                                                                                                                                                                                                                                                                                           |  |
| Values      | <i>result</i> One of the keywords <code>:array</code> , <code>:object</code> and <code>:string</code> , or <code>nil</code> .                                                                                                                                                                                                                                                                          |  |
| Description | The function <code>java-object-array-element-type</code> returns the element type (as a keyword as listed in “Types and conversion between Lisp and Java” on page 198) if <i>object</i> is an array with non-primitive element type. If <i>object</i> is some other type of Java object, <code>java-object-array-element-type</code> returns <code>nil</code> . Otherwise it signals an error.         |  |
| Notes       | <ol style="list-style-type: none"><li>1. You can use <code>java-object-array-element-type</code> to test whether a Java object is an array of non-primitive element type.<br/>If you want to check whether <i>object</i> is any array (primitive or not), use <code>java-array-element-type</code> instead. Sometimes <code>java-primitive-array-element-type</code> may be more convenient.</li></ol> |  |
| See also    | <code>java-array-element-type</code><br><code>java-primitive-array-element-type</code><br>“Working with Java arrays” on page 210                                                                                                                                                                                                                                                                       |  |

## **java-objects-eq** *Function*

|         |                                                           |
|---------|-----------------------------------------------------------|
| Summary | Tests whether two objects represent the same Java object. |
|---------|-----------------------------------------------------------|

|             |                                                                                                                                                      |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>lw-ji</code>                                                                                                                                   |
| Signature   | <code>java-objects-eq obj1 obj2 =&gt; result</code>                                                                                                  |
| Arguments   | <code>obj1, obj2</code> Lisp objects.                                                                                                                |
| Values      | <code>result</code> A boolean.                                                                                                                       |
| Description | The function <code>java-objects-eq</code> tests whether <code>obj1</code> and <code>obj2</code> represent the same Java object.                      |
| See also    | <code>jobject-p</code><br><code>jobject</code><br>“Types and conversion between Lisp and Java” on page 198<br>“CLOS partial integration” on page 218 |

**java-out-of-bounds-error****java-storing-wrong-type-error***Conditions*

|              |                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary      | Errors signaled when bad array indices are passed, or on trying to store a bad value into a Java array.                                                                                                                                                                                                                                                                                                                                        |
| Package      | <code>lw-ji</code>                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Superclasses | <code>java-array-error</code>                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Subclasses   | None.                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Description  | <p>The condition class <code>java-out-of-bounds-error</code> is signaled when a bad index value is passed to <code>jaref</code> or <code>jvref</code> or their setters, or bad <code>start/end</code> values are passed to <code>map-java-object-array</code> and other functions which access arrays.</p> <p>The condition class <code>java-storing-wrong-type-error</code> is signaled on an attempt to store value of wrong type into a</p> |

Java array by `(setf jvref)`, `(setf jaref)` or `map-java-object-array`.

You can use the `java-array-error` readers `java-array-error-caller` and `java-array-error-array` on these conditions.

## **java-primitive-array-element-type** *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                 |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|
| Summary     | Returns the element type of a Java array of a primitive element type.                                                                                                                                                                                                                                                                                                                                                                         |                                                 |
| Package     | <code>lw-ji</code>                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                 |
| Signature   | <code>java-primitive-array-element-type object =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                            |                                                 |
| Arguments   | <code>object</code>                                                                                                                                                                                                                                                                                                                                                                                                                           | A Java object.                                  |
| Values      | <code>result</code>                                                                                                                                                                                                                                                                                                                                                                                                                           | A keyword, <code>t</code> or <code>nil</code> . |
| Description | The function <code>java-primitive-array-element-type</code> returns the element type (as a keyword as listed in “Types and conversion between Lisp and Java” on page 198) if <code>object</code> is an array with primitive element type. If <code>object</code> is some other type of Java object, <code>java-primitive-array-element-type</code> returns <code>nil</code> . Otherwise it signals an error.                                  |                                                 |
| Notes       | <ol style="list-style-type: none"><li>1. <code>java-primitive-array-element-type</code> is designed to be fast, so you can use it to test whether a Java object is an array of primitive element type.</li><li>2. If you want to check whether <code>object</code> is any array (primitive or not), use <code>java-array-element-type</code> instead. Sometimes <code>java-object-array-element-type</code> may be more convenient.</li></ol> |                                                 |

See also      `java-array-element-type`  
`java-object-array-element-type`  
“Working with Java arrays” on page 210

## **java-serious-exception** *Condition*

Summary      Conditions signaled when something in the system is not really not as it should be.

Package      `lw-ji`

Superclasses      `java-exception`

Subclasses      `java-id-exception`  
`java-low-level-exception`

Description      The condition class `java-serious-exception` is signaled for an exception that is serious, which means something in the system is not really not as it should be. Applications that get this should try to save everything and exit.  
In general, these exceptions should not happen, and you should not need to worry about these. If you do get any such exception, please report it with as many details as possible to Lisp Support, following the guidelines at [www.lisp-works.com/support/bug-report.html](http://www.lisp-works.com/support/bug-report.html).

## **java-type-to-lisp-array-type** *Functions* **lisp-array-type-to-java-type**

Summary      Return the Lisp array element type matching a supplied foreign type, or the foreign type matching a Lisp array element type.

Package      `lw-ji`

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                  |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|
| Signature   | <code>java-type-to-lisp-array-type <i>jtype</i> =&gt; <i>l-result</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                  |
| Signature   | <code>lisp-array-type-to-java-type <i>lisp-type</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                  |
| Arguments   | <i>jtype</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | A foreign type.                                  |
|             | <i>lisp-type</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | A Lisp type specifier.                           |
| Values      | <i>l-result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | A Lisp array element type, or <code>nil</code> . |
| Description | <p>The function <code>java-type-to-lisp-array-type</code> returns the matching Lisp array element type for the foreign type <i>jtype</i>, which needs to be one of the foreign types corresponding to a Java primitive type, or <code>nil</code> if the argument is not such a foreign type.</p> <p>The function <code>lisp-array-type-to-java-type</code> returns the matching foreign type, corresponding to a Java primitive type, for the Lisp array element type <i>lisp-type</i>, or <code>nil</code> if there is no match.</p> |                                                  |

Both functions use the table below for doing the match:

Table 41.1 Correspondence between Java foreign types and Lisp array element types

| Foreign type          | Lisp type                       |
|-----------------------|---------------------------------|
| <code>jbyte</code>    | <code>(signed-byte 8)</code>    |
| <code>jshort</code>   | <code>(signed-byte 16)</code>   |
| <code>jint</code>     | <code>(signed-byte 32)</code>   |
| <code>jlong</code>    | <code>(signed-byte 64)</code>   |
| <code>jdouble</code>  | <code>double-float</code>       |
| <code>jfloat</code>   | <code>single-float</code>       |
| <code>jchar</code>    | <code>(unsigned-byte 16)</code> |
| <code>jboolean</code> | <code>(unsigned-byte 8)</code>  |

|             | <i>FLI type descriptor</i>                                                                                                                                                                                                                                   |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | The Java virtual machine pointer type.                                                                                                                                                                                                                       |
| Package     | <code>lw-ji</code>                                                                                                                                                                                                                                           |
| Syntax      | <code>java-vm-poi</code>                                                                                                                                                                                                                                     |
| Description | The FLI type <code>java-vm-poi</code> is used for the Java virtual machine pointer ( <code>Javavm*</code> in C). You need it only when you want to pass the virtual machine to <code>init-java-interface</code> by the <i>java-virtual-machine</i> argument. |
| See also    | <code>init-java-interface</code>                                                                                                                                                                                                                             |

|                 | <i>FLI type descriptors</i> |
|-----------------|-----------------------------|
| <b>jboolean</b> |                             |
| <b>jbyte</b>    |                             |
| <b>jchar</b>    |                             |
| <b>jdouble</b>  |                             |
| <b>jfloat</b>   |                             |
| <b>jint</b>     |                             |
| <b>jlong</b>    |                             |
| <b>jshort</b>   |                             |

|             |                                                                                                                                                                                           |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | FLI types corresponding to the Java primitive types.                                                                                                                                      |
| Package     | <code>lw-ji</code>                                                                                                                                                                        |
| Description | These FLI types correspond to the Java primitive types. Normally you do not need to use any of these.<br><br>See “Types and conversion between Lisp and Java” on page 198 for discussion. |

## **jni-env-poi** *FLI type descriptor*

|             |                                                                                                                                                                                                                                                                             |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | The JNI environment pointer type.                                                                                                                                                                                                                                           |
| Package     | <code>lw-jl</code>                                                                                                                                                                                                                                                          |
| Syntax      | <code>jni-env-poi</code>                                                                                                                                                                                                                                                    |
| Description | <p>The FLI type <code>jni-env-poi</code> is used for the JNI environment pointer (<code>JNIEnv*</code> in C).</p> <p>When <code>jni-env-finder</code> is passed to <code>init-java-interface</code>, it needs to be a function that returns a <code>jni-env-poi</code>.</p> |
| See also    | <code>init-java-interface</code>                                                                                                                                                                                                                                            |

## **jobject** *FLI type descriptor*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | The type of objects representing all non-primitive Java objects.                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Package     | <code>lw-jl</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Syntax      | <code>jobject</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Description | <p>The FLI type <code>jobject</code> is the type of objects representing all non-primitive Java objects (including arrays).</p> <p><code>jobjects</code> that represent the same Java object are not necessarily equal in any Lisp sense, and their addresses are not necessarily equal either. In fact, normally they will be different if they come from a different Java call. To check whether two <code>jobjects</code> represent the same Java object, use <code>java-objects-eq</code> (which takes CLOS Java instances too).</p> |
| Notes       | The <code>print-function</code> of <code>jobject</code> tries to print its Java class name, but what it prints may be a parent class of the actual                                                                                                                                                                                                                                                                                                                                                                                       |

class of the `jobject`. The function `jobject-class-name` returns the name of the actual class of the `jobject`, and also caches it in the `jobject`.

## See also

`jobject-p`  
`java-objects-eq`  
`jobject-string`  
`jobject-class-name`  
`jobject-of-class-p`  
`jobject-to-lisp`  
`jobject-pretty-class-name`

“Types and conversion between Lisp and Java” on page 198

## **jobject-class-name** *Function*

Summary      Returns the name of the class to which a `jobject` belongs.

Package      `lw-ji`

Signature      `jobject-class-name jobject => class-name`

Arguments      `jobject`      A `jobject`.

Values      `class-name`      A string.

Description      The function `jobject-class-name` returns a string which is the name of the class to which the Java object `jobject` belongs. The name is then cached in the `jobject`.

The class for arrays is the internal class name, which is different from the way it is declared in Java. For other objects, the name is the full name of the class.

To obtain the class name as declared in Java, use `jobject-pretty-class-name`.

See also `jobject`  
`jobject-of-class-p`  
`jobject-pretty-class-name`  
“Types and conversion between Lisp and Java” on page 198

## **jobject-ensure-global** *Function*

Summary Returns a global `jobject` pointing to the same Java object as the argument.

Package `lw-ji`

Signature `jobject-ensure-global jobject => global-jobject`

Arguments `jobject` A `jobject`.

Values `global-jobject` A `jobject`.

Description The function `jobject-ensure-global` returns a `jobject` pointing to the same Java object as the argument `jobject`, but which is guaranteed to be global.

In most cases, `jobjects` are global anyway. However, when using `map-java-object-array`, by default, the `jobjects` are local and cannot be used outside the scope of the function that was passed to `map-java-object-array`. Similarly, `jobjects` can be made local inside functions that are invoked by proxies, using the `:jobject-scope` option (see `define-lisp-proxy`). In these situations, if you want to access the Java object outside the scope of the function that was invoked by `map-java-object-array` or by the proxy, you need to use `jobject-ensure-global` inside the scope of the function, and then you can use the result outside the scope of the function.

If the argument `jobject` is not a `jobject` an error is signaled.

If the argument *jobject* is already a global reference, `jobject-ensure-global` simply returns it.

|          |                                                                                                                                                                                                                                                                                            |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | <ol style="list-style-type: none"> <li>1. <code>jobject-ensure-global</code> cannot access local references outside the right scope (like any other function).</li> <li>2. <code>jobject-ensure-global</code> does not accept an instance of <code>standard-java-object</code>.</li> </ol> |
| See also | <code>jobject-p</code><br><code>map-java-object-array</code><br><code>define-lisp-proxy</code>                                                                                                                                                                                             |

## **jobject-of-class-p** *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                              |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| Summary     | The predicate for whether a Java object is an instance of a given Java class.                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                              |
| Package     | <code>lw-ji</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                              |
| Signature   | <code>jobject-of-class-p object class-spec =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                              |
| Arguments   | <code>object</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | A Java object.                                                               |
|             | <code>class-spec</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | A class specifier that <code>find-java-class</code> accepts or a Java class. |
| Values      | <code>result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | A generalized boolean.                                                       |
| Description | <p>The function <code>jobject-of-class-p</code> takes a Java object and a Java class specification, and returns true if the object is an instance of this class or any of its subclasses.</p> <p><i>class-spec</i> must be either a class specifier that <code>find-java-class</code> accepts, or a Java class, that is a <code>Jobject</code> of class <code>java.lang.Class</code>. The Java class may be an interface, in which case the result verifies whether the object implements the interface.</p> |                                                                              |

See also      `jobject`  
`jobject-class-name`  
“Types and conversion between Lisp and Java” on page 198

## **jobject-p** *Function*

Summary      The predicate for objects of type `jobject`.  
Package      `lw-ji`  
Signature      `jobject-p object => result`  
Arguments      `object`      A Lisp object.  
Values      `result`      A boolean.  
Description      The function `jobject-p` is the predicate for objects of type `jobject`.  
See also      `jobject`  
`lisp-java-instance-p`  
`get-jobject`  
`ensure-is-jobject`  
“Types and conversion between Lisp and Java” on page 198

## **jobject-pretty-class-name** *Function*

Summary      Returns a string which is the name of the class to which a given `jobject` belongs.  
Package      `lw-ji`  
Signature      `jobject-pretty-class-name jobject => name`  
Arguments      `jobject`      A `jobject`.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                     |           |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Values      | <i>name</i>                                                                                                                                                                                                                                                                                                                                                                                                         | A string. |
| Description | The function <code>jobject-pretty-class-name</code> returns a string which is the name of the class to which the <code>jobject</code> object belongs. The name is then cached in the <code>jobject</code> .<br><br>The class for arrays is "prettified", which means converting it to the way it is declared in Java. For other objects, <i>name</i> is the same as the result of <code>jobject-class-name</code> . |           |
| See also    | <code>jobject</code><br><code>jobject-class-name</code><br>“Types and conversion between Lisp and Java” on page 198                                                                                                                                                                                                                                                                                                 |           |

| <b>jobject-string</b> |                                                                                                                                                                                      | <i>Function</i>          |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| Summary               | Calls the Java method <code>object.toString</code> on a Java object.                                                                                                                 |                          |
| Package               | <code>lw-jl</code>                                                                                                                                                                   |                          |
| Signature             | <code>jobject-string jobject =&gt; string</code>                                                                                                                                     |                          |
| Arguments             | <i>jobject</i>                                                                                                                                                                       | A <code>jobject</code> . |
| Values                | <i>string</i>                                                                                                                                                                        | A string.                |
| Description           | The function <code>jobject-string</code> returns a string which is the result of calling the Java method <code>object.toString</code> on the Java object <code>jobject</code> on it. |                          |
| See also              | <code>jobject</code><br>“Types and conversion between Lisp and Java” on page 198                                                                                                     |                          |

## jobject-to-lisp *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                              |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| Summary     | Converts a <code>jobject</code> to a Lisp object where possible.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                              |
| Package     | <code>lw-jni</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                              |
| Signature   | <code>jobject-to-lisp object &amp;optional nil-when-fail =&gt; lisp-object</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                              |
| Arguments   | <code>object</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | A <code>jobject</code> or <code>nil</code> . |
|             | <code>nil-when-fail</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | A generalized boolean.                       |
| Values      | <code>lisp-object</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | A Lisp object.                               |
| Description | <p>The function <code>jobject-to-lisp</code> converts a <code>jobject</code> to a Lisp object where possible.</p> <p>The argument <code>object</code> must be a <code>jobject</code> or <code>nil</code>, otherwise an error is signaled. If <code>object</code> is <code>nil</code>, <code>jobject-to-lisp</code> returns <code>nil</code>. If <code>object</code> is a <code>jobject</code> of type <code>java.lang.String</code> or any of the primitive types, <code>jobject-to-lisp</code> returns the matching Lisp object. See “Types and conversion between Lisp and Java” on page 198 for a full description.</p> <p>If the conversion cannot be done, the return value depends on the value of <code>nil-when-fail</code>. When <code>nil-when-fail</code> is true <code>jobject-to-lisp</code> returns <code>nil</code> for failure. When <code>nil-when-fail</code> is false, <code>jobject-to-lisp</code> returns the <code>jobject</code> itself. The default value of <code>nil-when-fail</code> is true.</p> |                                              |
| Notes       | <p>You need to pass <code>nil-when-fail</code> as <code>nil</code> for the cases when you want to be able to distinguish between return value <code>nil</code> for the Java boolean <code>false</code> and failure to convert. When you do that, the caller code needs to compare the result to the argument, instead of checking for non-<code>nil</code>, like this:</p> <pre>(let ((my-res (jobject-to-lisp my-obj nil)))   (if (eq my-obj my-res)       (fail-branch)       (success-branch)))</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                              |

| <b>jvref</b>           | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                    |               |                    |                         |                        |                                        |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------|--------------------|-------------------------|------------------------|----------------------------------------|
| Summary                | Read and set an element in a Java array.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                    |               |                    |                         |                        |                                        |
| Package                | <code>lw-ji</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                    |               |                    |                         |                        |                                        |
| Signature              | <code>jvref array index =&gt; element</code><br><code>(setf jvref) new-value array index =&gt; new-value</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                    |               |                    |                         |                        |                                        |
| Arguments              | <table> <tr> <td><code>array</code></td> <td>A Java array.</td> </tr> <tr> <td><code>index</code></td> <td>A non-negative integer.</td> </tr> <tr> <td><code>new-value</code></td> <td>A valid value for <code>array</code>.</td> </tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <code>array</code> | A Java array. | <code>index</code> | A non-negative integer. | <code>new-value</code> | A valid value for <code>array</code> . |
| <code>array</code>     | A Java array.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                    |               |                    |                         |                        |                                        |
| <code>index</code>     | A non-negative integer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                    |               |                    |                         |                        |                                        |
| <code>new-value</code> | A valid value for <code>array</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                    |               |                    |                         |                        |                                        |
| Values                 | <code>element</code> A Lisp object, a <code>jobject</code> or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                    |               |                    |                         |                        |                                        |
| Description            | <p>The function <code>jvref</code> reads and sets the value of an element in the Java array <code>array</code>.<br/> <code>index</code> must be in the right range:</p> $0 \leq \text{index} < (\text{java-array-length } \text{array})$ <p><code>new-value</code> must be a valid value to store in <code>array</code> (discussed below)</p> <p><code>jvref</code> returns the corresponding element from <code>array</code>. If the element is of a primitive type, or is of type <code>java.lang.String</code>, it is converted to the Lisp object, otherwise it is returned as a <code>jobject</code> or <code>nil</code> if it is <code>null</code>. See “Types and conversion between Lisp and Java” on page 198.</p> <p><code>(setf jvref)</code> sets the element to <code>new-value</code>. <code>new-value</code> must be a valid element for <code>array</code>. For a primitive array, <code>new-value</code> must be a Lisp object of the correct type:</p> <ul style="list-style-type: none"> <li><code>byte, short, int, long</code><br/>Integers with less than 8, 16, 32 and 64 bits respectively.</li> <li><code>float, double</code></li> </ul> |                    |               |                    |                         |                        |                                        |

Any float.

boolean

nil or t.

char

Integers in the inclusive range [0, #xffff].

For a non-primitive array, *new-value* must be convertible to a  *jobject* of the correct class. If the element type of *array* is `java.lang.Object` (`java-array-element-type` returns `:object`), then any Lisp value that can be converted to a Java primitive type is acceptable (see “Types and conversion between Lisp and Java” on page 198), as well as strings and any Java object. If the element type of *array* is `java.lang.String` (`java-array-element-type` returns `:string`), then strings or Java objects of class `java.lang.String` are acceptable. In all other cases, only Java objects are acceptable, and need to be of the correct type.

|       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes | <p>For accessing multiple elements in the same array, the multiple access functions (<code>map-java-object-array</code>, <code>primitive-array-to-lisp-array</code>, <code>lisp-array-to-primitive-array</code>) can be much faster.</p> <p><code>jvref</code> and <code>(setf jvref)</code> access the top level of the array. If <i>array</i> is multi-dimensional, <code>jvref</code> and <code>(setf jvref)</code> will return and set the sub-array. See <code>jaref</code> for accessing elements in a multi-dimensional array.</p> <p><code>jvref</code> and <code>(setf jvref)</code> are slightly faster than <code>jaref</code> and <code>(setf jaref)</code> with one index, and give a proper error when called with the wrong number of arguments.</p> |
|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|          |                                                                                                                                                                                                |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| See also | <code>map-java-object-array</code><br><code>lisp-array-to-primitive-array</code><br><code>primitive-array-to-lisp-array</code><br><code>jaref</code><br>“Working with Java arrays” on page 210 |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|             |                                                                                                                                                                                                                    | <i>Function</i> |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Summary     | The predicate for objects of type <code>standard-java-object</code> .                                                                                                                                              |                 |
| Package     | <code>lw-ji</code>                                                                                                                                                                                                 |                 |
| Signature   | <code>lisp-java-instance-p object =&gt; result</code>                                                                                                                                                              |                 |
| Arguments   | <code>object</code>                                                                                                                                                                                                | A Lisp object.  |
| Values      | <code>result</code>                                                                                                                                                                                                | A boolean.      |
| Description | The function <code>lisp-java-instance-p</code> is the predicate determining whether an object is an instance of <code>standard-java-object</code> .                                                                |                 |
| See also    | <code>jobject-p</code><br><code>jobject</code><br><code>get-jobject</code><br><code>ensure-is-jobject</code><br>“Types and conversion between Lisp and Java” on page 198<br>“CLOS partial integration” on page 218 |                 |

|           |                                                                            | <i>Function</i>                              |
|-----------|----------------------------------------------------------------------------|----------------------------------------------|
| Summary   | Converts a Lisp object to an appropriate <code>jobject</code> .            |                                              |
| Package   | <code>lw-ji</code>                                                         |                                              |
| Signature | <code>lisp-to-jobject lisp-object &amp;optional errorp =&gt; result</code> |                                              |
| Arguments | <code>lisp-object</code>                                                   | A Lisp object.                               |
| Values    | <code>result</code>                                                        | A <code>jobject</code> or <code>nil</code> . |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | The function <code>lisp-to-jobject</code> tries to convert the argument <i>lisp-object</i> to a <code>jobject</code> . It succeeds if <i>lisp-object</i> is of a type that matches any Java primitive type or is a string. In general that means integers up to 64 bits, floats, <code>t</code> , <code>nil</code> and strings.<br><br>See “Types and conversion between Lisp and Java” on page 198 for a full description. |
|             | If it fails, <code>lisp-to-jobject</code> calls <code>cl:error</code> , unless the argument <code>errorp</code> is <code>nil</code> , in which case it returns <code>nil</code> .                                                                                                                                                                                                                                           |
| See also    | <code>jobject-to-lisp</code><br>“Types and conversion between Lisp and Java” on page 198                                                                                                                                                                                                                                                                                                                                    |

## make-java-array *Function*

|             |                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                 |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Create a Java array object.                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                 |
| Package     | <code>lw-ji</code>                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                 |
| Signature   | <code>make-java-array type first-dim &amp;rest dims =&gt; array</code>                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                 |
| Arguments   | <code>type</code>                                                                                                                                                                                                                                                                                                     | A string, one of the keywords <code>:byte</code> ,<br><code>:short</code> , <code>:int</code> , <code>:long</code> , <code>:float</code> , <code>:double</code> ,<br><code>:char</code> , <code>:boolean</code> , <code>:object</code> and <code>:string</code> , an<br>FLI type specifier, or <code>t</code> . |
|             | <code>first-dim</code>                                                                                                                                                                                                                                                                                                | A non-negative integer.                                                                                                                                                                                                                                                                                         |
|             | <code>dims</code>                                                                                                                                                                                                                                                                                                     | Non-negative integers.                                                                                                                                                                                                                                                                                          |
| Values      | <code>array</code>                                                                                                                                                                                                                                                                                                    | A new array.                                                                                                                                                                                                                                                                                                    |
| Description | The function <code>make-java-array</code> creates a Java array object <i>array</i> .<br><br><i>type</i> specifies the type of elements in <i>array</i> . To make an array of any Java class, <i>type</i> needs to be a string with the full name of the class. To make an array of primitive type, <i>type</i> should |                                                                                                                                                                                                                                                                                                                 |

be the corresponding keyword (`:byte`, `:short`, `:int`, `:long`, `:float`, `:double`, `:char` or `:boolean`). `type` can also be `:object` or `t` meaning `java.lang.Object`, and `:string` meaning `java.lang.String`, and the FLI types matching the primitive types.

The dimension(s) of the array are specified by `first-dim` and the `dims` list, which must all be non-negative integer(s).

`make-java-array` returns the new array.

## make-java-instance *Function*

Summary      Create a CLOS instance and its `jobject`.

Package      `lw-ji`

Signature      `make-java-instance symbol-or-class &rest args => instance`

Arguments      `symbol-or-class`    A class designator.  
                   `args`                Lisp objects.

Values          `instance`          A CLOS object.

Description      The function `make-java-instance` creates a CLOS instance and its `jobject`.

The class `symbol-or-class` must be a subclass of `standard-java-object`, and must have been associated with a Java constructor by passing the class name to `define-java-constructor` or `setup-java-constructor` as the `class-symbol` argument (the importing interface, when defining a class, does it automatically).

`make-java-instance` makes the CLOS instance by calling `make-instance` on `symbol-or-class`, then passing the instance and `args` to `create-instance-jobject-list` to create the `jobject`, and then returns the instance.

The result is a CLOS instance of *symbol-or-class*, which can be passed to Java interface functions and Java methods.

See also

`create-instance-jobject-list`  
`define-java-constructor`  
`setup-java-constructor`  
“CLOS partial integration” on page 218

## **make-lisp-proxy**

### **make-lisp-proxy-with-overrides**

### *Functions*

Summary      Make a Lisp proxy.

Package      `lw-ji`

Signature      `make-lisp-proxy name &key user-data print-name overrides overrides-plist => proxy`

Signature      `make-lisp-proxy-with-overrides name &rest args &key user-data print-name &allow-other-keys => proxy`

Arguments      `name`      A symbol.

`user-data`      A Lisp object.

`print-name`      A string or a symbol.

`overrides`      An association list.

`overrides-plist`      A plist.

`args`      A plist.

Values      `proxy`      A `jobject`.

Description      The functions `make-lisp-proxy` and `make-lisp-proxy-with-overrides` make a Lisp proxy, which is a Java proxy where method invocation ends up calling Lisp code. The result is a `jobject proxy` which represents the proxy, which

can then be used in Java where an object that implements any of the interfaces that the proxy implements is required.

**Note:** The `jobject` is "local", which means that if it is generated in the scope of a call from Java it must be used (passed to Java method, return to the call from Java or pass it to `jobject-ensure-global`) in the scope of the call from Java. You cannot store it in Lisp and use it later (but you can do that with the result of `jobject-ensure-global`). If the `jobject` is generated not in the scope of a Java call, it must be used on the same thread that it was made.

`name` must be associated with a proxy definition, either by `define-lisp-proxy` or `setup-lisp-proxy`. The proxy definition determines which interfaces the proxy implements, and what happens when a method is invoked on the proxy. The processing of invocation of a method on the proxy is described in the entry for `define-lisp-proxy`.

`user-data` is an arbitrary object. It is passed to the Lisp function if the proxy definition specifies that it should be passed (keyword `:with-user-data` or `:default-function-with-user-data` for the default function).

`print-name` specifies the name of the proxy, after it is converted to a string by `c1:princ-to-string`. If the proxy definition has a `print-name` too, the full print name of the proxy is formed by concatenating the definition's `print-name` and the proxy's `print-name` separated by " - ", otherwise the full print name is the proxy's `print-name`. The full print name is used when printing the proxy, and is also returned when the Java method `toString` is applied to it. If `print-name` is `nil`, a counter is used.

`overrides`, if supplied, must be an association list specifying overriding (see "Overrides" below), that is a list of conses where the `c1:car` is the symbol to override and the `c1:cdr` is the target. When `overrides` is non-nil `overrides-plist` is ignored.

If *overrides-plist* is supplied it must be a plist specifying overriding, that is a list of even length where each even element is a symbol to override and the following odd element is the target.

The *args* argument of `make-lisp-proxy-with-overrides` is used as a plist specifying overrides, after removing any occurrences of `:print-name` and `:user-data` from it.

## Overrides

Overrides allow `make-lisp-proxy` and `make-lisp-proxy-with-overrides` to override symbols in the proxy definition, which means that instead of calling the symbol in the proxy definition the target in the overrides is called. See the entry for `define-lisp-proxy` for details of the processing.

`make-lisp-proxy-with-overrides` is intended to make it simpler to use overrides. It is equivalent to calling `make-lisp-proxy` with *overrides-plist*, and actually calls `make-lisp-proxy` (so may get errors that look like they came from `make-lisp-proxy`).

`make-lisp-proxy` and `make-lisp-proxy-with-overrides` signal error if name is not associated with a proxy definition, and if any overrides are not of the right form or any of the functions to call is not a function designator. They may also signal an error if the proxy definition was not initialized and they failed to initialize it.

### See also

`define-lisp-proxy`  
`setup-lisp-proxy`  
“Using proxies” on page 207

## map-java-object-array

*Function*

### Summary

Apply a function to the elements in an array.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>lw-ji</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Signature   | <code>map-java-object-array function array &amp;key collect reverse start end pass-args convert write-back =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Arguments   | <p><code>function</code> A function designator or <code>nil</code>.</p> <p><code>array</code> A Java array of non-primitive type.</p> <p><code>collect</code> A generalized boolean.</p> <p><code>reverse</code> A generalized boolean.</p> <p><code>start, end</code> Bounding index designators for <code>array</code>.</p> <p><code>pass-args</code> One of the keywords <code>:element</code>, <code>:index</code> and <code>:element-index</code>.</p> <p><code>convert</code> <code>nil</code>, <code>t</code>, or one of the keywords <code>:force-nil</code>, <code>:force-local</code> and <code>:force-global</code>.</p> <p><code>write-back</code> A generalized boolean.</p>                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Values      | <code>result</code> A list or a Lisp vector.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Description | <p>The function <code>map-java-object-array</code> applies the function <i>function</i> to the elements in the Java array <i>array</i>. The default behavior is simply to apply <i>function</i> to each element. The keyword arguments can be used to change this behavior, including modifying elements.</p> <p><i>function</i> should take one or two arguments, depending on <i>pass-args</i>. The default value of <i>pass-args</i> is <code>:element</code>, which means that <i>function</i> takes one argument, the element in the array. <i>pass-args</i> can also be <code>:element-index</code>, and then <i>function</i> should take two arguments, the element and the index. <i>pass-args</i> can also be <code>:index</code> in which case <i>function</i> just takes the index. The latter case is useful when <code>map-java-object-array</code> is used to modify the element in the array. When <i>function</i> is <code>nil</code>, the "result" of the function call is the element itself. That is useful for simple collection (that is, supplying a true value of <i>collect</i>).</p> |

**Note:** When the element that is passed to *function* is a `jobject`, it is by default a "local" object, which means it must not be used outside the dynamic scope of the function call. `collect` and `convert` can change this.

When *write-back* is `nil` the result of the call to *function* is ignored. When *write-back* is non-`nil`, the result of *function* is the new value to write back. The default value of *write-back* is `nil`.

When *reverse* is non-`nil` `map-java-object-array` starts from the highest index and maps down, otherwise it maps up. The default value of *reverse* is `nil`.

*start* and *end* specify the range in *array* to map: *start* defaults to 0 and is inclusive, and *end* defaults to the length of *array* and is exclusive. If either of these is not an integer or is out of bounds, or *end* is smaller than *start*, then an error of type `java-out-of-bounds-error` is signaled.

*pass-args* controls the arguments to *function* as described above.

*collect*, if non-`nil`, specifies that the results of applying *function* should be collected and returned from `map-java-object-array`. If *collect* is `t`, `map-java-object-array` returns a list of the results. *collect* can also be `:vector` or `cl:vector`, in which case *result* is a Lisp vector. When *convert* is either `nil` or `t`, *collect* overrides it and forces conversion of primitive types and strings to Lisp objects, and makes *jobjects* non-local, so they can be used outside the scope of the function calls and `map-java-object-array`. The default value of *collect* is `nil`.

*convert* controls conversion to Lisp objects. When *convert* is `t`, primitive types and strings are converted to Lisp objects before they are passed to *function*. When *convert* is `nil`, all elements are passed as *jobjects*. Note that when *collect* is non-`nil` and *convert* is `nil` or `t`, *collect* overrides *convert* as described above. The default value of *convert* is `t`.

When *convert* is one of :force-nil, :force-local or :force-global it overrides *collect*. :force-nil causes the object to pass as a *jobject* (the same as when *collect* is nil and *convert* is nil). :force-local causes primitive types to pass as Lisp objects, and other types as local *jobjects* (the same as when *collect* is nil and *convert* is t). :force-global causes primitive types to be passed as Lisp objects and other types as global objects.

**Note:** local *jobjects*, which you get when *convert* is either :force-nil or :force-local, or when *collect* is nil and *convert* is not :force-global, must not be used outside the scope of the function *function* that is passed to `map-java-object-array`. Using local objects out of scope can cause the system to crash (rather than signal an error). Note that you must not even use a local *jobject* from one call to *function* in another call to *function* within the same call to `map-java-object-array`.

Converting to global objects adds a substantial overhead to the system, though for small arrays this is not very bad. If you want to map over a large array, and dynamically decide to use only some of the *jobjects* out of scope, you can convert local *jobjects* to global using `jobject-ensure-global`.

When *write-back* is true, the result of the application of *function* is written back to *array*. The default value of *write-back* is nil.

If *array* is not a non-primitive Java array, or *pass-args* or *collect* is not one of the acceptable values, or *write-back* is non-nil and *function* returns an object of wrong type, `map-java-object-array` signals an error of type `java-array-error`.

- Notes
1. `map-java-object-array` accesses only non-primitive arrays. For primitive arrays use one of `primitive-array-to-lisp-array`, `lisp-array-to-primitive-array`, `get-primitive-array-region` and `set-primitive-array-region`.
  2. The function `java-object-array-element-type` can be used to test whether a Java object is a non-primitive array.
  3. When accessing more than one element, `map-java-object-array` may be much faster than accessing the elements using `jvref` or `jaref`.
  4. `map-java-object-array` traverses one level. If a multi-dimensional array is supplied, the elements that it passes to *function* are sub-arrays (which may be `null` too).

See also

`jvref`  
`jaref`  
`primitive-array-to-lisp-array`  
`lisp-array-to-primitive-array`  
`get-primitive-array-region`  
`set-primitive-array-region`  
`java-object-array-element-type`  
`jobject-ensure-global`  
“Working with Java arrays” on page 210

## primitive-array-to-lisp-array lisp-array-to-primitive-array

### Functions

- Summary      Copy elements between a Java primitive array and a Lisp array of matching type.
- Package      `lw-ji`
- Signature     `primitive-array-to-lisp-array p-array &key start end target-start target-end lisp-array => l-result`

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                           |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| Signature   | <code>lisp-array-to-primitive-array l-array &amp;key start end target-start target-end primitive-array =&gt; p-result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                           |
| Arguments   | <i>p-array</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | A Java array of primitive type.                           |
|             | <i>start, end</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Bounding index designators.                               |
|             | <i>target-start, target-end</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Bounding index designators.                               |
|             | <i>lisp-array</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | A Lisp array of an acceptable type, or <code>nil</code> . |
|             | <i>l-array</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | A Lisp array of an acceptable type.                       |
|             | <i>primitive-array</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | A Java array of primitive type, or <code>nil</code> .     |
| Values      | <i>l-result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <i>lisp-array</i> or a new Lisp array.                    |
|             | <i>p-result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <i>primitive-array</i> or a new primitive array.          |
| Description | <p>The function <code>primitive-array-to-lisp-array</code> takes a Java array <i>p-array</i> of primitive type and copies elements from it to a Lisp array of matching type. The target <i>lisp-array</i> is created by default, but can also be supplied as an argument.</p> <p>The function <code>lisp-array-to-primitive-array</code> takes a Lisp array <i>l-array</i> of an acceptable Lisp type and copies elements from it to a Java array of matching type. The target <i>primitive-array</i> is created by default, but can also be supplied as an argument.</p> <p><i>start</i> and <i>end</i> are bounding index designators for the source <i>p-array</i> or <i>l-array</i>, specifying the range to copy.</p> <p><i>target-start</i> and <i>target-end</i> are used only if the target is supplied (by <i>lisp-array</i> or <i>primitive-array</i>). They specify the start and end for copying in the target. The actual number of elements copied is the minimum of the lengths specified for the source and for the target.</p> <p>If the target (<i>lisp-array</i> or <i>primitive-array</i>) is not supplied, these functions create an array of the correct type and the copy length, and copy into it.</p> |                                                           |

The Lisp array that is passed to `lisp-array-to-primitive-array` must be of one of the types listed below, and when the target array is supplied, its type must match the type of the source array according to the table below, except that `cl:base-char` array (`cl:simple-base-string`) is acceptable when the Java side is `byte`.

Table 41.2 Correspondence between Java primitive and Lisp array element types

Table 41.3

| Java primitive type  | Keyword<br>(result of <code>java-array-element-type</code> ) | Lisp type<br>(result of <code>cl:array-element-type</code> ) |
|----------------------|--------------------------------------------------------------|--------------------------------------------------------------|
| <code>byte</code>    | <code>:byte</code>                                           | <code>(signed-byte 8)</code>                                 |
| <code>short</code>   | <code>:short</code>                                          | <code>(signed-byte 16)</code>                                |
| <code>int</code>     | <code>:int</code>                                            | <code>(signed-byte 32)</code>                                |
| <code>long</code>    | <code>:long</code>                                           | <code>(signed-byte 64)</code>                                |
| <code>double</code>  | <code>:double</code>                                         | <code>double-float</code>                                    |
| <code>float</code>   | <code>:float</code>                                          | <code>single-float</code>                                    |
| <code>char</code>    | <code>:char</code>                                           | <code>(unsigned-byte 16)</code>                              |
| <code>boolean</code> | <code>:boolean</code>                                        | <code>(unsigned-byte 8)</code>                               |

For `boolean`, 1 is `true` and 0 is `false`.

Notes For a large number of elements, these functions are much faster than `jvref`. If the primitive data is needed for passing to or from foreign functions, use `get-primitive-array-region` and `set-primitive-array-region` instead. These functions work only on arrays with one dimension with

primitive element type. For non-primitive arrays of one dimension you can use `map-java-object-array`.

## See also

`get-primitive-array-region`  
`set-primitive-array-region`  
`map-java-object-array`  
`jvref`  
`jaref`  
“Working with Java arrays” on page 210

**read-java-field****checked-read-java-field****set-java-field****check-java-field****java-field-class-name-for-setting***Functions*

Summary Access a field, either static or in a Java object.

Package `lw-jl`

Signature `read-java-field full-field-name &optional object => field-value`

Signature `checked-read-java-field full-field-name &optional object => field-value-or-nil, nil-or-condition`

Signature `set-java-field full-field-name value &optional object => value`

Signature `check-java-field full-field-name static-p => result`

Signature `java-field-class-name-for-setting full-field-name static-p => class-name or nil`

Arguments `full-field-name` A string.

`object` A Java object or `nil`.

`value` A type.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                          |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
|             | <i>static-p</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | A boolean.                                                                                                               |
| Values      | <i>field-value</i><br><i>field-value-or-nil</i><br><i>nil-or-condition</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | The value of the field.<br>The value of the field or <code>nil</code> .<br><code>nil</code> or a <code>cl:error</code> . |
|             | <i>result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | A boolean.                                                                                                               |
| Description | <p>The functions <code>read-java-field</code>, <code>checked-read-java-field</code> and <code>set-java-field</code> access the value of a field in a Java Object or a static field.</p> <p>The functions <code>check-java-field</code> and <code>java-field-class-name-for-setting</code> are used to check whether it is possible to access the value of the field.</p> <p><i>full-field-name</i> needs to be a full field name including the package and class, for example "<code>java.io.File.separator</code>".</p> <p>If <i>object</i> is supplied and is non-<code>nil</code>, it must be a Java object from which to read/to which set the value. The field must be non-static in this case. If <i>object</i> is <code>nil</code>, the field must be static.</p> <p><code>read-java-field</code> returns the value of the field. If it fails to get it, it signals an error. If the class is not found, this is a <code>java-class-error</code>, if the field is not found it is a <code>java-field-error</code>.</p> <p><code>checked-read-java-field</code> returns the value like <code>read-java-field</code> and another value which is <code>nil</code> when the read is successful. If the class or the field is not found, <code>checked-read-java-field</code> returns <code>nil</code> and a condition specifying the error (<code>java-field-error</code> or <code>java-class-error</code>). Note that it may still signal other errors, for example if <i>full-field-name</i> does not look like a proper field name.</p> <p><code>set-java-field</code> sets the field to the <i>value</i>. <i>value</i> must be of an acceptable type (see “Types and conversion between Lisp</p> |                                                                                                                          |

and Java” on page 198) and the field must not be final, otherwise it signals `java-field-setting-error`.

`check-java-field` checks whether the field exists and matches the value of `static-p`, and returns a boolean *result* accordingly.

`java-field-class-name-for-setting` checks whether the field exists and matches the value of `static-p` and whether it is not final, and if it is returns the class name of the field. It returns `nil` otherwise. `java-field-class-name-for-setting` is useful for checking whether `set-java-field` can be used on a field, and whether a value is suitable to be stored in his field, by using `jobject-of-class-p`.

Notes It is also possible to access fields using accessors defined by `define-field-accessor` and `setup-field-accessor`.

See also `java-field-error`  
`java-class-error`  
`java-field-setting-error`  
`define-field-accessor`  
`setup-field-accessor`  
Chapter 15, “Java interface”

## record-java-class-lisp-symbol *Function*

Summary Records a correspondence between the name of a Java class and a Lisp symbol.

Package `lw-ji`

Signature `record-java-class-lisp-symbol java-class-name lisp-name => lisp-name`

Arguments `java-class-name` A string.  
`lisp-name` A symbol.

|             |                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Values      | <i>lisp-name</i>                                                                                                                                                                                                                      | A symbol.                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Description | <i>java-class-name</i> must be the precise full name of a Java class.<br><i>lisp-name</i> must be a Lisp symbol corresponding to the Java class. The function <code>record-java-class-lisp-symbol</code> records this correspondence. | At the time of writing this correspondence is used only to find CLOS class names from Java class name by <code>create-instance-from-jobject</code> and <code>ensure-lisp-classes-from-tree</code> .<br><br><code>record-java-class-lisp-symbol</code> is used by the importing interface when <i>lisp-name</i> is non-nil. You can use it yourself, but <i>lisp-name</i> must name an appropriate class (subclass of <code>standard-java-object</code> ). |
| See also    |                                                                                                                                                                                                                                       | <code>write-java-class-definitions-to-stream</code><br><code>write-java-class-definitions-to-file</code><br><code>import-java-class-definitions</code><br><code>create-instance-from-jobject</code><br><code>ensure-lisp-classes-from-tree</code>                                                                                                                                                                                                         |

| <b>report-error-to-java-host</b> |                        | <i>Function</i>                                                                                       |
|----------------------------------|------------------------|-------------------------------------------------------------------------------------------------------|
| Summary                          |                        | Tries to report an error to the Java host.                                                            |
| Package                          |                        | <code>lw-ji</code>                                                                                    |
| Signature                        |                        | <code>report-error-to-java-host <i>error-string</i> <i>log-file-string</i> =&gt; <i>result</i></code> |
| Arguments                        | <i>error-string</i>    | A string.                                                                                             |
|                                  | <i>log-file-string</i> | A string or <code>nil</code> .                                                                        |
| Values                           | <i>result</i>          | A boolean.                                                                                            |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The function <code>report-error-to-java-host</code> tries to report an error to the Java host.</p> <p>It is assumed that <i>error-string</i> specifies the error and <i>log-file-string</i> specifies a file where a log of the error is written.</p> <p><code>report-error-to-java-host</code> funcalls the function that was passed as the <i>report-error-to-java-host</i> argument to <code>init-java-interface</code>, or the default function, with these two arguments.</p> <p>On Android the keyword argument to <code>init-java-interface</code> is passed with a function that invokes the user Java error reporters (set in Java by <code>com.lispworks.Manager.setErrorReporter</code> and <code>com.lispworks.Manager.setGuiErrorReporter</code>).</p> <p>The default function just prints to <code>cl:*terminal-io*</code>, which may be useful enough for debugging.</p> <p><i>result</i> is <code>t</code> if there is a function, and <code>nil</code> otherwise.</p> |
| See also    | <code>init-java-interface</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

|             |                                                                                                                                 | <i>Function</i> |
|-------------|---------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Summary     | Resets the Java interface.                                                                                                      |                 |
| Package     | <code>lw-ji</code>                                                                                                              |                 |
| Signature   | <code>reset-java-interface-for-new-jvm &amp;key for-shaking-p</code>                                                            |                 |
| Arguments   | <code>for-shaking-p</code> A generalized boolean.                                                                               |                 |
| Values      | None.                                                                                                                           |                 |
| Description | The function <code>reset-java-interface-for-new-jvm</code> resets the Java interface, which means eliminating all cached infor- |                 |

mation. *for-shaking-p* needs to be true when it is called before shaking.

The system automatically calls `reset-java-interface-for-new-jvm` when delivering, so you do not need to call it then. Applications should never use it. It may be useful during debugging if the JVM is manipulated in some way.

The default value of *for-shaking-p* is `nil`.

|             |                                  | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <b>send-message-to-java-host</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Summary     |                                  | Sends a message to the Java host.                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Package     |                                  | <code>lw-ji</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Signature   |                                  | <code>send-message-to-java-host message-string where-keyword =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                  |
| Arguments   | <i>message-string</i>            | A string.                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|             | <i>where-keyword</i>             | One of the keywords <code>:append</code> , <code>:add</code> ,<br><code>:prepend</code> , <code>:add-no-scroll</code> , <code>:append-no-</code><br><code>scroll</code> and <code>:reset</code> .                                                                                                                                                                                                                                                                 |
| Values      | <i>result</i>                    | A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Description |                                  | The function <code>send-message-to-java-host</code> sends a message to the Java host. It funcalls the function that was passed as the <code>send-message-to-java-host</code> argument to <code>init-java-interface</code> , or the default function, with <i>message-string</i> and <i>where-keyword</i> .<br><br>On Android <code>init-java-interface</code> is given a function that ends up calling the method <code>com.lispworks.Manager.addMessage</code> . |

The default function checks the keyword and then writes the string to `cl:*terminal-io*`, which is probably good enough for testing purposes.

`result` is `t` if there is a function, and `nil` otherwise.

|                    |                                                                                                                       |
|--------------------|-----------------------------------------------------------------------------------------------------------------------|
| Notes              | The intended meanings of <code>where-keyword</code> are:                                                              |
|                    | <code>:reset</code> Erase any existing text and replace it by the message.                                            |
|                    | <code>:prepend</code> Insert the message and a newline before any existing text.                                      |
|                    | <code>:add-no-scroll</code> Add the message after all existing text.                                                  |
|                    | <code>:add</code> Like <code>:add-no-scroll</code> , and scroll to the beginning of the new message.                  |
|                    | <code>:append-no-scroll</code> Like <code>:add-no-scroll</code> , plus add a following newline.                       |
|                    | <code>:append</code> Like <code>:append-no-scroll</code> , and scroll to the beginning of the new message.            |
| Compatibility note | The values <code>:add-no-scroll</code> and <code>:add</code> for <code>where-keyword</code> are new in LispWorks 7.1. |
| See also           | <code>init-java-interface</code><br><code>format-to-java-host</code>                                                  |

## setup-deliver-dynamic-library-for-java *Function*

Summary      Prepare for delivery of a dynamic library that can be loaded by Java.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                       |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| Package     | lw-ji                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                       |
| Signature   | <code>setup-deliver-dynamic-library-for-java &amp;key <i>init-java</i><br/><i>function</i> <b>asynchronous</b> =&gt; <i>result</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                       |
| Arguments   | <i>init-java</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Boolean, default t.                                   |
|             | <i>function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A function designator for a function of no arguments. |
|             | <i>asynchronous</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Boolean, default nil.                                 |
| Values      | <i>result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Always t.                                             |
| Description | <p>The function <code>setup-deliver-dynamic-library-for-java</code> prepares the LispWorks internal state for delivering (using <code>deliver</code>) a dynamic library that can be loaded from Java and use the Java interface.</p> <p><code>setup-deliver-dynamic-library-for-java</code> should be called just before calling <code>deliver</code>. It causes the call to <code>deliver</code> to produce a dynamic library even if the call to <code>deliver</code> is not given any keywords that indicate it should produce a dynamic library. When the delivered image is loaded into Java by <code>System.loadLibrary</code> or <code>System.load</code> (or the underlying <code>Runtime</code> methods), the host Java virtual machine is remembered by LispWorks and can be retrieved by calling <code>get-host-java-virtual-machine</code>, and if <code>init-java</code> is non-nil (the default) the Java interface is automatically initialized by a call to <code>init-java-interface</code>. Finally, if <code>function</code> is non-nil, it is then called with no arguments.</p> <p>The initialization of the Java interface and calling of <code>function</code> are done after the rest of the initialization of LispWorks. In particular, they occur after the <code>deliver</code> startup function (the first argument of <code>deliver</code>) has returned. If the <code>deliver</code> startup function does not return, the Java initialization does not occur.</p> |                                                       |

**asynchronous** controls whether the initialization is asynchronous from the Java point of view. When **asynchronous** is false (the default), the Java method that loads Lisp waits until Lisp has finished initialization, initialized the Java interface and **function** (if non-nil) has been called and returned. When **asynchronous** is true, the loading method returns immediately and LispWorks initializes asynchronously.

In the asynchronous case, calls from Java to Lisp (using methods in the `com.lispworks.LispCalls` class) may happen before Lisp is ready. Such calls are blocked until Lisp is ready, or 50 seconds have passed. If Lisp is not ready within 50 seconds, you will get an exception. It is possible to check if Lisp is ready by using `com.lispworks.LispCalls.waitForInitialization`.

There is a minimal example of delivering LispWorks for Java in:

```
(example-edit-file "java/lisp-as-dll/README.txt")
```

#### Notes

**function** is intended for performing Java-specific initialization after the Java interface has been initialized, including any initialization that requires the Java interface (which therefore cannot be done by the `deliver` startup function).

`setup-deliver-dynamic-library-for-java` works by setting up and exporting the C symbol `JNI_OnLoad`, which the loading methods in Java invoke. If you want to export your own `JNI_OnLoad`, you must not use `setup-deliver-dynamic-library-for-java`.

The function `get-host-java-virtual-machine` can be used to get the host Java virtual machine. In the synchronous case (the default), `get-host-java-virtual-machine` returns `nil` when called from the `deliver` startup function (first argument to `deliver`), because Lisp did not receive the Java virtual machine yet. In the asynchronous case, `get-host-java-virtual-machine` returns the virtual machine from the beginning.

A non-Java program can also load a dynamic library that was created by delivering with `setup-deliver-dynamic-library-for-java`. In this case, the Java interface is not initialized automatically, *function* is not called, and `get-host-java-virtual-machine` returns `nil`. `get-host-java-virtual-machine` can be used as predicate to tell whether the loading was done from a Java program or not.

If you want initialization that happens only when loaded by Java but not otherwise and you need this to happen before the Java interface is initialized, the easiest approach is to pass `nil` for *init-java* and pass, as *function*, a function that does your initialization and before calling `init-java-interface`. For example:

```
(setup-deliver-dynamic-library-for-java
  :init-java nil
  :function #'(lambda ()
    (my-java-pre-init)
    (init-java-interface)
    (my-java-post-init)))
```

If *init-java* is `nil`, you cannot use the Java interface until you call `init-java-interface`, as in the example above. The call to `init-java-interface` in this case can happen much later than the initialization, but note that calls from Java to Lisp that happen without checking if Lisp is ready will hang, and get an exception after 50 seconds.

In the asynchronous case with `nil` for *init-java*, `init-java-interface` can be called from the deliver startup function or later.

`setup-deliver-dynamic-library-for-java` modifies the way that `init-java-interface` looks for the virtual machine. In particular, you can call `init-java-interface` without specifying the Java virtual machine as in the example above, and `init-java-interface` will use `get-host-java-virtual-machine` to find it.

When `init-java` is true (the default), you can use `setup-java-interface-callbacks` to set some of the callbacks that in other situations you would pass to `init-java-interface`. `setup-java-interface-callbacks` should be called inside `function`, so they happen after the initialization of the Java interface.

LispWorks dynamic libraries that were delivered without using `setup-deliver-dynamic-library-for-java` can be loaded into Java, but to use the Java interface `init-java-interface` must be called with the Java virtual machine. It requires some expertise to pass the virtual machine to Lisp.

## See also

`init-java-interface`  
`get-host-java-virtual-machine`  
`setup-java-interface-callbacks`  
 “Loading a LispWorks dynamic library into Java” on page 217

## setup-field-accessor *Function*

Summary      Defines a Java field accessor.

Package      `lw-ji`

Signature      `setup-field-accessor name class-name field-name static-p &optional is-final => result, error`

Arguments      `name`      A symbol.

`class-name`      A string.

`field-name`      A string.

`static-p`      A boolean.

`is-final`      A boolean.

Values      `result`      `name` or `nil`.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                   |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|
|             | <i>error</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | A condition or <code>nil</code> . |
| Description | The function <code>setup-field-accessor</code> defines a field accessor for a field in a Java class.<br><br><code>class-name</code> must name a Java class.<br><br><code>field-name</code> must be a field name.<br><br><code>static-p</code> specifies whether the field is static or not.<br><br><code>is-final</code> specifies whether the field is final (read-only) or not.<br><br><code>setup-field-accessor</code> sets the symbol function of <code>name</code> to a function that reads the value of the field. If <code>is-final</code> is <code>nil</code> , it also defines <code>(setf name)</code> as the setter.<br><br>The arguments for the getter and setter are determined by the value of <code>static-p</code> . If <code>static-p</code> is non- <code>nil</code> , the getter takes no arguments and the setter takes the new value. If <code>static-p</code> is <code>nil</code> , the getter takes that object from which to get the value, and the setter gets the value and the object.<br><br><code>setup-field-accessor</code> looks up the field definition in Java, and if the definition is incorrect returns <code>nil</code> and the condition as the second value. |                                   |
| Notes       | In general, accessing fields should be avoided, because they are typically a less well-defined and implemented interface than methods, but sometimes it is necessary.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                   |
| See also    | <code>define-field-accessor</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                   |

## **setup-java-caller**

## **setup-java-constructor**

*Functions*

|         |                                                                                      |
|---------|--------------------------------------------------------------------------------------|
| Summary | Define a Java caller, which is a function that calls a Java method or a constructor. |
| Package | <code>lw-ji</code>                                                                   |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signature   | <code>setup-java-caller name class-name method-name &amp;key<br/>signatures =&gt; result, condition</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Signature   | <code>setup-java-constructor name class-name &amp;key class-symbol<br/>signatures =&gt; result, condition</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Arguments   | <p><code>name</code> A symbol.</p> <p><code>class-name</code> A string.</p> <p><code>method-name</code> A string.</p> <p><code>signatures</code> A list of strings.</p> <p><code>class-symbol</code> A symbol.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Values      | <p><code>result</code> <code>name</code> or <code>nil</code>.</p> <p><code>condition</code> A condition object.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Description | <p>The functions <code>setup-java-caller</code> and <code>setup-java-constructor</code> define a Java caller, which is a function that calls a Java method or a constructor. Once this the caller is defined, calls to <code>name</code> ultimately invoke the Java method or constructor.</p> <p>Interpretation of the arguments and behavior of the defined caller is the same as the macros <code>define-java-caller</code> and <code>define-java-constructor</code>.</p> <p>Unlike the macros <code>define-java-caller</code> and <code>define-java-constructor</code>, the functions <code>setup-java-caller</code> and <code>setup-java-constructor</code> do the lookup immediately, and therefore require running Java. If the lookup fails, they do not set the symbol function, and return two values: <code>nil</code> and a condition indicating the reason for the failure.</p> <p>The functions (when successful) return <code>name</code>.</p> |
| See also    | <p><code>define-java-caller</code></p> <p>“Defining specific callers” on page 202</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

|             | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Defines a Lisp proxy                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Package     | <code>lw-ji</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Signature   | <code>setup-lisp-proxy name interface-and-method-descs =&gt; lisp-proxy-name</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Arguments   | <p><i>name</i> A symbol.</p> <p><i>interface-and-method-descs</i> A list.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Values      | <i>lisp-proxy-name</i> A symbol.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Description | <p>The function <code>setup-lisp-proxy</code> defines a Lisp proxy, as described for <code>define-lisp-proxy</code>.</p> <p>Unlike <code>define-lisp-proxy</code> <i>name</i> can be <code>nil</code>, in which case <code>setup-lisp-proxy</code> generates a symbol by <code>c1:gensym</code>, uses it as the name and returns it.</p> <p><i>interface-and-method-descs</i> describes the Java interfaces to implement and the Lisp functions to call. <code>setup-lisp-proxy</code> takes it as a single argument, which must be a list, but otherwise parses it just like <code>define-lisp-proxy</code>.</p> |
| See also    | <code>define-lisp-proxy</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

|              | <i>Class</i>                       |
|--------------|------------------------------------|
| Summary      | A class for <code>jobject</code> . |
| Package      | <code>lw-ji</code>                 |
| Superclasses | None.                              |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Subclasses  | None.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Initargs    | <code>:jobject</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Accessors   | <code>java-instance-jobject</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Description | <p>The class <code>standard-java-object</code> is a class for <code>jobject</code>. Instances of <code>standard-java-object</code> can be passed to the Java interface functions and callers you define, and returned from Java calls whenever a <code>jobject</code> is needed. Each instance is normally associated with a <code>jobject</code>, which is used by the Java interface.</p> <p>Apart from accessing the <code>jobject</code> in the instance, the Java interface does not do anything with the class, and makes no assumptions about it. There is no need for the class hierarchy in Lisp to reflect the class hierarchy in Java.</p> <p>You can define your own classes that inherit from <code>standard-java-object</code> as well as other classes using standard <code>def-class</code>. Alternatively, you can tell the importing interface to define classes. There is no obvious advantage for using the latter.</p> <p>The <code>jobject</code> slot defaults to <code>nil</code>, which the Java interface interprets as an invalid value. Your code needs to do something to set it. One option is to set it explicitly using the accessor <code>java-instance-jobject</code>. When you do that, the object must be a <code>jobject</code>, but the interface does not put any other restrictions. As long as it fits with the logic of your program, an instance of any Lisp class can hold a <code>jobject</code> of any Java class.</p> <p>The other way to set the <code>jobject</code> slot is to use one of the interface functions that does it implicitly. This include the functions <code>make-java-instance</code>, <code>create-instance-jobject</code> and <code>create-instance-jobject-list</code>, and the <code>:construct</code> keyword argument to <code>make-instance</code>.</p> |

The `:construct` keyword is processed by an `:after` method of `cl:initialize-instance` on `standard-java-object`. When `:construct` is supplied, it needs to be either a list (possibly `nil`) of arguments for the constructor, or `t`, which means use `default-constructor-arguments` to get the argument list. The method then calls `create-instance-jobobject-list` with the instance and the arguments to set create and set the `jobject`.

Additionally, the instance that is returned by `create-instance-from-jobobject` also has the `jobject`.

|       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes | <p>When you pass <code>:construct t</code>, the call to <code>default-constructor-arguments</code> happens inside <code>cl:initialize-instance</code>, before all the <code>cl:initialize-instance</code> methods were called (the actual order of calls is the standard order). That means that if <code>default-constructor-arguments</code> depends on some values in the instance that may be set by an <code>cl:initialize-instance</code> method of another class, it may not work properly. You can avoid this problem by not passing the keyword <code>:construct</code> and instead using <code>create-instance-jobobject-list</code> on the result of <code>make-instance</code>.</p> <p>The interface for setting the <code>jobject</code> implicitly requires an association from the CLOS class name to the constructor, by using <code>define-java-constructor</code> or <code>setup-java-constructor</code> with the <code>class-symbol</code> argument.</p> <p><code>create-instance-from-jobobject</code> requires an association from the Java class name to the CLOS class name, which is created by <code>record-java-class-lisp-symbol</code>.</p> |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## throw-an-exception

## *Function*

|         |                                                         |
|---------|---------------------------------------------------------|
| Summary | Throws a Java exception from a proxy method invocation. |
| Package | <code>lw-ji</code>                                      |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signature   | <code>throw-an-exception <i>exception-class-or-exception</i> &amp;rest <i>args</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Arguments   | <p><i>exception-class-or-exception</i><br/> A string or a Java object.</p> <p><i>args</i>            Lisp objects.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Description | <p>The function <code>throw-an-exception</code> throws a Java exception from a proxy method invocation.</p> <p><code>throw-an-exception</code> must be called inside the function that is invoked from a proxy, otherwise a Lisp error is signaled. It causes throwing of a Java exception from the call.</p> <p><i>exception-class-or-exception</i> can be either a string naming an exception class or a Java object of an exception class. When it is a string, <code>throw-an-exception</code> constructs an exception of this class using <i>args</i> as arguments (same as <code>create-java-object</code>). If <i>exception-class-or-exception</i> is an exception then the <i>args</i> are ignored.</p> <p><code>throw-an-exception</code> throws in the Lisp sense out of your code, thus executing unwinding forms of surrounding <code>cl:unwind-protect</code>, and only then actually does the Java throwing (using JNI).</p> <p><code>throw-an-exception</code> can be used with the exception that is caught by <code>catching-java-exceptions</code>, if it is desired that the exception will be handled by the Java caller to the proxy. It is also needed when the method is documented to throw a specific exception in some situation.</p> |
| See also    | <p><code>define-lisp-proxy</code></p> <p>“Using proxies” on page 207</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

## \*to-java-host-stream\* *Variable*

|         |                                                          |
|---------|----------------------------------------------------------|
| Summary | An output stream that sends its output to the Java host. |
|---------|----------------------------------------------------------|

|               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package       | <code>lw-ji</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Initial Value | An output stream.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Description   | The variable <code>*to-java-host-stream*</code> is bound globally to an output stream that sends any output that is written to it to the Java host, by calling <code>send-message-to-java-host</code> . The <i>where-keyword</i> argument to <code>send-message-to-java-host</code> is <code>:add</code> , so the output is added at the end and scrolled if needed. If you do not want scrolling, you can use <code>*to-java-host-stream-no-scroll*</code> instead.<br><br>See <code>send-message-to-java-host</code> for details. |
| Notes         | The connection to the Java host is made by <code>init-java-interface</code> . Until <code>init-java-interface</code> has been called, output to <code>*to-java-host-stream*</code> does nothing.<br><br><code>*to-java-host-stream*</code> is not buffered and makes frequent calls to <code>send-message-to-java-host</code> . This should be OK for dealing with a few kilobytes for each user gesture.                                                                                                                           |
| See also      | <code>send-message-to-java-host</code><br><code>*to-java-host-stream-no-scroll*</code>                                                                                                                                                                                                                                                                                                                                                                                                                                              |

## **\*to-java-host-stream-no-scroll\*** *Variable*

|               |                                                                                                                                                                                                        |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary       | An output stream that sends its output to the Java host without scrolling.                                                                                                                             |
| Package       | <code>lw-ji</code>                                                                                                                                                                                     |
| Initial Value | An output stream.                                                                                                                                                                                      |
| Description   | The variable <code>*to-java-host-stream-no-scroll*</code> is bound globally to an output stream that sends any output that is written to it to the Java host, by calling <code>send-message-to-</code> |

`java-host`. The *where-keyword* argument to `send-message-to-java-host` is `:add-no-scroll`, so the output is added at the end, without ever scrolling. If you want it to scroll when needed, you can use `*to-java-host-stream*` instead.

See `send-message-to-java-host` for details.

|          |                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | The connection to the Java host is made by <code>init-java-interface</code> . Until <code>init-java-interface</code> is called, output to <code>*to-java-host-stream-no-scroll*</code> does nothing.<br><br><code>*to-java-host-stream-no-scroll*</code> is not buffered and makes frequent calls to <code>send-message-to-java-host</code> . This should be OK for dealing with a few kilobytes for each user gesture. |
| See also | <code>send-message-to-java-host</code><br><code>*to-java-host-stream*</code>                                                                                                                                                                                                                                                                                                                                            |

## verify-java-caller *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                          |  |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Summary     | Verify the Java caller.                                                                                                                                                                                                                                                                                                                                                                                                  |  |
| Package     | <code>lw-ji</code>                                                                                                                                                                                                                                                                                                                                                                                                       |  |
| Signature   | <code>verify-java-caller name =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                        |  |
| Arguments   | <code>name</code> A symbol.                                                                                                                                                                                                                                                                                                                                                                                              |  |
| Values      | <code>result</code> A boolean.                                                                                                                                                                                                                                                                                                                                                                                           |  |
| Description | <p>The function <code>verify-java-caller</code> verifies the Java caller, which means looking up the corresponding Java methods and setting up the caller for <code>name</code>.</p> <p><code>name</code> must be a caller name defined by <code>define-java-caller</code> (but not any of the other definers or <code>setup-java-caller</code>). If it is not, an error is signaled. Note that the importing inter-</p> |  |

face defines the caller using `define-java-caller` and that `define-java-callers` also expands to `define-java-caller`, so `verify-java-caller` can be used on such caller (but not on constructors or field accessors).

`verify-java-caller` looks up the Java class and method of the caller (unless they are already cached), and caches the information (so future calls to *name* or verification can use it).

`verify-java-caller` returns `t` if successful, `nil` otherwise.

`verify-java-caller` requires running Java.

- Notes
1. In most cases using `verify-java-callers` to verify all the callers is more convenient.
  2. Verification is useful to guard against typing mistakes when you typed the `define-java-caller` explicitly because that does not do any lookup until run time, or when you are not sure that the class definition has not changed between the time you imported the definition and the time it is used.

- See also
- `verify-java-callers`  
`define-java-caller`  
`define-java-callers`  
“Calling from Lisp to Java” on page 200

## **verify-java-callers** *Function*

- Summary Verify all Java callers and return information about which was successful.

- Package `lw-ji`

- Signature `verify-java-callers &key classes return -> result`

- Arguments `classes` A list of strings, or `nil`.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                               |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
|             | <i>return</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <code>t</code> , or one of the keywords <code>:name-only</code> , <code>:name</code> , <code>:info-only</code> and <code>:successful</code> . |
| Values      | <i>result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | A list.                                                                                                                                       |
| Description | <p>The function <code>verify-java-callers</code> verifies all Java callers and returns information about which was successful and which was not.</p> <p>If <i>classes</i> is non-nil, it must be a list of strings specifying Java classes. In this case, <code>verify-java-callers</code> verifies only callers for these classes. By default <code>verify-java-callers</code> verifies all callers that were defined by <code>define-java-caller</code>.</p> <p><i>return</i> specifies what to return. See below for details.</p> <p><code>verify-java-callers</code> maps through all the callers that were defined by <code>define-java-caller</code> on all classes (if <i>classes</i> is nil) or on the supplied <i>classes</i>.</p> <p>Note that the importing interface defines the caller using <code>define-java-caller</code> and that <code>define-java-callers</code> also expands to <code>define-java-caller</code>, so <code>verify-java-callers</code> verifies these callers too. <code>verify-java-callers</code> does not verify constructors or field accessors.</p> <p>For each caller, <code>verify-java-callers</code> looks up the Java class and the method of the caller (unless it is already cached), and caches the information so calls to the caller and future verifications can use it.</p> <p><code>verify-java-callers</code> returns a list containing an item for each failed lookup, except when <i>return</i> is the keyword <code>:successful</code>, in which case there is an item for each successful lookup. The value of each item depends on the value of <i>return</i> as follows:</p> <ul style="list-style-type: none"> <li><code>t</code> Each item is a cons (<code>args . condition</code>) where <code>args</code> is a list (<code>name class-name method-name</code>) of the required arguments of the <code>define-java-caller</code> form, and <code>condition</code> is the con-</li> </ul> |                                                                                                                                               |

dition that was produced when looking up. Unless something very unusual happened, this condition will be of type either `java-class-error` (if it failed to find the class) or `java-method-error` (if it failed to find the method).

|                          |                                                                                                                                                              |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>:name-only</code>  | Each item is the name of the caller that failed.                                                                                                             |
| <code>:name</code>       | Each item is a cons where the <code>c1:car</code> is the name caller and the <code>c1:cdr</code> is the condition that was generated when trying the lookup. |
| <code>:info-only</code>  | Each item is the list ( <code>name class-name method-name</code> ) of the required arguments for <code>define-java-caller</code> of the failed caller.       |
| <code>:successful</code> | Each item is the name of a successful caller.                                                                                                                |

The default value of *return* is `t`.

`verify-java-callers` requires running Java.

Verification is useful to guard against typing mistakes when you typed the `define-java-callers` explicitly because that does not do any lookup until run time, or when you are not sure that the class definition has not changed between the time you imported the definition and the time it is used.

The intention is that you call `verify-java-callers` on starting your application, at least during the development phase, log the result and check it to see if anything is missing.

#### See also

`verify-java-caller`  
`define-java-caller`  
`define-java-callers`  
“Calling from Lisp to Java” on page 200

|             | <b>verify-lisp-proxy</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>verify-lisp-proxies</b>                                                                                                                                                                                                     | <i>Functions</i> |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| Summary     | Verify proxy definition(s).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                |                  |
| Package     | <code>lw-ji</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                |                  |
| Signature   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <code>verify-lisp-proxy &amp;optional do-undefined-method =&gt; unbounds, undefined-methods</code><br><code>verify-lisp-proxies &amp;optional do-undefined-method =&gt; defs-with-unbounds, defs-with-undefined-methods</code> |                  |
| Arguments   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <code>do-undefined-method</code><br>A generalized boolean.                                                                                                                                                                     |                  |
| Values      | <code>unbounds</code><br><code>undefined-methods</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | A list of lists, each of length 2.<br>A string or a list or <code>nil</code> .                                                                                                                                                 |                  |
|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <code>defs-with-unbounds</code><br>A list of lists.                                                                                                                                                                            |                  |
|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <code>defs-with-undefined-methods</code><br>A list of lists.                                                                                                                                                                   |                  |
| Description | <p>The function <code>verify-lisp-proxy</code> verifies a single proxy definition.</p> <p>The function <code>verify-lisp-proxies</code> verifies all the proxy definitions that were defined by <code>define-lisp-proxy</code> (but not those created by <code>setup-lisp-proxy</code>).</p> <p>Verify means two things:</p> <ul style="list-style-type: none"> <li>• Check that all symbols in the definition which are not keywords have function definitions, and</li> <li>• Check that the methods that are declared in the interfaces that the definition uses have <i>method-specs</i>. This check is</li> </ul> |                                                                                                                                                                                                                                |                  |

performed only if *do-undefined-method* is non-nil, and requires running Java. The default value of *do-undefined-method* is `nil`.

`verify-lisp-proxy` returns two values:

*unbounds* reports symbols lacking function definitions. For each list in *unbounds*, its first element is the method name, and its second element is the symbol that is not fbound. If the default function is not fbound, there is a list where the first element is "`Default function`".

*undefined-methods* (if *do-undefined-method* is non-nil) can be either a string if one of the interfaces cannot be found (the string says that it cannot find an interface and gives its names), or a list. Each element in the list corresponds to an interface. The first element is the interface name, and the rest of the elements are strings specifying methods for which there is no matching *method-descs*.

`verify-lisp-proxies` maps through the proxy definitions that were defined by `define-lisp-proxy`, and verifies each one of them. It returns two values, a list for definitions with symbols are not fbound, and a list for definitions with methods that are undefined. Each item of *defs-with-unbounds* is a list corresponding to a definition with symbol not fbound, where the `c1:car` is the definition name and the `c1:cdr` is the *unbounds* list as returned by `verify-lisp-proxy`. Each item in *defs-with-undefined-methods* is a cons corresponding to a definition where a method is undefined, where the `c1:car` is the definition name and the `c1:cdr` is a string or a list of undefined methods as described above.

## Notes

Failure to find an interface is a real error, and will cause `make-lisp-proxy` to signal error when trying to make a proxy. Symbols which are not fbound and missing methods would cause the default function to be called, which may or may not be the intention. Symbols that are not fbound are useful when they are intended to be always overridden, in

which case they should be keywords, so verification ignores them.

See also [define-lisp-proxy](#)

## **write-java-class-definitions-to-file** **write-java-class-definitions-to-stream**

*Functions*

|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary   | Generate and output the definitions for a specified Java class.                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Package   | <code>lw-ji</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Signature | <code>write-java-class-definitions-to-file <i>java-class-name</i><br/>filename &amp;key lisp-name lisp-class-p package-name prefix name-<br/>constructor export-p create-defpackage lisp-supers add-in-package<br/>print-case if-exists =&gt; <i>java-class-name</i></code>                                                                                                                                                                                                                                                  |
| Signature | <code>write-java-class-definitions-to-stream <i>java-class-name</i><br/>stream &amp;key lisp-name lisp-class-p package-name name-constructor<br/>prefix export-p create-defpackage lisp-supers add-in-package print-<br/>case =&gt; <i>java-class-name</i></code>                                                                                                                                                                                                                                                            |
| Arguments | <p><i>java-class-name</i> A string.</p> <p><i>filename</i> A pathname designator.</p> <p><i>stream</i> An output stream.</p> <p><i>lisp-name</i> A symbol.</p> <p><i>lisp-class-p</i> A generalized boolean.</p> <p><i>package-name</i> A package designator.</p> <p><i>prefix</i> A string or <code>nil</code>.</p> <p><i>name-constructor</i> A function designator.</p> <p><i>export-p</i> A generalized boolean.</p> <p><i>create-defpackage</i> A generalized boolean.</p> <p><i>lisp-supers</i> A list of symbols.</p> |

|             |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <i>add-in-package</i>  | A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|             | <i>print-case</i>      | One of the symbols <code>:upcase</code> , <code>:downcase</code> , or <code>:capitalize</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|             | <i>if-exists</i>       | One of the symbols <code>:error</code> , <code>:new-version</code> , <code>:rename</code> , <code>:rename-and-delete</code> , <code>:overwrite</code> , <code>:append</code> , <code>:supersede</code> , or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Values      | <i>java-class-name</i> | A string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Description |                        | <p>The functions <code>write-java-class-definitions-to-file</code> and <code>write-java-class-definitions-to-stream</code> generate the definitions for the Java class named by <i>java-class-name</i>, and then write them to the destination specified by <i>filename</i> or <i>stream</i>.</p> <p>The generation of forms as the same as <code>generate-java-class-definitions</code> does, except that when <i>add-in-package</i> is non-nil <code>write-java-class-definitions-to-stream</code> and <code>write-java-class-definitions-to-file</code> insert a <code>cl:in-package</code> form after the package manipulation forms. The default value of <i>add-in-package</i> is non-nil.</p> <p>The arguments <i>java-class-name</i>, <i>lisp-name</i>, <i>lisp-class-p</i>, <i>package-name</i>, <i>name-constructor</i>, <i>prefix</i>, <i>export-p</i>, <i>create-defpackage</i> and <i>lisp-supers</i> are processed as described in the entry for <code>generate-java-class-definitions</code>.</p> <p>If <i>add-in-package</i> is non-nil, then after writing the package manipulation forms, a <code>cl:in-package</code> form is written with the package in which the definition names are interned, and the current package is bound to this package, which means the definition names do not need to be qualified with the package name.</p> <p><i>print-case</i> controls the binding of <code>cl:*print-case*</code> while outputting. The default value of <i>print-case</i> is <code>:downcase</code>.</p> <p><i>if-exists</i> is used by <code>write-java-class-definitions-to-file</code> when opening the file, in the same way as <code>open</code>.</p> |

`write-java-class-definitions-to-stream` generates the definitions for the class, and then writes all the definitions to the stream *stream*, with all the printer control variable set to the default except `cl:*print-case*` which takes its value from the *print-case* argument. It adds some comments, as lines starting with ";;".

`write-java-class-definitions-to-file` first open the file for output using the *filename* and *if-exists* arguments, and then calls `write-java-class-definitions-to-stream` with all the arguments except *filename* and *if-exists*.

`write-java-class-definitions-to-stream` and `write-java-class-definitions-to-file` return the *java-class-name*.

## Notes

1. `write-java-class-definitions-to-stream` and `write-java-class-definitions-to-file` require Java running, that is a working Java Virtual Machine and access to the definition of the class.

The generated code, however, is plain lisp, and can be compiled and loaded without Java. They allow you to use either of these functions once to generate the definitions, and add the output or file to your sources, and hence be able to compile and sources without running Java. Note that the output has no machine dependency at all. so as long as you can assume that the definition of the class does not change, you can output the definitions anywhere. For "globally public" classes (in the Java or Android packages), you can probably ask Lisp Support to generate the classes you need, and never bother with running Java on your development machine.

2. The output of these functions is all "user code", that is it uses only exported functions and macros that are available to user. It can be edited as desired, and definitions from it can be copied and used elsewhere.

3. `write-javascript-definitions-to-stream` is intended to allow writing the definitions of several classes to the same file. This especially useful when you write the definitions of several Java classes with the same package.

See also

`generate-javascript-definitions`

`import-javascript-definitions`

“Importing classes” on page 201



# 42

---

## Java classes and methods

This chapter describes the Java classes and methods available in LispWorks.

For an overview of this functionality with examples of use, see Chapter 15, “Java interface”.

### `com.lispworks.LispCalls`

*Java class*

#### Summary

```
public class com.lispworks.LispCalls implements  
InvocationHandler
```

The Java class `com.lispworks.LispCalls` defines methods for calling from Java to Lisp.

`com.lispworks.LispCalls` is part of the LispWorks distribution. For Android it is part of the `7-1-0-0/etc/lisp-works.jar` file. See the Chapter 16, “Android interface” for details. On other platforms it is defined in the JAR file `lisp-calls.jar` which is part of the LispWorks distribution in the `etc` directory, that is (`(lispworks-file "etc/lisp-calls.jar")`). This JAR file needs to be on the classpath (for example by the keyword argument `:java-class-path` to `init-java-interface`).

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| com.lispworks.LispCalls.callIntV<br>com.lispworks.LispCalls.callIntA<br>com.lispworks.LispCalls.callDoubleV<br>com.lispworks.LispCalls.callDoubleA<br>com.lispworks.LispCalls.callObjectV<br>com.lispworks.LispCalls.callObjectA<br>com.lispworks.LispCalls.callVoidV<br>com.lispworks.LispCalls.callVoidA                                                                                                                                                                                                      | <i>Methods</i> |
| <pre> public static int callIntV (String name, Object... args) public static int callIntA (String name, Object[] args) public static double callDoubleV (String name, Object... args) public static double callDoubleA (String name, Object[] args)  public static Object callObjectV (String name, Object... args) public static Object callObjectA (String name, Object[] args)  public static void callVoidV (String name, Object... args) public static void callVoidA (String name, Object[]) args) </pre> |                |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | In the method name, the type specifies the return type, and v or A specifies whether the arguments are supplied as variable arguments or Array. Otherwise the pairs of v and A methods behave the same.<br><br>The <i>name</i> argument is a string specifying a Lisp symbol. The name is parsed by a simple parser as described for <code>com.lispworks.LispCalls.checkLispSymbol</code> (with <code>fboundp = true</code> ). |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

If the symbol is not found or is not fbound, these methods throw a `RuntimeException` with a string giving the reason for failure.

If the symbol is found, it is applied to the arguments `args`. For each argument, if it is a primitive type or of a class corresponding to a primitive type or a string, it is converted to the corresponding Lisp value. Otherwise it is passed as a `jobject`. See “Types and conversion between Lisp and Java” on page 198. The result of the call is converted to the return type of the method and returned from the method. The conversion of the result type allows any float to be returned as a double, but does not coerce between integers and floats. For the `Object` return value, the result must be either a Java object (`jobject` or an instance of `standard-java-object`), or a Lisp object that can be converted to a Java object. See “Types and conversion between Lisp and Java” on page 198.

The Lisp function is an ordinary Lisp function, but it needs to return the right value. Unless the call is using the `void` callers (`com.lispworks.LispCalls.callVoidA` or `com.lispworks.LispCalls.callVoidV`), returning the wrong value will call the `java-to-lisp-debugger-hook` (see `init-java-interface`) with an appropriate condition, and then return zero of the correct type (that is 0, 0d0 or Java `null`) from the call.

The call to the Lisp function is wrapped such that trying to throw out of it does not actually finish the throw, and instead returns zero of the correct type from the call. It is also wrapped by a debugger hook, which is invoked if the code tries to enter the debugger (normally as a result of an unhandled error, but could be any call to `c1:invoke-debugger`). The hook calls the `java-to-lisp-debugger-hook` (see `init-java-interface`) with the condition, and then calls `c1:abort`. If there is no `c1:abort` restart inside the Lisp function that catches this abort, this causes returning a zero of the correct type.

An important issue to remember is that when delivering with shaking, LispWorks eliminates symbols for which there is no reference. If the only call to a Lisp symbol `foo` is from Java, LispWorks will not see the reference and it will eliminate `foo`. To guard against this, you can either pass `foo` in a list to the `deliver` keyword `:keep-symbols`, or more conveniently, use the function `hcl:deliver-keep-symbols` (see the *LispWorks Delivery User Guide*), for example:

```
(defun function-called-from-java (arg1 arg2)
  ...
)

(deliver-keep-symbols 'function-called-from-java)
```

|          |                                                                                                                                                                                                                                                                                          |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Examples | <pre>int sum = com.lispworks.LispCalls.callIntV ("+", 2, 3, 10); =&gt; sum = 15  int position = com.lispworks.LispCalls.callIntV ("search", "r", "international"); =&gt; position = 4  double logThree = com.lispworks.LispCalls.callDoubleV("log", 3); =&gt; logThree = 1.0986123</pre> |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## com.lispworks.LispCalls.checkLispSymbol *Method*

```
public static boolean checkLispSymbol(String name,
                                     boolean fboundp)
```

|             |                                                                                                                                                                                                                                                                                                                                                        |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>Checks whether a Lisp symbol exists, and optionally whether it is <code>fbound</code>.</p> <p><code>name</code> specifies the name of the Lisp symbol. The string <code>name</code> is parsed in a simple way, rather than using the Lisp reader. The parsing involves:</p> <ol style="list-style-type: none"> <li>1. Upcase the string.</li> </ol> |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

2. If there is a colon, take the part before it as a package name. Otherwise use "COMMON-LISP-USER" as the package name.
3. If the colon is followed by another colon, skip it and set a flag allowing internals. Otherwise, set a flag allowing only externals.
4. Take the rest of the string as the symbol name.
5. Find the package from the package name.
6. Find the symbol using the package and the symbol name. If it is internal, use it only if the flag allowing internal was set.
7. If *fboundp* is `true`, check whether the symbol is fbound.

If all these steps succeed, `checkLispSymbol` returns `true`. Otherwise it returns `false`.

For symbols with names that do not need escaping, the result is the same normal processing by the Lisp reader without interning when there is no symbol.

`checkLispSymbol` caches the results in the Java side, which means that if the symbol appears or gets defined after the first call to `checkLispSymbol` it may return the wrong result.

|          |                                                                                                                                                       |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| See also | <a href="#">“Calling from Java to Lisp” on page 206</a><br><code>init-java-interface</code><br><code>define-lisp-proxy</code><br><code>deliver</code> |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------|

## `com.lispworks.LispCalls.createLispProxy` *Method*

```
public static native Object createLispProxy(String
name)
```

|             |                                                                         |
|-------------|-------------------------------------------------------------------------|
| Description | Creates a Lisp proxy, which is a Java proxy which calls Lisp functions. |
|-------------|-------------------------------------------------------------------------|

*name* specifies a symbol which is the name of a proxy definition, defined in Lisp by either `define-lisp-proxy` or `setup-lisp-proxy`. The *name* is parsed by a simple parser as described for `com.lispworks.LispCalls.checkLispSymbol` (with `fboundp = false`).

Once it found the symbol, it makes a proxy the same way that calling `make-lisp-proxy` with *name* would, and returns it. The result is an object that implements all the interfaces that are defined in the proxy definition, and when the methods of these interfaces are called on the object it calls into Lisp. See `define-lisp-proxy` for details.

If `createLispProxy` is successful it returns the proxy object. If there is any problem, this will cause a call to `c1:error`. If the `c1:error` call is not handled, the `java-to-lisp-debugger-hook` (see `init-java-interface`) is called with the condition, and then `null` is returned from `createLispProxy`. If the error is handled and tries to throw out of the context of the Lisp side of `createLispProxy`, the throw is blocked and `createLispProxy` returns `null`.

|                                                      |               |
|------------------------------------------------------|---------------|
| <b>com.lispworks.LispCalls.waitForInitialization</b> | <i>Method</i> |
|------------------------------------------------------|---------------|

```
static public boolean waitForInitialization ()

static public boolean waitForInitialization (long
seconds)

static public boolean waitForInitialization (long
timeout , java.util.concurrent.TimeUnit unit)
```

|             |                                                                                          |
|-------------|------------------------------------------------------------------------------------------|
| Description | Waits for a LispWorks dynamic library to finish initialization and accept foreign calls. |
|-------------|------------------------------------------------------------------------------------------|

Note: You should not use `waitForInitialization` on Android. Use the methods in `com.lispworks.Manager` instead, in particular `com.lispworks.Manager.init` and `com.lispworks.Manager.status`.

The method without arguments waits for up to 10000 seconds. The method that takes `long` waits for up to `seconds` seconds. The method that takes `long` and

`java.util.concurrent.TimeUnit` waits for up to the period defined by `timeout` and `unit`. See the Java documentation for the possible values of `java.util.concurrent.TimeUnit`.

`waitForInitialization` returns when LispWorks has finished its initialization or when the wait period has passed. If LispWorks finishes its initialization first, `waitForInitialization` returns true. If the wait period has passed, `waitForInitialization` returns false.

When `waitForInitialization` is called with 0 seconds, it returns immediately with true if LispWorks is already initialized, and false otherwise. Thus it can be used as a predicate without waiting.

**Notes** Until LispWorks finishes its initialization, calls into LispWorks from Java using the other methods in `com.lispworks.LispCalls` hang, and raise an exception if hanging for too long. If this is an acceptable behavior, then you do not need `waitForInitialization`. If this is not acceptable, `waitForInitialization` allows you to check and avoid this situation. Typically your code will do something like:

```
if (com.lispworks.LispCalls.waitForInitialization(1))
    com.lispworks.LispCalls.callIntV("A-LISP-FUNCTION");
else
    do_something_else();
```

If the LispWorks dynamic library was created with synchronous initialization (the default), then by the time the loading method (normally `System.loadLibrary` or `System.load`) returns, LispWorks has finished initializing. In this case you need `waitForInitialization` only in code that does not know if the loading method has returned (or even called at all).

If the LispWorks dynamic library was created with asynchronous initialization (`setup-deliver-dynamic-library-for-java` was called with true for `asynchronous`), the loading method returns immediately, and LispWorks initializes asynchronously. In this situation you can be sure that LispWorks finished initializing only after a call to `waitForInitialization` has returned true.

If you don't know how the LispWorks dynamic library was created, just assume that it is asynchronous and always check using `waitForInitialization`.

See also

`setup-deliver-dynamic-library-for-java`

# 43

---

## Android Java classes and methods

This chapter describes the Android interface Java code.

For an overview of this functionality with examples of use, see Chapter 16, “Android interface”.

### **com.lispworks.Manager** *Java class*

#### Summary

```
public class com.lispworks.Manager
```

A Java class that defines methods for using Lisp on Android .

It contains one essential method, `com.lispworks.Manager.init`, which loads and initializes LispWorks. It also contains methods to set error reporters that will get called when an error inside Lisp is not caught by user handlers or when `report-error-to-java-host` is called, some methods to define where messages from Lisp (calls to `send-message-to-java-host` or `format-to-java-host`) go, and some other utilities.

`com.lispworks.Manager` defines these methods and fields:

## Initialization

```

public static int init(Context context , String
deliverName, Runnable reporter)

public static int init(Context context)

public static int init(Context context, Runnable reporter)

public static int init(Context context, String
deliverName)

public static int status()

public static int init_result_code()

public static String mInitErrorString = ""

public static boolean loadLibrary()

public static boolean loadLibrary(String deliverName)

final public static int STATUS_INITIALIZING = 0
final public static int STATUS_READY = 1
final public static int STATUS_NOT_INITIALIZED = -1
final public static int STATUS_ERROR = -2

final public static int INIT_ERROR_NO_LIBRARY = -2000
final public static int INIT_ERROR_NO_ASSET = -2001
final public static int INIT_ERROR_FAIL_HEAP = -2002

```

## Error handling

```

public static void setErrorReporter(LispErrorReporter
ler)

public static void
setGuiErrorReporter(LispGuiErrorReporter ler)

public interface LispErrorReporter

public interface LispGuiErrorReporter

public static synchronized void clearBugFormLogs(int
count)

```

```
public static void showBugFormLogs(Activity act)
public static String mInitErrorString = ""
public static int mMaxErrorLogsNumber = 5
```

## Message handling

```
public interface MessageHandler
public void setMessageHandler(MessageHandler handler)
public static synchronized void
setTextView(android.widget.TextView textView)
public static void addMessage(String message, int where)
public static int mMessagesMaxLength
final public static int ADDMESSAGE_RESET = 0
final public static int ADDMESSAGE_APPEND = 1
final public static int ADDMESSAGE_PREPEND = 2
final public static int ADDMESSAGE_APPEND_NO_SCROLL = 3
final public static int ADDMESSAGE_ADD = 4
final public static int ADDMESSAGE_ADD_NO_SCROLL = 5
```

## Others

```
public static void
setCurrentActivity(android.app.Activity)
public static ClassLoader getClassLoader()
public static Context getApplicationContext()
```

Notes      The `com.lispworks.Manager` class is part of the LispWorks distribution, inside the `lispworks.jar` file.

See also    “Delivering for Android” on page 224

## com.lispworks.Manager.init

### Method

```
public static int init(Context context)
public static int init(Context context, Runnable reporter)
```

```
public static int init(Context context, String
deliverName)
```

```
public static int init(Context context, String
deliverName, Runnable reporter)
```

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>Load and initialize Lispworks asynchronously.</p> <p><code>init</code> first checks whether LispWorks is already initialized or in the process of initializing, and if it is returns immediately the appropriate value (<code>STATUS_READY</code> or <code>STATUS_INITIALIZING</code>). Otherwise it loads LispWorks, and initiates the initialization process on another thread. It returns before initialization finished.</p> <p>The argument <code>context</code> is any object of class <code>android.content.Context</code>. <code>init</code> uses it to find the application context, and hence where the LispWorks heap is.</p> <p>The argument <code>reporter</code> is a <code>Runnable</code> that is invoked (that is its run method is invoked) when LispWorks finished initialization. The invocation is on the main thread. The <code>reporter</code> in general should use <code>com.lispworks.Manager.status</code> to check that initializing LispWorks succeeded. Once the <code>reporter</code> is invoked and <code>com.lispworks.Manager.status</code> returned <code>STATUS_READY</code>, it is possible to make calls into Lisp by methods in <code>com.lispworks.LispCalls</code>. If <code>reporter</code> is not supplied, it is possible to know that LispWorks is ready by two other mechanisms:</p> <ul style="list-style-type: none"> <li>• Use the <code>com.lispworks.Manager.status</code> method from other places, or</li> <li>• Call from Lisp into Java from the restart <i>function</i> (the first argument to <code>deliver-to-android-project</code>). When this restart <i>function</i> runs, LispWorks is already ready.</li> </ul> <p>The argument <code>deliverName</code> specifies the name of the delivered LispWorks, specifically the base name of the heap and the dynamic library. See <code>deliver-to-android-project</code> for discussion. The default for <code>deliverName</code> is "LispWorks", which is</p> |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

the default in `deliver-to-android-project`, so normally you do not need it.

`init` returns one of the `STATUS_*` constants. See the entry for `com.lispworks.Manager.status`.

`init` can be called repeatedly and it is thread-safe. The second and subsequent calls will not try to initialize it, unless the status is `STATUS_ERROR`, in which case it will try again. Each *reporter* that is passed to `init` is called independently. This is designed so if your application does not initialize LispWorks on startup, each part of it that relies on LispWorks can use `com.lispworks.Manager.status` to check whether LispWorks is ready, and if not call `init` with a *reporter*, and when the *reporter* is invoked check that `com.lispworks.Manager.status` returns `STATUS_READY`, and then rely on working LispWorks.

See also

`com.lispworks.Manager.status`  
`deliver-to-android-project`  
`com.lispworks.Manager`  
“Delivering for Android” on page 224

## `com.lispworks.Manager.status`

### *Method and Fields*

```
public static int status()

final public static int STATUS_INITIALIZING = 0
final public static int STATUS_READY =1
final public static int STATUS_NOT_INITIALIZED = -1
final public static int STATUS_ERROR = -2
```

Description

Return the status of LispWorks:

`STATUS_INITIALIZING`

LispWorks started initializing but has not finished yet. Because `com.lispworks.Manager.init` is asynchronous, it typically returns this value.

`STATUS_READY`

LispWorks finished initializing.

**STATUS\_NOT\_INITIALIZED**

LispWorks has not started initializing, that is before `com.lispworks.Manager.init` was called.

**STATUS\_ERROR**

There was an error during initialization that prevented initialization. The method `com.lispworks.Manager.init_result_code` and the field `com.lispworks.Manager.mInitErrorString` gives more information about the reason for failure.

See also

`com.lispworks.Manager.init`  
`com.lispworks.Manager.init_result_code`  
`com.lispworks.Manager.mInitErrorString`  
“Delivering for Android” on page 224

## `com.lispworks.Manager.init_result_code`

## *Method and Fields*

```
public static int init_result_code()

final public static int INIT_ERROR_NO_LIBRARY = -2000
final public static int INIT_ERROR_NO_ASSET = -2001
final public static int INIT_ERROR_FAIL_HEAP = -2002
```

Description

Return a more detailed code specifying the result of the call to `com.lispworks.Manager.init`. The code is either one of the three `INIT_ERROR_*` constants above, or one of the codes that `InitLispWorks` returns.

`INIT_ERROR_NO_LIBRARY`

`com.lispworks.Manager.init` did not find the library.

Normally that would mean it is not in the project where it should be (`libs/armeabi-v7a` for Eclipse, `jnilibs/armeabi-v7a` for Android Studio), or its name is not correct. See [deliver-to-android-project](#) for details.

#### `INIT_ERROR_NO_ASSET`

`com.lispworks.Manager.init` failed to find the LispWorks heap in the assets. Normally that means that the LispWorks heap is missing from the project (it should be in assets), or its name is incorrect. See [deliver-to-android-project](#) for details.

#### `INIT_ERROR_FAIL_HEAP`

Extracting the heap from the assets failed. That in general should not happen. It may happen if the disk on the system is full.

Other values are documented for `InitLispWorks`. In general:

- 0 or greater means success (`com.lispworks.Manager.status` returns `STATUS_READY`).
- Values greater than -100 and lower than 0 mean timeout. Since `com.lispworks.Manager.init` is asynchronous, that would be the values during initialization (`com.lispworks.Manager.status` returns `STATUS_INITIALIZING`).
- -100 means not initialized (`com.lispworks.Manager.status` returns `STATUS_NOT_INITIALIZED`).
- Values lower than -100 indicate an error (`com.lispworks.Manager.status` returns `STATUS_ERROR`).

`init_result_code` would typically be used after `com.lispworks.Manager.status` returned `STATUS_ERROR`

When there is an error, `com.lispworks.Manager.mInitErrorString` contains a string describing it.

See also      `com.lispworks.Manager.mInitErrorString`  
`com.lispworks.Manager.init`  
`com.lispworks.Manager.status`  
`deliver-to-android-project`  
“Delivering for Android” on page 224

## **com.lispworks.Manager.mInitErrorString** *Field*

```
public static String mInitErrorString = ""
```

Description      Contains a string explaining the result for an error during initialization.  
  
`mInitErrorString` is set to a non-empty string if there is an error during initialization of LispWorks, which would be detected either by using `com.lispworks.Manager.status` or `com.lispworks.Manager.init_result_code`.  
  
The explanation is technical, so it will not be useful to show it to end users, but it should be helpful to developers, and certainly to LispWorks support.

See also      `com.lispworks.Manager.init`  
`com.lispworks.Manager.status`  
`com.lispworks.Manager.init_result_code`  
“Delivering for Android” on page 224

## **com.lispworks.Manager.loadLibrary** *Method*

```
public static boolean loadLibrary()  
  
public static boolean loadLibrary(String deliverName)
```

Description      Loads only the LispWorks dynamic library without initializing, for debugging.  
  
Normally `loadLibrary` is called by `com.lispworks.Manager.init`, and in general you should not use it. It is supplied because it is sometimes useful for debugging.

`com.lispworks.Manager.init` can be called after `loadLibrary` was called, and will skip the call to it in this case.

`deliverName` has the same meaning as in `com.lispworks.Manager.init`.

Note that `loadLibrary` is not thread-safe on its own.

`loadLibrary` returns `true` on success, otherwise it returns `false` and sets `com.lispworks.Manager.mInitErrorString`

See also      `com.lispworks.Manager.init`  
                `com.lispworks.Manager.mInitErrorString`

`com.lispworks.Manager.LispErrorReporter`

`com.lispworks.Manager.setErrorReporter`

`com.lispworks.Manager.LispGuiErrorReporter`

`com.lispworks.Manager.setGuiErrorReporter` *Methods and Interfaces*

```
public interface LispErrorReporter {
    boolean report(String errorString, String filename);
}

public static void setErrorReporter(LispErrorReporter ler)

public interface LispGuiErrorReporter {
    boolean report(String errorString, String filename);
}

public static void
setGuiErrorReporter(LispGuiErrorReporter ler)
```

Description      Set error reporters that gets invoked when either `report-error-to-java-host` is called, or an error is not caught by your handler or hook.

`setErrorReporter` and `setGuiErrorReporter` are used to set error reporters. When either `report-error-to-java-host` is called (by your code, the system does not use it) or an error is not handled by your handlers (including debugger-

wrappers and `cl:*debugger-hook*)`, the `report` method of the interface is invoked. By default the reporters are both `null`.

The `errorString` of the report message is a string describing the error. The `filename` is the name of a file that contains a log file, but can be also `null`.

**Note:** when `report-error-to-java-host` is called it is your responsibility to pass the right strings.

The reporters should do whatever you want to do. The return value should indicate if the error was dealt with completely, so there is no need to call `com.lispworks.Manager.addMessage` (see below).

The reporter that is set by `setErrorReporter` (“the Lisp error reporter”) and the reporter that is set by `setGuiErrorReporter` (“the Lisp GUI error reporter”) differ by the scope in which their `report` method is invoked:

- The `report` method of the Lisp error reporter is invoked within the scope of the error, which also means it can be any thread. It is therefore cannot do anything related to the GUI, and needs to be runnable on any thread. In general, it should only set internal variables and return, but it may also do things like copying the log file somewhere.
- The `report` method of the Lisp GUI error reporter is invoked outside the scope of the error, on the GUI thread. It is done by the event loop of the GUI thread, so it is also synchronous with respect to processing events. It can therefore safely access the GUI and perform what is needed to inform the user that an error has occurred.

`setErrorReporter` and `setGuiErrorReporter` can be called at any time, before or after `com.lispworks.Manager.init`. There is only one Lisp error reporter and one Lisp GUI error reporter, and each call to `setErrorReporter`

or `setGuiErrorReporter` overwrites the previous value. The reporters can be set to `null`.

When Lisp calls into Java to report an error, it does the following steps:

1. If `com.lispworks.Manager.mMaxErrorLogsNumber` is greater than 0, records the error and delete previous record(s) if the number of records reached `com.lispworks.Manager.mMaxErrorLogsNumber` (these records can be displayed by `com.lispworks.Manager.showBugFormLogs`).
2. If the Lisp error reporter (the non-GUI one) is not `null`, invoke its `report` method.
3. If the Lisp GUI error reporter is not `null`, arrange for its `report` method to be invoked on the GUI process, and does the next 2 steps after this invocation.
4. If neither of the reporters returned `true`, use `com.lispworks.Manager.addMessage` to append the error message. See documentation for `com.lispworks.Manager.addMessage`.
5. If `com.lispworks.Manager.mMaxErrorLogsNumber` is not greater than 0, delete the log file if it is not `null`.

|       |                                                                                                                                                                                                                                                                                                                          |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes | The log files are deleted when LispWorks starts (when <code>com.lispworks.Manager.init</code> is successful). They are also in the internal cache directory, which means they are not visible to other applications. If you want to make the logs visible, the reporter needs to copy the file to an external directory. |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|          |                                                                                                                                                                                                                                                    |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| See also | <code>report-error-to-java-host</code><br><code>com.lispworks.Manager.init</code><br><code>com.lispworks.Manager.addMessage</code><br><code>com.lispworks.Manager.showBugFormLogs</code><br><code>com.lispworks.Manager.mMaxErrorLogsNumber</code> |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**com.lispworks.Manager.clearBugFormLogs** *Method*

```
public static synchronized void clearBugFormLogs(int
count)
```

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>Clear the bug form logs list.</p> <p>LispWorks keeps a record of error reports containing the error strings and the file names containing the log (the arguments to the <code>report</code> method of <code>com.lispworks.Manager.LispErrorReporter</code> received). <code>clearBugFormLogs</code> eliminates all entries except the last <code>count</code> entries, and removes the files.</p> <p>The record is limited to <code>com.lispworks.Manager.mMaxErrorLogsNumber</code>, which defaults to 5.</p> <p>The record can be displayed by <code>com.lispworks.Manager.showBugFormLogs</code>, which allows the user to open the log file of a record by selecting it.</p> |
| Notes       | The log files are also automatically deleted when LispWorks starts (that is when <code>com.lispworks.Manager.init</code> is successful).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| See also    | <code>com.lispworks.Manager.setErrorReporter</code><br><code>com.lispworks.Manager.mMaxErrorLogsNumber</code><br><code>com.lispworks.Manager.showBugFormLogs</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

**com.lispworks.Manager.mMaxErrorLogsNumber** *Field*

```
public static int mMaxErrorLogsNumber = 5
```

|             |                                                                                                                                                                                                                                                                                                                                                          |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>Maximum number of error logs to keep.</p> <p>The default value of 5 is a compromise between keeping many logs (in case some are useful) and avoiding filling the disk. During development you may want to enlarge it, and in the finished product maybe reduce it, possibly to 0.</p> <p>The log files are deleted when LispWorks is initialized.</p> |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## com.lispworks.Manager.showBugFormLogs

### Method

```
public static void showBugFormLogs(Activity act)
```

#### Description

This method is for debugging.

`showBugFormLogs` shows a list of the `BugFormLogs`, where each item is an error string, and allows you to open the associated log file by touching the item. If there is only one item, it opens it immediately.

The argument `act` is the activity that invokes the bug list.

The bug list is displayed in its own activity, `com.lispworks.BugFormLogsList`, and the log file is opened to another activity, `com.lispworks.BugFormViewer`. To make `showBugFormLogs` work, you must add these activities to the file `AndroidManifest.xml` in your project like this:

```
<activity android:name="com.lispworks.BugFormViewer"  
        android:label="Bug Form viewer"> </activity>  
<activity android:name="com.lispworks.BugFormLogsList"  
        android:label="Bug Form Logs"> </activity>
```

The `AndroidManifest.xml` of the OthelloDemo examples contains these lines. Apart from putting the activities in the `AndroidManifest.xml`, you should not do anything else with them.

This method shows Lisp bug forms, so is useful only for Lisp developers.

There will not be any bug form logs if there was no error, or `com.lispworks.Manager.mMaxErrorLogsNumber` is set to 0, in which case `showBugFormLogs` does nothing. It is also possible for the user error reporters (see `com.lispworks.Manager.setErrorReporter`) to delete the log files, so `com.lispworks.BugFormViewer` will fail to show it.

`showBugFormLogs` is useful during development. Once the application is working, you probably want to remove the activities from `AndroidManifest.xml` and not use `showBugFormLogs`.

**See also**

`com.lispworks.Manager.mMaxErrorLogsNumber`  
`com.lispworks.Manager.setErrorReporter`  
`com.lispworks.BugFormLogsList`  
`com.lispworks.BugFormViewer`

**com.lispworks.Manager.addMessage****com.lispworks.Manager.mMessagesMaxLength      Method and Fields**

```
public static void addMessage(String message, int where)
public static int mMessagesMaxLength = 10000

final public static int ADDMESSAGE_RESET = 0
final public static int ADDMESSAGE_APPEND = 1
final public static int ADDMESSAGE_PREPEND = 2
final public static int ADDMESSAGE_APPEND_NO_SCROLL = 3
final public static int ADDMESSAGE_ADD = 4
final public static int ADDMESSAGE_ADD_NO_SCROLL = 5
```

**Description**

Adds a message.

The actual meaning of adding a message is either to call the message handler if it was set by `com.lispworks.Manager.setMessageHandler`, or put the message in the output text view if it was set by `com.lispworks.Manager.setTextView`, if neither the handler or the view are set, then `addMessage` accumulates the messages, and inserts the text next time that that `com.lispworks.Manager.setTextView` is called.

The operation of `addMessage` is first to check whether the handler is not `null`, and if it is call the handler with the two arguments. If the handler returns `true`, `addMessage` does not do anything else. Otherwise, if there is a textview it adds the message to it, otherwise it adds the message to its own buffer.

`where` needs to be one of the six `ADDMESSAGE_*` constants, and determines how the message is added. `ADDMESSAGE_RESET` causes `addMessage` to first clear the textview or the internal string before adding the message. `ADDMESSAGE_PREPEND` means adding the string at the beginning of the textview or

internal string, followed by a newline. `ADDMESSAGE_APPEND`, `ADDMESSAGE_APPEND_NO_SCROLL`, `ADDMESSAGE_ADD` and `ADDMESSAGE_ADD_NO_SCROLL` all add the message to the end of the textview or internal string. `ADDMESSAGE_APPEND` and `ADDMESSAGE_APPEND_NO_SCROLL` follow the message by a newline, while the `ADDMESSAGE_ADD` and `ADDMESSAGE_ADD_NO_SCROLL` do not.

`ADDMESSAGE_APPEND_NO_SCROLL` and `ADDMESSAGE_ADD_NO_SCROLL` do not scroll, while `ADDMESSAGE_APPEND` and `ADDMESSAGE_ADD` scroll the textview to make at least the top of the new message visible.

`addMessage` is used by LispWorks to perform the operation of `send-message-to-java-host`, and to report errors which are not dealt with by the error reporters. You can use it when it is useful.

The call to the handler is done on the thread on which `addMessage` is called, so the handler must be able to cope with being called on any thread, and needs to be thread-safe. The access to the textview or the internal string is done on the GUI thread and is thread-safe.

`mMessagesMaxLength` limits the length that `addMessage` accumulates. The length of the text that `addMessage` accumulates, either internally or in the `TextView`, is limited to the value `mMessagesMaxLength` (default 10000). When appending causes the length to overflow this value, `addMessage` removes the beginning of the old accumulated text so the total is limited to `mMessagesMaxLength`. However, it does not remove part of the message itself, so calling `addMessage` with a string longer than `mMessagesMaxLength` will cause the `TextView` or internal string to be longer than `mMessagesMaxLength` (the old text would be removed completely in this case).

Compatibility notes

`ADDMESSAGE_ADD` and `ADDMESSAGE_ADD_NO_SCROLL` are new in LispWorks 7.1. In LispWorks 7.0, the `ADDMESSAGE_APPEND` and `ADDMESSAGE_APPEND_NO_SCROLL` inserted the newline

before the message. If you rely on that, you may have to modify your code.

## See also

[send-message-to-java-host](#)  
[com.lispworks.Manager.setErrorReporter](#)  
[com.lispworks.Manager.setMessageHandler](#)  
[com.lispworks.Manager.setTextView](#)

**com.lispworks.Manager.setMessageHandler****com.lispworks.Manager.MessageHandler** *Method and Interface*

```
public void setMessageHandler(MessageHandler handler) {
    mMessagehandler = handler }

public interface MessageHandler {
    boolean handle(String message, int where);
}
```

## Description

Sets the message handler which `com.lispworks.Manager.addMessage` uses.

The `handler` is `null` by default, and can be set to `null`.

When the `handler` is not `null`, `com.lispworks.Manager.addMessage` calls the `handle` method with its arguments. The result tells

`com.lispworks.Manager.addMessage` whether to deal further with the string, see its reference entry for further details.

Note that the `handler` can be called on any thread, and needs to be thread-safe.

## See also

[com.lispworks.Manager.addMessage](#)

**com.lispworks.Manager.setTextView***Method*

```
public static synchronized void
setTextView(android.widget.TextView textview)
```

Description Sets the textview for `com.lispworks.Manager.addMessage`.

The `textview` defaults to `null` and can be set to `null`. When it is `null`, `com.lispworks.Manager.addMessage` accumulates the message.

When `setTextView` is called, if there is already a textview it takes the content first and puts it in the buffer of `com.lispworks.Manager.addMessage`. If the new value `textview` is not `null`, it puts into it the buffer of `com.lispworks.Manager.addMessage` and clears the buffer. This is designed such that you can set the `TextView` to another `TextView` or to `null` without losing text.

The intention is that `TextView` makes it easy to display messages that come from Lisp. In a fully-developed product you probably want a better mechanism, by setting the message handler with `com.lispworks.Manager.setMessageHandler`.

There is no expectation by `setTextView` or `com.lispworks.Manager.addMessage` about the properties of the `TextView` except that it is possible to add text to it and delete all the text from it. You can manipulate it yourself (for example delete all the text, or all the text except the last 100 lines) while is set.

`setTextView` can be called on any thread, and is thread-safe. The manipulation of the `TextView` by `com.lispworks.Manager.addMessage` is always done on the GUI process,

See also `com.lispworks.Manager.addMessage`

`com.lispworks.Manager.setMessageHandler`

`com.lispworks.Manager.getClassLoader`

`com.lispworks.Manager.getApplicationContext`

*Methods*

```
public static ClassLoader getClassLoader()  
public static Context getApplicationContext()
```

|             |                                                                                                                                                                          |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | Return the application context of the <i>context</i> that was supplied to <code>com.lispworks.Manager.init</code> , and the <code>ClassLoader</code> associated with it. |
|             | These are utility methods that LispWorks itself uses and you may find useful. They must be called only after <code>com.lispworks.Manager.init</code> was called.         |
| See also    | <code>com.lispworks.Manager.init</code>                                                                                                                                  |

## `com.lispworks.Manager.setCurrentActivity` *Method*

```
public static void
setCurrentActivity(android.app.Activity activity)
```

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | Sets the current activity that can be used inside Lisp using <code>android-get-current-activity</code> .<br><br>The argument <i>activity</i> must be the current active <code>Activity</code> , or <code>null</code> . The Lisp function <code>android-get-current-activity</code> returns this activity.<br><br>Once the <i>activity</i> becomes inactive, <code>setCurrentActivity</code> needs to be called with <code>null</code> , or the new active <code>Activity</code> .                                                                                                                                                                                                                               |
| Notes       | <ol style="list-style-type: none"> <li>1. <code>setCurrentActivity</code> is effectively licensing the Lisp side to raise dialogs in the current activity.</li> <li>2. Activity instances that are used in <code>setCurrentActivity</code> should reset it by calling it with <code>null</code> in their <code>onPause</code> method, to ensure that they are not used after they are no longer visible.</li> <li>3. Activities that allow Lisp to raise dialogs throughout their lifetime should set it on in the <code>onResume</code> method.</li> <li>4. If all the activities in the application set the current activity, then you do not need to reset it in the <code>onPause</code> method.</li> </ol> |

5. `setCurrentActivity` only affects what `android-get-current-activity` returns. Code that gets the `Activity` in other way will not be affected.

See also      `android-get-current-activity`

**com.lispworks.BugFormLogsList**                            *Java class*

```
public class BugFormLogsList extends ListActivity
```

Description      Used by `com.lispworks.Manager.showBugFormLogs` to show the list of bug form logs.

See also      `com.lispworks.Manager.showBugFormLogs`

**com.lispworks.BugFormViewer**                            *Java class*

```
public class BugFormViewer extends Activity
```

Description      Used by `com.lispworks.Manager.showBugFormLogs` to show an individual log.

See also      `com.lispworks.Manager.showBugFormLogs`



# The MP Package

This chapter describes symbols available in the `mp` package, giving you access to the multiprocessing capabilities of LispWorks.

Multiprocessing is discussed in detail in Chapter 19, “Multiprocessing”.

## **allowing-block-interrupts** *Macro*

**Summary** Allows control over blocking interrupts.

**Package** `mp`

**Signature** `allowing-block-interrupts start-blocked &body body => results`

**Arguments** `start-blocked` A generalized boolean

`body` Code

**Values** `results` Values returned by evaluating `body`.

**Description** The macro `allowing-block-interrupts` executes `body` allowing control over blocking interrupts by `current-pro-`

`process-unblock-interrupts` and `current-process-unblock-interrupts`.

Within the dynamic scope of `allowing-block-interrupts`, you can switch the blocking of interrupts on and off. Blocking interrupts prevents any interruption of the current process, including `process-interrupt`, `process-kill`, `process-reset`, `process-break` and `process-stop`. These interrupts are all queued and processed once interrupts become unblocked.

Blocking interrupts also blocks interrupts due to POSIX signals. Such interrupts are processed either by another Lisp thread, or once interrupts become unblocked.

If `start-blocked` is true, `allowing-block-interrupts` blocks interrupts on entry. If `start-blocked` is false, the state does not change on entry. If you want to ensure that the initial forms of `allowing-block-interrupts` are interruptible even if it is inside the scope of another `allowing-block-interrupts`, you need to explicitly call `current-process-unblock-interrupts` on entry.

`allowing-block-interrupts` can be used recursively.

In compiled code, `allowing-block-interrupts` with a true value of the `start-blocked` argument is guaranteed not to process interrupts before an explicit change to the blocking state (that includes exiting the scope of `allowing-block-interrupts`). In particular, if the first cleanup form of an `unwind-protect` is a call to `allowing-block-interrupts`, it is guaranteed to execute without interrupts on exit from the protected form. No such guarantee is given in interpreted code.

On exit from `allowing-block-interrupts`, the current state of interrupt blocking and whether there is a surrounding use of `allowing-block-interrupts` OR with-interrupts-blocked is restored to the state that existed on entry.

`allowing-block-interrupts` returns the results of `body`.

#### See also

```
current-process-block-interrupts  
current-process-unblock-interrupts  
process-break  
process-interrupt  
process-kill  
process-reset  
process-stop  
with-interrupts-blocked
```

## any-other-process-non-internal-server-p

## *Function*

**Summary** Tests whether there is any other process except the caller that is not marked as "internal server".

## Package mp

Signature any-other-process-non-internal-server-p => result

Arguments      None.

Values              *result*              A boolean.

Description The function `any-other-process-non-internal-server-p` is the predicate for whether there is any other process, except the caller process, that is not marked as "internal server".

**Notes** Processes are marked as "internal server" by a true value for `:internal-server` amongst the *keywords* in a call to `process-run-function`.

See also [process-run-function](#)  
[process-internal-server-p](#)

**barrier** *System Class*

|              |                                                                                                                                                                                                                  |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary      | A class of objects for synchronizing processes.                                                                                                                                                                  |
| Package      | <code>mp</code>                                                                                                                                                                                                  |
| Superclasses | <code>t</code>                                                                                                                                                                                                   |
| Description  | Instances of the system class <code>barrier</code> are used for synchronizing processes. They are made by <code>make-barrier</code> and <code>barrier-wait</code> is typically called at synchronization points. |
| See also     | <code>make-barrier</code><br><code>barrier-wait</code><br>“Synchronization barriers” on page 287                                                                                                                 |

**barrier-arriver-count** *Function*

|             |                                                                                                                                                                          |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Returns the arriver count of a <code>barrier</code> .                                                                                                                    |
| Package     | <code>mp</code>                                                                                                                                                          |
| Signature   | <code>barrier-arriver-count barrier =&gt; result</code>                                                                                                                  |
| Arguments   | <code>barrier</code> A <code>barrier</code> .                                                                                                                            |
| Values      | <code>result</code> A positive fixnum, or <code>nil</code> .                                                                                                             |
| Description | The function <code>barrier-arriver-count</code> returns the arriver count of the <code>barrier</code> <code>barrier</code> , or <code>nil</code> for a disabled barrier. |
| Notes       | If <code>barrier</code> is in use, the arriver count can change at any time.                                                                                             |
| See also    | <code>barrier</code><br><code>barrier-wait</code>                                                                                                                        |

**`make-barrier`**

“Synchronization barriers” on page 287

|                               |                 |
|-------------------------------|-----------------|
| <b>barrier-block-and-wait</b> | <i>Function</i> |
|-------------------------------|-----------------|

|         |                                                                                                           |
|---------|-----------------------------------------------------------------------------------------------------------|
| Summary | Enables a <b>barrier</b> , waits until a specified number of arrivers arrive, and then wakes immediately. |
|---------|-----------------------------------------------------------------------------------------------------------|

|         |                 |
|---------|-----------------|
| Package | <code>mp</code> |
|---------|-----------------|

|           |                                                                                                                   |
|-----------|-------------------------------------------------------------------------------------------------------------------|
| Signature | <code>barrier-block-and-wait barrier count &amp;key wait-if-used-p<br/>errorp timeout unblock =&gt; result</code> |
|-----------|-------------------------------------------------------------------------------------------------------------------|

|           |                                   |
|-----------|-----------------------------------|
| Arguments | <i>barrier</i> A <b>barrier</b> . |
|-----------|-----------------------------------|

|  |                                  |
|--|----------------------------------|
|  | <i>count</i> A positive integer. |
|--|----------------------------------|

|  |                                              |
|--|----------------------------------------------|
|  | <i>wait-if-used-p</i> A generalized boolean. |
|--|----------------------------------------------|

|  |                          |
|--|--------------------------|
|  | <i>errorp</i> A boolean. |
|--|--------------------------|

|  |                                                           |
|--|-----------------------------------------------------------|
|  | <i>timeout</i> A non-negative <b>real</b> or <b>nil</b> . |
|--|-----------------------------------------------------------|

|  |                           |
|--|---------------------------|
|  | <i>unblock</i> A boolean. |
|--|---------------------------|

|        |                                                                   |
|--------|-------------------------------------------------------------------|
| Values | <i>result</i> An integer, a symbol or a <b>mp:process</b> object. |
|--------|-------------------------------------------------------------------|

|             |                                                                                                                                                                                                       |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | The function <b>barrier-block-and-wait</b> enables the <b>barrier</b> <i>barrier</i> with <i>t</i> , that is it makes any number of arrivers wait, and then waits until <i>count</i> arrivers arrive. |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|  |                                                                                                                                                                                |
|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <i>wait-if-used-p</i> controls whether to wait if another process is already inside <b>barrier-block-and-wait</b> . The default value of <i>wait-if-used-p</i> is <b>nil</b> . |
|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|  |                                                                  |
|--|------------------------------------------------------------------|
|  | <i>barrier</i> is a <b>barrier</b> made by <b>make-barrier</b> . |
|--|------------------------------------------------------------------|

|  |                                                                                                                                                                                                                   |
|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <i>errorp</i> controls whether to signal an error if another process is already inside <b>barrier-block-and-wait</b> and <i>wait-if-used-p</i> is <b>nil</b> . The default value of <i>errorp</i> is <b>nil</b> . |
|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

*timeout*, if non-nil, specifies the time in seconds to wait before timing out. The default value of *timeout* is `nil`.

*unlock* specifies whether processes that already wait on *barrier* should be unblocked first. The default value of *unlock* is `nil`.

`barrier-block-and-wait` is "using" *barrier*, and only one process can do this the same time. `barrier-block-and-wait` first tries to mark *barrier* as used by the current process, which will fail if another process is inside `barrier-block-and-wait` with the same barrier. In this case it does one of three options:

1. If *wait-if-used-p* is non-nil, it calls `barrier-wait` on *barrier* (without any keyword argument) and returns the result.
2. If *errorp* is non-nil, it calls `error`.
3. Otherwise it returns the other process.

Once `barrier-block-and-wait` has successfully marked *barrier* as used, it changes its count to *t* as if by calling `(barrier-change-count barrier t)`, which will cause other `barrier-wait` calls to wait. If *unlock* is non-nil, it first unblocks all processes that wait on the barrier, so the effect is the same as `(barrier-enable barrier t)`.

It then waits until the arriver count of *barrier* is greater than or equal to *count*, or, if *timeout* is supplied, *timeout* seconds passed. It then returns the number of arrivers.

*result* can be one of three types:

|                         |                                                                                                                                                                      |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>integer</code>    | The call was successful, and <i>result</i> is the number of arrivers.                                                                                                |
| <code>symbol</code>     | <i>barrier</i> was in use, and <i>wait-if-used-p</i> is non-nil, so <code>barrier-wait</code> was called. <i>result</i> is the result of <code>barrier-wait</code> . |
| <code>mp:process</code> | <i>barrier</i> is in use, and <i>result</i> is the process that uses it.                                                                                             |

## Notes

1. When `barrier-block-and-wait` returns, `barrier` is still set with `t`, that is calls to `barrier-wait` on barrier will wait. Normally the current process will go on to do some operations that require the other processes to wait, and then release them by calling `barrier-disable` or `barrier-enable`.
2. In typical usage, the arriver count is just increased by one by each call to `barrier-wait`, so as long as other processes use only `barrier-wait` (or `barrier-block-and-wait` with `wait-if-used-p` non-nil), `barrier-block-and-wait` will return after `count` processes called `barrier-wait` and are waiting. That is the intended purpose of `barrier-block-and-wait`. If other processes call functions that manipulate the arriver count or the count of `barrier` (`barrier-disable`, `barrier-enable`, `barrier-unblock`, `barrier-change-count`), then `barrier-block-and-wait` will "get confused", in the sense that while its behavior is still well-defined, it is not intuitive.
3. With the default keyword values (not counting `timeout`), `barrier-block-and-wait` is useful for controlling a fixed set of processes by another "master" process. The processes in the set need to call `barrier-wait` at appropriate points. When the "master" process wants to stop them for a while, it calls `barrier-block-and-wait`. When it wants to restart them, it calls `barrier-disable`.
4. A non-nil value of `wait-if-used-p` is useful when any member of a group of processes may decide that it needs to stop all the other processes in the group. In this case, this process calls `barrier-block-and-wait` with `wait-if-used-p` non-nil (and count the number of processes in the group minus one). If two of the processes happen to call it at the same time, one will get the barrier, and the other process will have to wait.

5. The effect of `barrier-block-and-wait` can be approximated by using `barrier-change-count` followed by normal `process-wait` that checks the arrivers count in the wait function. `barrier-block-and-wait` has two advantages:
  - a) It checks against more than one process trying to do it at the same time.
  - b) `barrier-block-and-wait` will wake up immediately when the arriver count reaches the right number. `process-wait` will wake up only when the scheduler checks the wait function and wakes it up.

See also

`barrier`  
`barrier-wait`  
`make-barrier`  
`barrier-enable`  
`barrier-disable`

“Synchronization barriers” on page 287

|             |                                                | <i>Function</i>                                                                                                                               |
|-------------|------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     |                                                | Changes the count of a <code>barrier</code> .                                                                                                 |
| Package     |                                                | <code>mp</code>                                                                                                                               |
| Signature   |                                                | <code>barrier-change-count barrier new-count =&gt; result</code>                                                                              |
| Arguments   | <code>barrier</code><br><code>new-count</code> | A <code>barrier</code> .<br>A positive fixnum, or <code>t</code> meaning <code>most-positive-fixnum</code> .                                  |
| Values      | <code>result</code>                            | A boolean.                                                                                                                                    |
| Description |                                                | The function <code>barrier-change-count</code> changes the count of the <code>barrier</code> <code>barrier</code> to <code>new-count</code> . |

If *barrier* is enabled and the arriver count is less than *new-count*, this just sets the count of *barrier* to *new-count* and returns *t*. Otherwise, it calls

```
(barrier-unblock barrier :reset-count new-count)
```

and returns *nil*.

See also

**barrier**

**barrier-unblock**

“Synchronization barriers” on page 287

## barrier-count

## *Function*

Summary      Returns the current count of a **barrier**.

Package      **mp**

Signature      **barrier-count barrier => result**

Arguments      *barrier*      A **barrier**.

Values      *result*      A positive fixnum, or **nil**.

Description      The function **barrier-count** returns the current count of the **barrier** *barrier*, or **nil** if *barrier* is disabled.

Notes      The count value can be changed by **barrier-unblock**, **barrier-enable**, **barrier-disable** or **barrier-change-count**.

See also

**barrier**

**barrier-wait**

**make-barrier**

**barrier-change-count**

**barrier-disable**

**barrier-enable**

**barrier-unblock**  
 “Synchronization barriers” on page 287

|                        | <i>Function</i>                                                                                                                                                                                                                                                                                      |                |                    |                     |            |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------------------|---------------------|------------|
| <b>barrier-disable</b> |                                                                                                                                                                                                                                                                                                      |                |                    |                     |            |
| Summary                | Unblocks and disables a <b>barrier</b> .                                                                                                                                                                                                                                                             |                |                    |                     |            |
| Package                | <code>mp</code>                                                                                                                                                                                                                                                                                      |                |                    |                     |            |
| Signature              | <code>barrier-disable barrier &amp;optional kill-waiting</code>                                                                                                                                                                                                                                      |                |                    |                     |            |
| Arguments              | <table> <tr> <td><i>barrier</i></td><td>A <b>barrier</b>.</td></tr> <tr> <td><i>kill-waiting</i></td><td>A boolean.</td></tr> </table>                                                                                                                                                               | <i>barrier</i> | A <b>barrier</b> . | <i>kill-waiting</i> | A boolean. |
| <i>barrier</i>         | A <b>barrier</b> .                                                                                                                                                                                                                                                                                   |                |                    |                     |            |
| <i>kill-waiting</i>    | A boolean.                                                                                                                                                                                                                                                                                           |                |                    |                     |            |
| Description            | <p>The function <b>barrier-disable</b> unblocks the <b>barrier</b> <i>barrier</i> and then disables it. If <i>kill-waiting</i> is true, <b>barrier-disable</b> also kills any waiting thread. This is done by calling</p> <pre>(barrier-unblock barrier :disable t :kill-waiting kill-waiting)</pre> |                |                    |                     |            |
| See also               | <ul style="list-style-type: none"> <li><b>barrier</b></li> <li><b>barrier-unblock</b></li> <li><b>barrier-wait</b></li> <li><b>make-barrier</b></li> <li>“Synchronization barriers” on page 287</li> </ul>                                                                                           |                |                    |                     |            |

|                       | <i>Function</i>                                                      |
|-----------------------|----------------------------------------------------------------------|
| <b>barrier-enable</b> |                                                                      |
| Summary               | Ensures that a <b>barrier</b> is enabled.                            |
| Package               | <code>mp</code>                                                      |
| Signature             | <code>barrier-enable barrier count &amp;optional kill-waiting</code> |

|             |                                                                                                                                                                                                                                                                                                                                                                                           |                                                                      |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| Arguments   | <i>barrier</i>                                                                                                                                                                                                                                                                                                                                                                            | A <b>barrier</b> .                                                   |
|             | <i>count</i>                                                                                                                                                                                                                                                                                                                                                                              | A positive fixnum, or <b>t</b> meaning <b>most-positive-fixnum</b> . |
|             | <i>kill-waiting</i>                                                                                                                                                                                                                                                                                                                                                                       | A boolean.                                                           |
| Description | The function <b>barrier-enable</b> ensures that the <b>barrier</b> <i>barrier</i> is enabled after unblocking it if it is already enabled, and sets its count to <i>count</i> . If <i>kill-waiting</i> is true, <b>barrier-enable</b> also kills any waiting threads. This is done by calling<br><br><code>(barrier-unblock barrier :reset-count count :kill-waiting kill-waiting)</code> |                                                                      |
| See also    | <a href="#">barrier</a><br><a href="#">barrier-wait</a><br><a href="#">make-barrier</a><br><a href="#">barrier-unblock</a><br>“Synchronization barriers” on page 287                                                                                                                                                                                                                      |                                                                      |

| <b>barrier-name</b> |                                                                                                                                     | <i>Function</i>    |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| Summary             | Returns the name of a <b>barrier</b>                                                                                                |                    |
| Package             | <b>mp</b>                                                                                                                           |                    |
| Signature           | <b>barrier-name</b> <i>barrier</i> => <i>name</i>                                                                                   |                    |
| Arguments           | <i>barrier</i>                                                                                                                      | A <b>barrier</b> . |
| Values              | <i>name</i>                                                                                                                         | A string.          |
| Description         | The function <b>barrier-name</b> returns the name of <i>barrier</i> , as supplied or defaulted in the call to <b>make-barrier</b> . |                    |

See also [barrier](#)  
[make-barrier](#)  
“Synchronization barriers” on page 287

## barrier-pass-through *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                    |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|
| Summary     | Increments the arriver count of a <b>barrier</b> .                                                                                                                                                                                                                                                                                                                                                                                           |                                                                    |
| Package     | <b>mp</b>                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                    |
| Signature   | <b>barrier-pass-through barrier =&gt; result</b>                                                                                                                                                                                                                                                                                                                                                                                             |                                                                    |
| Arguments   | <b>barrier</b>                                                                                                                                                                                                                                                                                                                                                                                                                               | A <b>barrier</b> .                                                 |
| Values      | <b>result</b>                                                                                                                                                                                                                                                                                                                                                                                                                                | One of the keywords <b>:unblocked</b> and <b>:passed-through</b> . |
| Description | <p>The function <b>barrier-pass-through</b> increments the arriver count of the <b>barrier barrier</b>. If the arriver count thereby reaches the count, <b>barrier-pass-through</b> unblocks <b>barrier</b> and returns <b>:unblocked</b>, otherwise it returns <b>:passed-through</b>.</p> <p><b>barrier-pass-through</b> is equivalent to calling <b>barrier-wait</b> with <b>pass-through t</b>. See <b>barrier-wait</b> for details.</p> |                                                                    |

See also [barrier](#)  
[barrier-wait](#)  
[make-barrier](#)  
“Synchronization barriers” on page 287

## barrier-unblock *Function*

|         |                             |
|---------|-----------------------------|
| Summary | Unblocks a <b>barrier</b> . |
|---------|-----------------------------|

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Signature   | <code>barrier-unblock barrier &amp;key disable reset-count kill-waiting</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Arguments   | <p><code>barrier</code> A <code>barrier</code>.</p> <p><code>disable</code> A boolean.</p> <p><code>reset-count</code> A positive fixnum, <code>t</code> or <code>nil</code>.</p> <p><code>kill-waiting</code> A boolean.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Description | <p>The function <code>barrier-unblock</code> unblocks the <code>barrier</code> <code>barrier</code>, potentially disabling it, resetting its count or killing the waiting processes.</p> <p>Without keyword arguments, <code>barrier-unblock</code> unblocks <code>barrier</code>, which means that any thread that is waiting on <code>barrier</code> wakes and returns from <code>barrier-wait</code>, and its arriver count is reset to 0.</p> <p>If <code>disable</code> is true, or if <code>disable</code> is not passed and <code>barrier</code> was made with <code>disable-on-unblock</code> true, then <code>barrier-unblock</code> also disables <code>barrier</code>, so any further calls to <code>barrier-wait</code> return <code>nil</code> immediately.</p> <p>If <code>reset-count</code> is non-nil, it must be valid count (a positive fixnum or <code>t</code>), and <code>barrier-unblock</code> sets the count of <code>barrier</code> to this value.</p> <p>If <code>kill-waiting</code> is true, instead of waking up the waiting threads, <code>barrier-unblock</code> kills them (by <code>process-terminate</code>).</p> |
| See also    | <p><code>process-terminate</code></p> <p><code>barrier</code></p> <p><code>barrier-wait</code></p> <p><code>make-barrier</code></p> <p>“Synchronization barriers” on page 287</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

|                     | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>barrier-wait</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Summary             | Waits on a <b>barrier</b> until enough threads arrive.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Package             | <b>mp</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Signature           | <b>barrier-wait barrier &amp;key timeout callback pass-through discount-on-abort discount-on-timeout disable-on-unblock =&gt; result</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Arguments           | <p><i>barrier</i>      A <b>barrier</b>.</p> <p><i>timeout</i>      A non-negative <b>real</b> or <b>nil</b>.</p> <p><i>pass-through</i>      A boolean.</p> <p><i>discount-on-abort</i>      A boolean.</p> <p><i>discount-on-timeout</i></p> <p style="padding-left: 40px;">A boolean.</p> <p><i>disable-on-unblock</i></p> <p style="padding-left: 40px;">A boolean.</p> <p><i>callback</i>      A function designator.</p>                                                                                                                                                                                                                                                                                             |
| Values              | <p><i>result</i>      <b>t</b>, <b>nil</b> or one of the keywords :<b>unblocked</b>, :<b>passed-through</b> and :<b>timeout</b>.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Description         | <p>The function <b>barrier-wait</b> waits on a barrier until enough threads arrive on <i>barrier</i>. When <b>barrier-wait</b> is called, it "arrives", and when the number of arrivers reaches the count of the barrier (that is, the <i>count</i> argument to <b>make-barrier</b>), <b>barrier-wait</b> returns. Effectively, the last "arriver" unblocks the barrier and wakes up all the other waiting threads.</p> <p><i>timeout</i> is the maximum time to wait in seconds.</p> <p>If <i>pass-through</i> is true, <b>barrier-wait</b> performs the other operations but does not wait.</p> <p><i>discount-on-abort</i> controls whether to change the arrivers count of <i>barrier</i> on an abort (see later).</p> |

*discount-on-timeout* controls whether to change the arrivers count of *barrier* on a timeout (see later).

*disable-on-unblock* controls whether to disable *barrier* when unblocking.

*callback*, if supplied, specifies a callback called before unblocking.

**barrier-wait** first checks whether *barrier* is disabled, and if it is then **barrier-wait** returns `nil` immediately. It then checks the number of arrivers of *barrier*, which is the number of other calls to **barrier-wait** on the same barrier since it was last unblocked or created.

If the number of arrivers is less than the count minus 1, **barrier-wait** increases the number of arrivers by 1, and then waits for *barrier* to be unblocked (unless *pass-through* is true, which causes it to return immediately). If the number of arrivers of *barrier* equals its count minus 1, then **barrier-wait** unblocks *barrier* (as described below) and returns `:unblocked`.

*discount-on-abort*, *discount-on-timeout*, *disable-on-unblock* and *callback* allow you to control how **barrier-wait** waits and also how *barrier* is unblocking. For each of these, the effective value is either that supplied to **barrier-wait**, or if it was not supplied to **barrier-wait**, the value in *barrier* itself (see **make-barrier**).

*timeout* can be used to limit the time that **barrier-wait** waits. It is either a number of seconds or `nil` (the default), meaning wait forever. If **barrier-wait** times out, it returns `:timeout`. By default it does not change the number of arrivers after a timeout, so the call is still counted as an "arrival", but this can be changed by using *discount-on-timeout*. If *discount-on-timeout* is true then **barrier-wait** decrements the arrivers count after a timeout, so the call has no overall effect on the arrivers count.

If `barrier-wait` is aborted while it waits (for example by `process-terminate` or throwing using `process-interrupt`), it does not change the arrivers count by default, so the call still counts as an arrival, but this can be changed by using `discount-on-abort`. If `discount-on-abort` is true, then `barrier-wait` decrements the arrivers count on aborting, so the call has no overall effect on the arrivers count.

If `barrier-wait` would have waited but `pass-through` is true, it returns the symbol `:passed-through` instead of waiting. Hence a call to `barrier-wait` with a true value of `pass-through` has the effect of incrementing the arriver count, and unblocking other waiters if needed, but never itself waiting.

Unblocking a barrier: when the number of arrivers at `barrier` equals its count minus 1, `barrier-wait` "unblocks the barrier". This involves the following steps:

1. If `callback` is non-nil, it is called with `barrier` while holding an internal lock in the barrier. See the comment in `make-barrier`. If `callback` aborts, nothing will have been changed in `barrier` (including no change to the number of arrivers).
2. `barrier` is marked as unblocked for the currently waiting threads.
3. The number of arrivers in `barrier` is reset to 0. Unless the next step disables `barrier`, this means that any subsequent call to `barrier-wait` will wait, as if `barrier` had just been created.
4. If `disable-on-unblock` is true, `barrier-wait` then disables `barrier`. Until it is re-enabled, any other call to `barrier-wait` will return immediately.
5. All the threads waiting on `barrier` are woken.
6. The symbol `:unblocked` is returned.

The possible values of `result` occur in these circumstances:

|                              |                                                                              |
|------------------------------|------------------------------------------------------------------------------|
| <code>t</code>               | The current process waited and some other process unblocked <i>barrier</i> . |
| <code>:unblocked</code>      | The current process unblocked <i>barrier</i> .                               |
| <code>:timeout</code>        | The wait timed out.                                                          |
| <code>:passed-through</code> | The current process did not wait because <i>pass-through</i> is true.        |
| <code>nil</code>             | <i>barrier</i> is disabled.                                                  |

See also

`barrier`  
`barrier-arriver-count`  
`barrier-block-and-wait`  
`barrier-change-count`  
`barrier-count`  
`barrier-disable`  
`barrier-enable`  
`barrier-name`  
`barrier-pass-through`  
`barrier-unblock`  
`make-barrier`  
“Synchronization barriers” on page 287

|                     | <i>Function</i>                                                                                                                |                |            |                     |           |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------|----------------|------------|---------------------|-----------|
| Summary             | Changes the priority of a process.                                                                                             |                |            |                     |           |
| Package             | <code>mp</code>                                                                                                                |                |            |                     |           |
| Signature           | <code>change-process-priority process new-priority =&gt; new-priority</code>                                                   |                |            |                     |           |
| Arguments           | <table> <tr> <td><i>process</i></td><td>A process.</td></tr> <tr> <td><i>new-priority</i></td><td>A fixnum.</td></tr> </table> | <i>process</i> | A process. | <i>new-priority</i> | A fixnum. |
| <i>process</i>      | A process.                                                                                                                     |                |            |                     |           |
| <i>new-priority</i> | A fixnum.                                                                                                                      |                |            |                     |           |
| Description         | Changes the priority of <i>process</i> to be <i>new-priority</i>                                                               |                |            |                     |           |

See also [process-priority](#)

## condition-variable

## System Class

Summary A class of objects for synchronizing processes.

Package `mp`

Superclasses `t`

Description Instances of the system class `condition-variable` are used for synchronizing processes. They are made by `make-condition-variable`.

See also [make-condition-variable](#)  
[condition-variable-wait](#)  
[condition-variable-signal](#)  
“Condition variables” on page 285

## condition-variable-broadcast

## Function

Summary Wakes all threads currently waiting on a given `condition-variable`.

Package `mp`

Signature `condition-variable-broadcast condvar => signaledp`

Arguments `condvar` A `condition-variable`.

Values `signaledp` A generalized boolean.

Description The function `condition-variable-broadcast` wakes all threads currently waiting on the `condition-variable` `condvar`. In most uses of condition variables, the caller should

be holding the `lock` that the waiter used when calling `condition-variable-wait` for `condvar`, but this is not required. When using the `lock`, you may prefer to use `lock-and-condition-variable-broadcast`.

The return value `signaledp` is non-nil if some processes were signaled, or `nil` if there were no processes waiting.

See also

`condition-variable-wait`  
`make-condition-variable`  
`lock-and-condition-variable-broadcast`  
`lock-and-condition-variable-wait`  
`simple-lock-and-condition-variable-wait`  
`lock-and-condition-variable-signal`  
`condition-variable-signal`  
“Condition variables” on page 285

## condition-variable-signal *Function*

Summary      Wakes one thread waiting on a given `condition-variable`.

Package      `mp`

Signature      `condition-variable-signal condvar => signaledp`

Arguments      `condvar`      A `condition-variable`

Values      `signaledp`      A generalized boolean

Description      The function `condition-variable-signal` wakes exactly one thread waiting on the `condition-variable` `condvar`. In most uses of condition variables, the caller should be holding the `lock` that the waiter used when calling `condition-variable-wait` for `condvar`, but this is not required. When using the `lock`, you may prefer to use `lock-and-condition-variable-signal`.

The return value *signaledp* is non-nil if a process was signaled, or nil if there were no processes waiting.

## See also

`condition-variable-wait`  
`make-condition-variable`  
`lock-and-condition-variable-signal`  
`lock-and-condition-variable-wait`  
`simple-lock-and-condition-variable-wait`  
`lock-and-condition-variable-broadcast`  
`condition-variable-broadcast`  
“Condition variables” on page 285

|             |                                                                                               | <i>Function</i>                                                                                                                                                                                                                                                                                                                                          |
|-------------|-----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Waits for a given <code>condition-variable</code> to be signaled.                             |                                                                                                                                                                                                                                                                                                                                                          |
| Package     | <code>mp</code>                                                                               |                                                                                                                                                                                                                                                                                                                                                          |
| Signature   |                                                                                               | <code>condition-variable-wait condvar lock &amp;key timeout wait-reason =&gt; wakep</code>                                                                                                                                                                                                                                                               |
| Arguments   | <code>condvar</code><br><code>lock</code><br><code>timeout</code><br><code>wait-reason</code> | A <code>condition-variable</code> .<br>A <code>lock</code> .<br>A non-negative <code>real</code> or <code>nil</code> .<br>A string.                                                                                                                                                                                                                      |
| Values      | <code>wakep</code>                                                                            | A generalized boolean.                                                                                                                                                                                                                                                                                                                                   |
| Description |                                                                                               | The function <code>condition-variable-wait</code> waits at most <i>timeout</i> seconds for the <code>condition-variable</code> <i>condvar</i> to be signaled. The <code>lock</code> <i>lock</i> is released while waiting and claimed again before returning. The caller must be holding the <code>lock</code> <i>lock</i> before calling this function. |

The return value `wakep` is non-nil if the signal was received or nil if there was a timeout. If `timeout` is nil, `condition-variable-wait` waits indefinitely.

If `wait-reason` is non-nil, it is used as the `wait-reason` while waiting for the signal.

It is recommended that you use `lock-and-condition-variable-wait` or `simple-lock-and-condition-variable-wait` instead of `condition-variable-wait`. The locking functions make it easier to avoid mistakes, and can be more efficient.

Notes      `timeout` controls how long to wait for the signal: before returning, the function waits to claim `lock`, possibly indefinitely.

See also    `condition-variable-wait-count`  
`make-condition-variable`  
`lock-and-condition-variable-wait`  
`simple-lock-and-condition-variable-wait`  
`lock-and-condition-variable-signal`  
`lock-and-condition-variable-broadcast`  
`condition-variable-signal`  
`condition-variable-broadcast`  
“Condition variables” on page 285

|           |                                                                                                      | <i>Function</i>                   |
|-----------|------------------------------------------------------------------------------------------------------|-----------------------------------|
| Summary   | Returns the current number of threads that are still waiting for a <code>condition-variable</code> . |                                   |
| Package   | <code>mp</code>                                                                                      |                                   |
| Signature | <code>condition-variable-wait-count condvar =&gt; wait-count</code>                                  |                                   |
| Arguments | <code>condvar</code>                                                                                 | A <code>condition-variable</code> |

|             |                                                                                                                                                                                                                                                              |                        |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Values      | <code>wait-count</code>                                                                                                                                                                                                                                      | A non-negative integer |
| Description | The function <code>condition-variable-wait-count</code> returns the current number of threads that are still waiting for <code>condvar</code> . Note that for a <code>condition-variable</code> that is actually in use, this number can change at any time. |                        |
| See also    | <code>condition-variable-wait</code><br>“Condition variables” on page 285                                                                                                                                                                                    |                        |

### **\*current-process\*** *Variable*

|             |                                                                        |
|-------------|------------------------------------------------------------------------|
| Summary     | Contains the object that is the current process.                       |
| Package     | <code>mp</code>                                                        |
| Description | This special variable contains the object that is the current process. |
| See also    | <code>get-current-process</code>                                       |

### **current-process-block-interrupts** *Function*

|             |                                                                                                                                                                                                                                                               |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Blocks interrupts in the current process.                                                                                                                                                                                                                     |
| Package     | <code>mp</code>                                                                                                                                                                                                                                               |
| Signature   | <code>current-process-block-interrupts =&gt; t</code>                                                                                                                                                                                                         |
| Description | <p>The function <code>current-process-block-interrupts</code> blocks interrupts in the current process.</p> <p>It signals an error if called outside the dynamic scope of <code>allowing-block-interrupts</code> or <code>with-interrupts-blocked</code>.</p> |

Blocking interrupts prevents any interruption of the current process, including `process-interrupt`, `process-kill`, `process-reset`, `process-break` and `process-stop`. These interrupts are all queued and processed once interrupts become unblocked.

Blocking interrupts also blocks interrupts due to POSIX signals. Such interrupts are processed either by another Lisp thread, or once interrupts become unblocked.

The effect of `current-process-block-interrupts` stays in force until the next call to either `current-process-unblock-interrupts` or `current-process-block-interrupts`, or an exit out of the scope of a surrounding `allowing-block-interrupts` or `with-interrupts-blocked`. Inside this range bodies of `allowing-block-interrupts` and `with-interrupts-blocked` have their own state, but they restore it on exit.

See also

`allowing-block-interrupts`  
`current-process-unblock-interrupts`  
`process-break`  
`process-interrupt`  
`process-kill`  
`process-reset`  
`process-stop`  
`with-interrupts-blocked`

## `current-process-in-cleanup-p`

## *Function*

|           |                                                                                  |
|-----------|----------------------------------------------------------------------------------|
| Summary   | The predicate for whether the current process is cleaning up after being killed. |
| Package   | <code>mp</code>                                                                  |
| Signature | <code>current-process-in-cleanup-p =&gt; result</code>                           |

|             |                     |                                                                                                                                                                                                                          |
|-------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Values      | <code>result</code> | A boolean.                                                                                                                                                                                                               |
| Description |                     | The function <code>current-process-in-cleanup-p</code> returns true after the current process is killed. In particular, it returns true while the cleanups that were set by <code>ensure-process-cleanup</code> execute. |
| See also    |                     | <code>ensure-process-cleanup</code>                                                                                                                                                                                      |

## **current-process-kill** *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Kill the current process.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Package     | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Signature   | <code>current-process-kill</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Arguments   | None.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Values      | None.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Description | <p>The function <code>current-process-kill</code> kills the current process.</p> <p><code>current-process-kill</code> signals an error if it is called when interrupts are blocked, unless it is inside the scope of <code>with-other-threads-disabled</code>, in which case the process is marked as "dying", and actually dies on exit from <code>with-other-threads-disabled</code>.</p> <p>Normally, <code>current-process-kill</code> throws out and does not return. It does execute all surrounding <code>unwind-protect</code> forms.</p> <p>If <code>current-process-kill</code> is called while the process is already doing cleanups, it just returns.</p> |

Notes If you have a process that is broken and repeatedly goes into the debugger and you are not interested in debugging it, then calling `current-process-kill` is the best way of getting rid of it. This is especially useful on non-Cocoa platforms (GTK+ and Windows) when you get an interface that is badly broken.

See also `with-other-threads-disabled`

## **current-process-pause** *Function*

Summary Sleeps for a specified time, but can be woken up.

Package `mp`

Signature `current-process-pause time &optional function &rest args => result`

Arguments `time` A positive number.

`function` A function designator.

`args` Arguments passed to `function`.

Values The keyword `:poked`, or `nil`.

Description The function `current-process-pause` sleeps for `time` seconds, but wakes up if another process did something to wake up the current process (normally this is `process-poke`, but it can also be `process-interrupt`, `process-stop`, `process-unstop` or `process-kill`).

`current-process-pause` is quite similar to `cl:sleep`, but it returns if anything causes the process to wake up, even if the time did not pass.

If `function` is passed just before going to sleep, `current-process-pause` applies `function` to `args`, and if this returns a true value `current-process-pause` returns it immediately.

*function* and *args* are not used otherwise. If another process calls `process-poke` on the current process after setting something that causes *function* to return true, it guarantees that `current-process-pause` will return immediately without sleeping.

If another process woke up the current process, `current-process-pause` returns the keyword `:poked`. If it slept the full time, it returns `nil`.

#### Notes

1. In contrast to `process-wait`, the *function* argument to `current-process-pause` is applied only once, and within the dynamic scope of `current-process-pause`. It therefore does not have any of the restrictions that the *wait-function* of `process-wait` has.
2. The purpose of *function* is to guard against the possibility that another process pokes the current process while it is in the process of going to sleep.
3. There is no way to distinguish between the function returning `:poked` and the process being poked in some way.
4. The pausing does not happen reliably, and it can return `:poked` in a situation when it seems unexpected. For example, if the current process does:

```
(mailbox-read *mailbox*)
...
(current-process-pause)
```

the call to `current-process-pause` may return `poked`, because a process that sent an event to the mailbox tried to poke the current process, and by the time this poke happened the current process is already inside `current-process-pause`. The only guarantees are that `current-process-pause` does not wait when a poke occurred, and that it returns `nil` only when it paused the full time.

Example      Supposed you want to have a process that each minute does some cleanup, but may also be told by other processes to go and do the cleanup. The process be doing:

```
(loop
  (mp:current-process-pause 60 'check-for-need-cleanup)
  (do-cleanup))
```

Another process which wants to provoke a cleanup will do:

```
(setup-cleanup-flag)

(mp:process-poke *cleanup-process*)
```

Note that `check-for-need-cleanup` is passed to `current-process-pause`, because another process may call `process-poke` after `current-process-pause` was called but before it went to sleep. If `check-for-need-cleanup` was not passed, `current-process-pause` would unnecessarily sleep the whole 60 seconds in this case. The same thing could be implemented by `process-wait-with-timeout`, but the implementation above does not require a wait function that can run in another dynamic scope repeatedly at arbitrary times, and it uses much less system resources. It is also easier to debug.

See also      `process-poke`

## **current-process-send** *Function*

Summary      Sends an object as an event to the current process.

Package      `mp`

Signature      `current-process-send object`

Arguments      `object`      A Lisp object.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The function <code>current-process-send</code> sends <i>object</i> as an event to the current process.</p> <p>This is useful when you want to execute code as an event rather than in the current context. A typical example is when a CAPI callback needs to do something in the current process which is not appropriate to invoke inside the callback.</p> <p>For the object to actually be processed as an event, the current process must process events sometime after <code>current-process-send</code> is called. In the "standard" situation, for example in a process started by CAPI, the object will be processed as an event by calling <code>general-handle-event</code>.</p> |
| See also    | <p><code>process-send</code><br/> <code>general-handle-event</code><br/> “Communication between processes and synchronization”<br/> on page 283</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

|                                             | <i>Function</i>                                                                                                                                                                                                                 |
|---------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>current-process-set-terminate-method</b> |                                                                                                                                                                                                                                 |
| Summary                                     | Sets the Terminate Method of the current process.                                                                                                                                                                               |
| Package                                     | <code>mp</code>                                                                                                                                                                                                                 |
| Signature                                   | <code>current-process-set-terminate-method &amp;key local-terminator<br/>remote-terminator terminate-by-send</code>                                                                                                             |
| Arguments                                   | <p><i>local-terminator</i> A function designator for a function of no arguments.</p> <p><i>remote-terminator</i>A function designator for a function of one argument.</p> <p><i>terminate-by-send</i>A generalized boolean.</p> |
| Description                                 | The function <code>current-process-set-terminate-method</code> sets the Terminate Method of the current process. See <code>pro-</code>                                                                                          |

`cess-run-function` for the meaning of the keyword arguments.

The default value of `terminate-by-send` is `t`. Therefore calling `current-process-set-terminate-method` without arguments sets the Terminate Method to terminate-by-send. Calling `current-process-set-terminate-method` with `terminate-by-send nil` makes the process not have a Terminate Method.

See also      `process-run-function`  
                 `process-terminate`  
                 `current-process-kill`

|             | <b>current-process-unblock-interrupts</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <i>Function</i> |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Summary     | Unblocks interrupts in the current process.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                 |
| Package     | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                 |
| Signature   | <code>current-process-unblock-interrupts =&gt; t</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                 |
| Description | <p>The function <code>current-process-unblock-interrupts</code> unblocks interrupts in the current process.</p> <p>It signals an error if called outside the dynamic scope of <code>allowing-block-interrupts</code> or <code>with-interrupts-blocked</code>.</p> <p>The effect of <code>current-process-unblock-interrupts</code> stays in force until the next call to either <code>current-process-unblock-interrupts</code> or <code>current-process-block-interrupts</code>, or an exit out of the scope of a surrounding <code>allowing-block-interrupts</code> or <code>with-interrupts-blocked</code>. Inside this range bodies of <code>allowing-block-interrupts</code> and <code>with-interrupts-blocked</code> have their own state, but they restore it on exit.</p> |                 |

See also      **allowing-block-interrupts**  
**current-process-block-interrupts**  
**with-interrupts-blocked**

## **debug-other-process** *Function*

Summary      Examine the stack of a process other than the current process.

Package      **mp**

Signature      **debug-other-process** *process*

Arguments      *process*      A process or a string.

Description      The function **debug-other-process** causes the debugger to be entered to examine the stack of another process *process*. The debugger itself continues to run in the current process, and the execution of the other process *process* is not affected. That means that all debugger commands that try to affect execution (for example **:a**, **:c**, **:res**, **:ret**, **:trap**) do not work as in the normal debugger. **:a** is changed instead to exit the debugger.

**Note:** if the other process is still active, the stack will change "under the feet" of the debugger, with unpredictable results. Thus **debug-other-process** is useful only for debugging purposes, or when you already stopped the other process.

The usual way to enter a debugger on another thread is to use **process-break**. However, that would fail if the other process hangs for some reason. In this situation, you can use **debug-other-process** to try to find out why it hangs.

If *process* is a string, the process is found as if by **find-process-from-name**. The list of process names can be found via **ps**.

See also [find-process-from-name](#)  
[process-break](#)  
[ps](#)

\*default-process-priority\* Variable

**Summary** The default priority for processes.

## Package mp

Description The variable **\*default-process-priority\*** contains the default priority for processes.

See also [process-run-function](#)

## **ensure-process-cleanup** *Function*

**Summary** Run forms when a given process terminates.

## Package mp

**Signature**      **ensure-process-cleanup** *cleanup-form* &**key priority force**  
**process** =>

**Signature**      `ensure-process-cleanup cleanup-form &optional process =>`

Arguments      *cleanup-form*      Form to run when process terminates.

*priority* An integer in the inclusive range [-1000000, 1000000].

*force* A boolean.

*process* A `mp:process` object.

Values      None.

|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description        | <p>The function <code>ensure-process-cleanup</code> ensures that the <i>cleanup-form</i> is present for the process <i>process</i>. When <i>process</i> terminates, its cleanup forms are run. Cleanup forms can be functions of one argument (the <i>process</i>), or lists, in which case the <code>c1:car</code> is applied to the <i>process</i> and the <code>c1:cdr</code> of the list.</p> <p><i>process</i> is the process to watch for termination. By default, this is the value returned by <code>get-current-process</code>.</p> <p><i>priority</i> determines the execution order of the forms. Higher <i>priority</i> means later execution. The system uses values between 700000 and 900000 for cleanups that need to be last, and 0 for other cleanups. The default value of <i>priority</i> is 0.</p> <p><i>force</i> determines what to do if the same cleanup is already registered but with a different <i>priority</i>. When adding cleanup forms, <code>ensure-process-cleanup</code> uses <code>c1:equal</code> to ensure that the form is only added once. If a cleanup already exists with the same priority, <code>ensure-process-cleanup</code> just returns <code>nil</code>, otherwise it acts according to <i>force</i>: if <i>force</i> is <code>nil</code> it invokes an error, but if <i>force</i> is <code>t</code> then <code>ensure-process-cleanup</code> removes the old entry before adding the new entry. The default value of <i>force</i> is <code>nil</code>.</p> <p>When <code>ensure-processes-cleanup</code> is called on a foreign thread, that is a thread that was not created by LispWorks, the cleanups are executed after the outermost foreign-callable returns and before return to the foreign code that called it (that is when no Lisp frames remain on the stack).</p> |
| Compatibility note | Before LispWorks 7.1, the cleanups were never executed when <code>ensure-processes-cleanup</code> was called in a foreign thread.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Notes              | <ol style="list-style-type: none"> <li>1. You can test for whether the current process is executing its cleanups with <code>current-process-in-cleanup-p</code>.</li> <li>2. For compatibility with LispWorks 6.1 and earlier versions, <code>ensure-process-cleanup</code> can also be called like this:</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

```
(ensure-process-cleanup cleanup-form process)
```

Such calls are still allowed, for backwards compatibility, however please update your programs to call it like this:

```
(ensure-process-cleanup cleanup-form
                      :priority priority
                      :force force
                      :process process)
```

**Example** A process calls `add-process-dependent` each time a dependent object is added to a process. When the process terminates, `inform-dependent-of-dead-process` is called on all dependent objects.

```
(defun add-process-dependent (dependent)
  (mp:ensure-process-cleanup
   ` (delete-process-dependent ,dependent)))
```

  

```
(defun delete-process-dependent (process dependent)
  (inform-dependent-of-dead-process dependent process))
```

**See also** `current-process-in-cleanup-p`  
`process-terminate`

## find-process-from-name *Function*

**Summary** Finds a process from its name.

**Package** `mp`

**Signature** `find-process-from-name process-name => result`

**Arguments** `process-name` A string.

**Values** `result` A `mp:process`, or `nil`.

**Description** The function `find-process-from-name` returns the process with the name `process-name`.

If there is no such process, the function returns `nil`.

**Example**      `CL-USER 16 > (mp:find-process-from-name "Listener 1")  
#<MP:PROCESS Name "Listener 1" Priority 600000 State  
"Running">`

**See also**      `get-process`

## **funcall-async**

## **funcall-async-list**

## *Functions*

**Summary**      Funcall a function asynchronously.

**Package**      `mp`

**Signature**      `funcall-async func &rest args`  
`funcall-async-list func-and-args`

**Arguments**      `func`      A function designator.

`args`      Arguments.

`func-and-args`      A cons.

**Description**      The functions `funcall-async` and `funcall-async-list` call the function `func` with the supplied arguments, that is what `c1:funcall` would do, but asynchronously.

`func-and-args` must be a cons of a function designator and a proper list of arguments.

Multiprocessing must have already started.

These functions do not return a useful value.

**Notes**      1. These functions are effectively lightweight versions of `process-run-function`.

2. On most architectures they are implemented using worker processes, which are named "**Background Execute n**".
3. The maximum number background processes is limited by default to 5 and this is adequate in most cases. However, if you use `funcall-async` and/or `funcall-async-list` often, you may want to increase the limit, by using `set-funcall-async-limit`.
4. The dynamic context of the call to *func* is undefined, and must not be relied upon.
5. The current process should not be accessed inside *func*, except when you want another process to poke the process that runs *func* (this is sometimes useful if *func* calls a wait function). In this case you can call `get-current-process` inside the dynamic scope of *func* to get the process that the other process should poke.
6. `funcall-async` and `funcall-async-list` are intended for functions that finish quickly. If *func* takes a long time, it prevents the background process from executing other async calls, and if all of the background processes become occupied by long-executing functions it will cause other async calls to be delayed until one of the background processes finishes. Thus if you have a long-executing function that you want to run asynchronously, it is better to use `process-run-function` instead, or use your own pool of worker processes.

See also

`process-run-function`  
`set-funcall-async-limit`

## general-handle-event

*Generic function*

Summary

"handles" an event, depending on the type of the event object.

|             |                                                                                                                                                              |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>mp</code>                                                                                                                                              |
| Signature   | <code>general-handle-event event-object</code>                                                                                                               |
| Arguments   | <code>event-object</code> A Lisp object.                                                                                                                     |
| Description | The generic function <code>general-handle-event</code> "handles" the <code>event-object</code> . What this actually means depends on the type of the object. |

There are system defined methods for these classes:

|                       |                                                      |
|-----------------------|------------------------------------------------------|
| <code>list</code>     | Apply the <code>car</code> to the <code>cdr</code> . |
| <code>function</code> | Call it.                                             |
| <code>symbol</code>   | If fbound call it, otherwise do nothing.             |
| <code>t</code>        | Do nothing.                                          |

You can add methods for your own classes.

`general-handle-event` is used by all functions that process events, for example `wait-processing-events` and `process-all-events`, as well as by internal waiting functions.

|          |                                                                                                                                      |
|----------|--------------------------------------------------------------------------------------------------------------------------------------|
| See also | <code>process-all-events</code><br><code>process-send</code><br>“Communication between processes and synchronization”<br>on page 283 |
|----------|--------------------------------------------------------------------------------------------------------------------------------------|

## get-current-process *Function*

|           |                                                                       |
|-----------|-----------------------------------------------------------------------|
| Summary   | Returns the current Lisp process.                                     |
| Package   | <code>mp</code>                                                       |
| Signature | <code>get-current-process =&gt; result</code>                         |
| Values    | <code>result</code> A <code>mp:process</code> , or <code>nil</code> . |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | The function <code>get-current-process</code> returns the actual process in which it is called. In this respect it differs from <code>*current-process*</code> , which can be bound to another process. In particular, when a process A calls the <i>wait-function</i> of process B, in the <i>wait-function</i> <code>get-current-process</code> returns the process A, but <code>*current-process*</code> is bound to process B.<br><br><code>result</code> is <code>nil</code> if multiprocessing is off. |
| See also    | <code>*current-process*</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

## get-process *Function*

|             |                                                                                                                                                |                                                                                                                                                  |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Returns a process corresponding to a supplied designator.                                                                                      |                                                                                                                                                  |
| Package     | <code>mp</code>                                                                                                                                |                                                                                                                                                  |
| Signature   | <code>get-process process-designator =&gt; process</code>                                                                                      |                                                                                                                                                  |
| Arguments   | <code>process-designator</code><br>A <code>mp:process</code> , a string, a stack-group, a function, a symbol or a fixnum.                      |                                                                                                                                                  |
| Values      | <code>process</code>                                                                                                                           | A <code>mp:process</code> .                                                                                                                      |
| Description | The function <code>get-process</code> returns a process according to the supplied <i>process-designator</i> , which is interpreted as follows: |                                                                                                                                                  |
|             | <code>mp:process</code>                                                                                                                        | Return it.                                                                                                                                       |
|             | A string                                                                                                                                       | Find the first process (highest priority) with matching name. Process names are compared by <code>string=</code> .                               |
|             | A stack-group                                                                                                                                  | Return the process of the stack-group.                                                                                                           |
|             | A function                                                                                                                                     | Return the first process that has <i>process-designator</i> as its function (that is, the third argument of <code>process-run-function</code> ). |

|          |                                                                                                                                                                                                                                            |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A symbol | First search for a process using the symbol name as a string, and (if that fails) then search using the symbol as a function.                                                                                                              |
| A fixnum | Find a process for which <i>process-designator</i> is its unique id. The unique id of the current process can be found by<br><code>(sys:current-thread-unique-id)</code> .<br><i>result</i> is <code>nil</code> if multiprocessing is off. |

See also `find-process-from-name`

## get-process-private-property *Function*

Summary Gets the value of a process private property.

Package `mp`

Signature `get-process-private-property indicator process &optional default => result`

Arguments `indicator` A Lisp object.

`process` A process.

`default` A Lisp object.

Values `result` A property value, or *default*.

Description The function `get-process-private-property` gets the value associated with *indicator* in the private properties of the process *process*. If there is no such property, the value *default* is returned.

`get-process-private-property` can be used to read the values of private properties from another process.

The default value of *default* is `nil`.

See also      **process-private-property**  
                **remove-process-private-property**  
                **pushnew-to-process-private-property**  
                **remove-from-process-private-property**

## initialize-multiprocessing *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Initializes multiprocessing before use.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Package     | <b>mp</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Signature   | <b>initialize-multiprocessing &amp;rest main-process-args =&gt; nil</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Arguments   | <b>main-process-args</b><br>A set of arguments for <b>process-run-function</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Values      | Returns <b>nil</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Description | The function <b>initialize-multiprocessing</b> initializes multiprocessing, and it does not return until multiprocessing is finished.<br><br><b>initialize-multiprocessing</b> applies the function <b>process-run-function</b> to each of the entries in <b>*initial-processes*</b> to create the initial processes.<br><br>When called with <b>main-process-args</b> , it creates a <b>mp:process</b> object for the initial thread using the arguments in that list as if in the call<br><br><b>(apply 'mp:process-run-function main-process-args)</b><br><br>Supplying <b>main-process-args</b> is useful on Mac OS X if you want to run a pure Cocoa application, since the main thread needs to run the Cocoa event loop. |

It is not necessary to call `initialize-multiprocessing` when the LispWorks IDE is running (that is, after `env:start-environment` has been called), as this automatically starts up multiprocessing.

|          |                                                                                                                                          |
|----------|------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | On Microsoft Windows, Linux, x86/x64 Solaris, FreeBSD, AIX and Mac OS X (using the Cocoa image), the LispWorks IDE starts up by default. |
| See also | <code>*initial-processes*</code><br><code>process-run-function</code>                                                                    |

## **\*initial-processes\*** *Variable*

|             |                                                                                                                                                                                                                                                     |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | A list of the processes the system initializes on startup.                                                                                                                                                                                          |
| Package     | <code>mp</code>                                                                                                                                                                                                                                     |
| Description | <p>The variable <code>*initial-processes*</code> specifies the processes which the system initializes on startup.</p> <p>Each element of the <code>*initial-processes*</code> list is a set of arguments for <code>process-run-function</code>.</p> |
| Example     | To create a listener process as well as your own processes, evaluate this form before saving your image:                                                                                                                                            |
|             | <pre>(push mp::*default-listener-process*       mp::*initial-processes*)</pre>                                                                                                                                                                      |
| See also    | <code>process-run-function</code>                                                                                                                                                                                                                   |

| <b>last-callback-on-thread</b> | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary                        | Informs LispWorks that there are probably not going to be more callbacks from foreign code on the current thread, allowing it to free some data.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Package                        | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Signature                      | <code>last-callback-on-thread =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Values                         | <code>result</code> <code>t</code> or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Description                    | <p>The function <code>last-callback-on-thread</code> informs LispWorks that there are probably not going to be more callbacks from foreign code on the current thread (but does not guarantee this).</p> <p><code>last-callback-on-thread</code> must be used in the scope of a call into LispWorks by a foreign callable on a thread that was not created by LispWorks. It informs LispWorks that there are unlikely to be more callbacks into Lisp on the current thread. As a result, LispWorks can cleanup its side.</p> <p>For each thread that was not created by Lisp and on which there was a call into Lisp, LispWorks keeps data on the Lisp side which it uses to make the entry faster. If the thread goes away, this data is not needed and so LispWorks can free it.</p> <p>If another callback occurs on the same thread after a callback that called <code>last-callback-on-thread</code>, LispWorks will have to recreate its side, which takes a little more time, but otherwise it works in the same way. Thus it is possible to call <code>last-callback-on-thread</code> even when it is not guaranteed that there will not be further callbacks on the same thread.</p> <p>Calling <code>last-callback-on-thread</code> on a thread that was created by LispWorks has no effect.</p> |

`last-callback-on-thread` returns `t` when called on a thread that was not created by LispWorks, otherwise it returns `nil`.

|                           |                 |
|---------------------------|-----------------|
| <b>list-all-processes</b> | <i>Function</i> |
|---------------------------|-----------------|

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Lists all the Lisp processes currently in the system.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Package     | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Signature   | <code>list-all-processes =&gt; process-list</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Arguments   | None.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Values      | <code>process-list</code> A list of all the currently active Lisp processes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Description | Returns a list of all the active Lisp processes in LispWorks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Example     | <pre>CL-USER 71 &gt; (pprint (mp:list-all-processes))  (#&lt;MP:PROCESS Name "Editor 1" Priority 70000000 State  "Waiting for events"&gt;  #&lt;MP:PROCESS Name "Listener 1" Priority 70000000 State  "Running"&gt;  #&lt;MP:PROCESS Name "LispWorks 5.1.0" Priority 70000000  State "Waiting for events"&gt;  #&lt;MP:PROCESS Name "default listener process" Priority  60000000 State "Waiting for terminal input."&gt;  #&lt;MP:PROCESS Name "CAPI Execution Listener 1" Priority  60000000 State "Running"&gt;  #&lt;MP:PROCESS Name "Background execute 2" Priority  50000000 State "Waiting for job to execute"&gt;  #&lt;MP:PROCESS Name "Background execute 1" Priority  50000000 State "Waiting for job to execute"&gt;  #&lt;MP:PROCESS Name "Editor DDE server" Priority 0 State  "Waiting for an event"&gt;  #&lt;MP:PROCESS Name "The idle process" Priority -  536870912 State "Running (preempted)"&gt;)</pre> |

**lock***System Class*

Summary     A class of objects for preventing synchronous access.

Package     `mp`

Superclasses     `t`

Description     Instances of the system class `lock` are used to prevent synchronous access to the some object(s) by more than one process at a time. They are made by `make-lock`.

See also     `make-lock`  
`with-lock`  
`process-lock`  
`process-unlock`  
“Locks” on page 277

**lock-and-condition-variable-broadcast***Function*

Summary     Locks, applies a setup function, calls `condition-variable-broadcast` and unlocks.

Package     `mp`

Signature     `lock-and-condition-variable-broadcast lock condvar lock-timeout setup-function &rest args => signaledp`

Arguments     `lock`     A `lock`.  
`condvar`     A `condition-variable`.  
`lock-timeout`     A non-negative `real` or `nil`.  
`setup-function`     A function designator.  
`args`     Arguments to `setup-function`.

Values     `signaledp`     A generalized boolean.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The function <code>lock-and-condition-variable-broadcast</code> locks the lock <code>lock</code>, applies the function <code>setup-function</code> to <code>args</code>, calls <code>condition-variable-broadcast</code> and unlocks <code>lock</code>. <code>lock-and-condition-variable-broadcast</code> makes it easier to avoid mistakes when using a <code>condition-variable</code>.</p> <p><code>lock-and-condition-variable-broadcast</code> performs the equivalent of:</p> <pre>(mp:with-lock (lock nil lock-timeout)   (apply setup-function args)   (mp:condition-variable-broadcast condvar))</pre> <p>It returns the result of the call to <code>condition-variable-broadcast</code>.</p> <p>See <code>condition-variable-broadcast</code> and <code>with-lock</code> for more details.</p> |
| Notes       | <code>setup-function</code> is called with the <code>lock</code> held, so it should do the minimum amount of work and avoid locking other locks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| See also    | <code>lock-and-condition-variable-wait</code><br><code>simple-lock-and-condition-variable-wait</code><br><code>lock-and-condition-variable-signal</code><br><code>condition-variable-wait</code><br><code>condition-variable-signal</code><br><code>condition-variable-broadcast</code><br><code>processes-count</code><br><code>with-lock</code><br>“Condition variables” on page 285<br>“Locks” on page 277                                                                                                                                                                                                                                                                                                                                                                                                |

## lock-and-condition-variable-signal

*Function*

|         |                                                                                            |
|---------|--------------------------------------------------------------------------------------------|
| Summary | Locks, applies a setup function, calls <code>condition-variable-signal</code> and unlocks. |
|---------|--------------------------------------------------------------------------------------------|

|             |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>mp</code>             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Signature   |                             | <code>lock-and-condition-variable-signal lock condvar lock-timeout setup-function &amp;rest args =&gt; signaledp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Arguments   | <code>lock</code>           | A <code>lock</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|             | <code>condvar</code>        | A <code>condition-variable</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|             | <code>lock-timeout</code>   | A non-negative <code>real</code> or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|             | <code>setup-function</code> | A function designator.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|             | <code>args</code>           | Arguments to <code>setup-function</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Values      | <code>signaledp</code>      | A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Description |                             | <p>The function <code>lock-and-condition-variable-signal</code> locks the <code>lock</code> <code>lock</code>, applies <code>setup-function</code> to <code>args</code>, calls <code>condition-variable-signal</code> and unlocks <code>lock</code>. <code>lock-and-condition-variable-signal</code> makes it easier to avoid mistakes when using a <code>condition-variable</code>.</p> <p><code>lock-and-condition-variable-signal</code> performs the equivalent of:</p> <pre>(mp:with-lock (lock nil lock-timeout)   (apply setup-function args)   (mp:condition-variable-signal condvar))</pre> <p>It returns the result of the call to <code>condition-variable-signal</code>.</p> <p>See <code>condition-variable-signal</code> and <code>with-lock</code> for more details.</p> |
| Notes       |                             | <p><code>setup-function</code> is called with <code>lock</code> held, so it should do the minimum amount of work and avoid locking other locks. Normally <code>setup-function</code> should only set the cell that the process(es) that wait(s) on the <code>condition-variable</code> <code>condvar</code> check with the predicate in <code>lock-and-condition-variable-wait</code>.</p>                                                                                                                                                                                                                                                                                                                                                                                              |

## See also

`lock-and-condition-variable-wait`  
`simple-lock-and-condition-variable-wait`  
`lock-and-condition-variable-broadcast`  
`condition-variable-wait`  
`condition-variable-signal`  
`condition-variable-broadcast`  
“Condition variables” on page 285  
“Locks” on page 277

|                             | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |                |                       |                  |                        |             |                                 |                        |                                             |                             |                                       |                     |                                                        |                         |                                |                        |                                                        |                            |  |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|---------|----------------|-----------------------|------------------|------------------------|-------------|---------------------------------|------------------------|---------------------------------------------|-----------------------------|---------------------------------------|---------------------|--------------------------------------------------------|-------------------------|--------------------------------|------------------------|--------------------------------------------------------|----------------------------|--|
| Summary                     | Locks a lock and calls a predicate. If this returns <code>nil</code> , performs the equivalent of <code>condition-variable-wait</code> . Optionally calls a function on return.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |                |                       |                  |                        |             |                                 |                        |                                             |                             |                                       |                     |                                                        |                         |                                |                        |                                                        |                            |  |
| Package                     | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |                |                       |                  |                        |             |                                 |                        |                                             |                             |                                       |                     |                                                        |                         |                                |                        |                                                        |                            |  |
| Signature                   | <code>lock-and-condition-variable-wait lock condvar predicate &amp;key args return-function return-function-args lock-timeout lock-wait-reason condvar-timeout condvar-wait-reason =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |                |                       |                  |                        |             |                                 |                        |                                             |                             |                                       |                     |                                                        |                         |                                |                        |                                                        |                            |  |
| Arguments                   | <table border="0"> <tr> <td><i>lock</i></td><td>A lock.</td></tr> <tr> <td><i>condvar</i></td><td>A condition-variable.</td></tr> <tr> <td><i>predicate</i></td><td>A function designator.</td></tr> <tr> <td><i>args</i></td><td>Arguments to <i>predicate</i>.</td></tr> <tr> <td><i>return-function</i></td><td>A function designator or <code>nil</code>.</td></tr> <tr> <td><i>return-function-args</i></td><td>Arguments to <i>return-function</i>.</td></tr> <tr> <td><i>lock-timeout</i></td><td>A non-negative <code>real</code> or <code>nil</code>.</td></tr> <tr> <td><i>lock-wait-reason</i></td><td>A string or <code>nil</code>.</td></tr> <tr> <td><i>condvar-timeout</i></td><td>A non-negative <code>real</code> or <code>nil</code>.</td></tr> <tr> <td><i>condvar-wait-reason</i></td><td></td></tr> </table> | <i>lock</i> | A lock. | <i>condvar</i> | A condition-variable. | <i>predicate</i> | A function designator. | <i>args</i> | Arguments to <i>predicate</i> . | <i>return-function</i> | A function designator or <code>nil</code> . | <i>return-function-args</i> | Arguments to <i>return-function</i> . | <i>lock-timeout</i> | A non-negative <code>real</code> or <code>nil</code> . | <i>lock-wait-reason</i> | A string or <code>nil</code> . | <i>condvar-timeout</i> | A non-negative <code>real</code> or <code>nil</code> . | <i>condvar-wait-reason</i> |  |
| <i>lock</i>                 | A lock.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |         |                |                       |                  |                        |             |                                 |                        |                                             |                             |                                       |                     |                                                        |                         |                                |                        |                                                        |                            |  |
| <i>condvar</i>              | A condition-variable.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             |         |                |                       |                  |                        |             |                                 |                        |                                             |                             |                                       |                     |                                                        |                         |                                |                        |                                                        |                            |  |
| <i>predicate</i>            | A function designator.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |                |                       |                  |                        |             |                                 |                        |                                             |                             |                                       |                     |                                                        |                         |                                |                        |                                                        |                            |  |
| <i>args</i>                 | Arguments to <i>predicate</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |                |                       |                  |                        |             |                                 |                        |                                             |                             |                                       |                     |                                                        |                         |                                |                        |                                                        |                            |  |
| <i>return-function</i>      | A function designator or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |         |                |                       |                  |                        |             |                                 |                        |                                             |                             |                                       |                     |                                                        |                         |                                |                        |                                                        |                            |  |
| <i>return-function-args</i> | Arguments to <i>return-function</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             |         |                |                       |                  |                        |             |                                 |                        |                                             |                             |                                       |                     |                                                        |                         |                                |                        |                                                        |                            |  |
| <i>lock-timeout</i>         | A non-negative <code>real</code> or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |                |                       |                  |                        |             |                                 |                        |                                             |                             |                                       |                     |                                                        |                         |                                |                        |                                                        |                            |  |
| <i>lock-wait-reason</i>     | A string or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |         |                |                       |                  |                        |             |                                 |                        |                                             |                             |                                       |                     |                                                        |                         |                                |                        |                                                        |                            |  |
| <i>condvar-timeout</i>      | A non-negative <code>real</code> or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |         |                |                       |                  |                        |             |                                 |                        |                                             |                             |                                       |                     |                                                        |                         |                                |                        |                                                        |                            |  |
| <i>condvar-wait-reason</i>  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |         |                |                       |                  |                        |             |                                 |                        |                                             |                             |                                       |                     |                                                        |                         |                                |                        |                                                        |                            |  |

A `string` or `nil`.

|             |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Values      | <code>result</code> | See below.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Description |                     | <p>The function <code>lock-and-condition-variable-wait</code> first locks the lock <code>lock</code> as in <code>with-lock</code>, using <code>lock-wait-reason</code> and <code>lock-timeout</code> for the <code>whostate</code> and <code>timeout</code> arguments of <code>with-lock</code>.</p> <p>It then applies <code>predicate</code> to <code>args</code>. If this call returns <code>nil</code> it performs the equivalent of a call to <code>condition-variable-wait</code>, passing it <code>condvar</code>, <code>lock</code>, <code>condvar-timeout</code> and <code>condvar-wait-reason</code>.</p> <p>If <code>return-function</code> is supplied, it is then applied to <code>return-function-args</code>, and the return value(s) are returned.</p> <p>Before returning, <code>lock</code> is unlocked (in an unwinding form) as in <code>with-lock</code>.</p> <p><code>lock-and-condition-variable-wait</code> returns whatever <code>return-function</code> returns if it is supplied. If <code>return-function</code> is not supplied, <code>lock-and-condition-variable-wait</code> returns the result of <code>predicate</code> if this is not <code>nil</code>, otherwise it returns the result of the equivalent call to <code>condition-variable-wait</code>.</p> |
| Notes       |                     | <ol style="list-style-type: none"><li>1. <code>predicate</code> and <code>return-function</code> are called with <code>lock</code> held, so they should do as little as needed, and avoid locking anything else.</li><li>2. <code>lock-and-condition-variable-wait</code> makes it much easier to avoid mistakes when using <code>condition-variables</code>.</li><li>3. When <code>return-function</code> is not supplied, <code>lock-and-condition-variable-wait</code> does not lock on return, which makes it much more efficient than the equivalent code using <code>with-lock</code> and <code>condition-variable-wait</code>.</li><li>4. When <code>return-function</code> is not needed, <code>simple-lock-and-condition-variable-wait</code> may be more convenient.</li></ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

5. All the four signaling functions (`condition-variable-signal`, `condition-variable-broadcast`, `lock-and-condition-variable-signal`, `lock-and-condition-variable-broadcast`) can be used to wake a process waiting in `lock-and-condition-variable-wait`.

## See also

`condition-variable-wait`  
`simple-lock-and-condition-variable-wait`  
`lock-and-condition-variable-signal`  
`lock-and-condition-variable-broadcast`  
`condition-variable-signal`  
`condition-variable-broadcast`  
“Condition variables” on page 285  
“Locks” on page 277

## lock-locked-p

### Function

|             |                                                                                                                                                                                                                                                                                                                           |            |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Summary     | The predicate for whether a lock is locked.                                                                                                                                                                                                                                                                               |            |
| Package     | <code>mp</code>                                                                                                                                                                                                                                                                                                           |            |
| Signature   | <code>lock-locked-p lock =&gt; result</code>                                                                                                                                                                                                                                                                              |            |
| Arguments   | <code>lock</code>                                                                                                                                                                                                                                                                                                         | A lock.    |
| Values      | <code>result</code>                                                                                                                                                                                                                                                                                                       | A boolean. |
| Description | <p>The function <code>lock-locked-p</code> is the predicate for whether <code>lock</code> is locked. Since that can change at any time, the result is reliable only if you know that the state is not going to change.</p> <p>If <code>lock</code> is a “sharing” lock, this checks whether it is locked exclusively.</p> |            |
| See also    | <code>lock</code><br><code>make-lock</code><br>“Locks” on page 277                                                                                                                                                                                                                                                        |            |

## **lock-owned-by-current-process-p** *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                           |                       |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Summary     | Checks whether a <code>lock</code> is locked by the current thread.                                                                                                                                                                                                                                                                                                                                                       |                       |
| Package     | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                           |                       |
| Signature   | <code>lock-owned-by-current-process-p lock =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                            |                       |
| Arguments   | <code>lock</code>                                                                                                                                                                                                                                                                                                                                                                                                         | A <code>lock</code> . |
| Values      | <code>result</code>                                                                                                                                                                                                                                                                                                                                                                                                       | A boolean.            |
| Description | <p>The function <code>lock-owned-by-current-process-p</code> checks whether the <code>lock</code> <code>lock</code> is locked by the current thread. If this returns <code>nil</code>, then <code>lock</code> is either unlocked or locked by another process.</p> <p>If <code>lock</code> is a "sharing" lock, this also checks whether the current process has an exclusive lock on it. It ignores any shared lock.</p> |                       |
| See also    | <code>lock</code><br><code>make-lock</code><br>“Locks” on page 277                                                                                                                                                                                                                                                                                                                                                        |                       |

## **lock-recursive-p** *Function*

|           |                                                                         |                       |
|-----------|-------------------------------------------------------------------------|-----------------------|
| Summary   | The predicate for whether a <code>lock</code> allows recursive locking. |                       |
| Package   | <code>mp</code>                                                         |                       |
| Signature | <code>lock-recursive-p lock =&gt; result</code>                         |                       |
| Arguments | <code>lock</code>                                                       | A <code>lock</code> . |
| Values    | <code>result</code>                                                     | A boolean.            |

|             |                                                                                                                                                                                                                                                                           |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | The function <code>lock-recursive-p</code> is the predicate for whether the <code>lock</code> <i>lock</i> allows recursive locking (that is, whether it can be repeatedly locked by the same process).<br><br>See the <code>make-lock</code> argument <i>recursivep</i> . |
| Notes       | <code>lock-recursive-p</code> does not check whether <i>lock</i> is currently locked recursively. The function <code>lock-recursively-locked-p</code> does that.                                                                                                          |
| See also    | <code>lock</code><br><code>make-lock</code><br>“Locks” on page 277                                                                                                                                                                                                        |

|             | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | The predicate for whether a <code>lock</code> is recursively locked.                                                                                                                                                                                                                                                                                                                                                                                                  |
| Package     | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Signature   | <code>lock-recursively-locked-p lock =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                              |
| Arguments   | <code>lock</code> A <code>lock</code> .                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Values      | <code>result</code> A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Description | The function <code>lock-recursively-locked-p</code> is the predicate for whether <i>lock</i> is recursively locked. Since that can change at any time, the result is reliable only if you know that the state is not going to change. For the definition of recursive locking, see the <code>make-lock</code> argument <i>recursivep</i> .<br><br>If <i>lock</i> is a “sharing” lock, <code>lock-recursively-locked-p</code> checks whether it is locked exclusively. |

See also      **lock**  
                **make-lock**  
                “Locks” on page 277

## **lock-name** *Function*

Summary     Returns the name of a **lock**.

Package     **mp**

Signature    **lock-name lock => name**

Arguments    **lock**        A **lock**.

Values        **name**        A string.

Description    The function **lock-name** returns the name of *lock*, which was either passed as the *name* argument to **make-lock** or defaulted.

Example     

```
(let ((lock (mp:make-lock :name "my lock")))
  (mp:lock-name lock))
=> "my lock"
```

See also      **lock**  
                **make-lock**  
                **with-lock**  
                **process-lock**  
                **process-unlock**  
                **lock-owner**  
                “Locks” on page 277

## **lock-owner** *Function*

Summary     Returns the owner of a **lock**.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Signature   | <code>lock-owner lock =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Arguments   | <code>lock</code> A <code>lock</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Values      | <code>result</code> A process, <code>t</code> or <code>:unknown</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Description | <p>The function <code>lock-owner</code> returns the process that currently owns <code>lock</code>, or <code>nil</code>.</p> <p>If <code>lock</code> is a "sharing" <code>lock</code> then <code>lock-owner</code> checks whether it is locked exclusively (see <code>lock-owned-by-current-process-p</code>).</p> <p>If <code>lock</code> is locked then <code>result</code> is normally the process that locked it. If <code>lock</code> was locked while multiprocessing was not running then <code>result</code> is <code>t</code>. Also, if <code>lock</code> was locked by an unknown process (for example, the process is killed while holding <code>lock</code>) then <code>result</code> is <code>:unknown</code>.</p> <p><code>result</code> is <code>nil</code> if <code>lock</code> is not locked.</p> |
| Example     | <pre>CL-USER 1 &gt; (let ((lock (mp:make-lock :name                                          "my lock")))                   (mp:lock-owner lock)) NIL  CL-USER 2 &gt; (let ((lock (mp:make-lock :name                                          "my lock")))                   (mp:with-lock (lock)                     (mp:lock-owner lock))) #&lt;MP:PROCESS Name "CAPI Execution Listener 1" Priority 0 State "Running"&gt;</pre>                                                                                                                                                                                                                                                                                                                                                                               |
| See also    | <code>lock</code><br><code>lock-owned-by-current-process-p</code><br><code>make-lock</code><br><code>with-lock</code><br><code>process-lock</code><br><code>process-unlock</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

`lock-name`  
`lock-owned-by-current-process-p`  
“Locks” on page 277

## mailbox

### *System Class*

|              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary      | The class of objects representing mailboxes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Package      | <code>mailbox</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Superclasses | <code>t</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Description  | Instances of the system class <code>mailbox</code> are used to communicate between processes. The communication is done by "sending" objects (any Lisp object) to a mailbox, and "reading" these objects from the mailbox. The objects will be read in the order in which they were sent. Sending is done by <code>mailbox-send</code> or <code>mailbox-send-limited</code> . Reading is done by <code>mailbox-wait-for-event</code> , <code>mailbox-wait</code> or <code>mailbox-read</code> . All mailbox access functions are thread-safe. You create a mailbox by using <code>make-mailbox</code> . You can also obtain the mailbox of a process by <code>process-mailbox</code> . |
| See also     | <code>mailbox-send</code><br><code>mailbox-send-limited</code><br><code>mailbox-wait-for-event</code><br><code>mailbox-wait</code><br><code>mailbox-read</code><br><code>make-mailbox</code><br>“Communication between processes and synchronization” on page 283                                                                                                                                                                                                                                                                                                                                                                                                                      |

## mailbox-count

### *Function*

|         |                                                                     |
|---------|---------------------------------------------------------------------|
| Summary | Returns the number of objects currently in a <code>mailbox</code> . |
|---------|---------------------------------------------------------------------|

|             |                                                                                                                                                                                                                                                                                  |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>mp</code>                                                                                                                                                                                                                                                                  |
| Signature   | <code>mailbox-count mailbox =&gt; count</code>                                                                                                                                                                                                                                   |
| Arguments   | <code>mailbox</code> A <b>mailbox</b> .                                                                                                                                                                                                                                          |
| Values      | <code>count</code> A non-negative integer.                                                                                                                                                                                                                                       |
| Description | <p>The function <code>mailbox-count</code> returns the number of objects currently in the mailbox <code>mailbox</code>.</p> <p><code>mailbox</code> should be an object of type <code>mailbox</code>.</p> <p>A <code>mailbox</code> is empty if its <code>count</code> is 0.</p> |
| See also    | <code>mailbox-empty-p</code><br><code>mailbox-not-empty-p</code><br><code>make-mailbox</code><br>“Communication between processes and synchronization”<br>on page 283                                                                                                            |

|             | <i>Function</i>                                                                                                                             |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Tests whether a <code>mailbox</code> is empty.                                                                                              |
| Package     | <code>mp</code>                                                                                                                             |
| Signature   | <code>mailbox-empty-p mailbox =&gt; bool</code>                                                                                             |
| Arguments   | <code>mailbox</code> A <b>mailbox</b>                                                                                                       |
| Values      | <code>bool</code> A boolean                                                                                                                 |
| Description | The function <code>mailbox-empty-p</code> returns <code>t</code> if the given <code>mailbox</code> is empty and <code>nil</code> otherwise. |

See also **`mailbox-not-empty-p`**  
**`mailbox-send`**  
**`mailbox-peek`**  
**`mailbox-read`**  
**`make-mailbox`**  
“Communication between processes and synchronization”  
on page 283

|                                    | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b><code>mailbox-full-p</code></b> |                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Summary                            | Tests whether a <b><code>mailbox</code></b> is full.                                                                                                                                                                                                                                                                                                                                                                                         |
| Package                            | <b><code>mp</code></b>                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Signature                          | <b><code>mailbox-full-p mailbox =&gt; bool</code></b>                                                                                                                                                                                                                                                                                                                                                                                        |
| Arguments                          | <b><code>mailbox</code></b> A <b><code>mailbox</code></b>                                                                                                                                                                                                                                                                                                                                                                                    |
| Values                             | <b><code>bool</code></b> A boolean                                                                                                                                                                                                                                                                                                                                                                                                           |
| Description                        | The function <b><code>mailbox-full-p</code></b> returns true if <i>mailbox</i> is empty and false otherwise.                                                                                                                                                                                                                                                                                                                                 |
| Notes                              | Because of multiprocessing, it cannot be guaranteed that a subsequent call to <b><code>mailbox-send</code></b> will work without expansion even if <b><code>mailbox-full-p</code></b> returns false. <b><code>mailbox-full-p</code></b> is intended to be used as a wait-function (or inside a wait-function), and once it returns false you should use <b><code>mailbox-send-limited</code></b> to actually send and check what it returns. |
| See also                           | <b><code>mailbox-send-limited</code></b><br><b><code>mailbox-size</code></b><br><b><code>mailbox-count</code></b><br>“Communication between processes and synchronization”<br>on page 283                                                                                                                                                                                                                                                    |

|             |                | <i>Function</i>                                                                                                                                                                                                                                                          |
|-------------|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     |                | Tests whether a <b>mailbox</b> has contents.                                                                                                                                                                                                                             |
| Package     |                | <b>mp</b>                                                                                                                                                                                                                                                                |
| Signature   |                | <b>mailbox-not-empty-p</b> <i>mailbox</i> => <i>bool</i>                                                                                                                                                                                                                 |
| Arguments   | <i>mailbox</i> | A <b>mailbox</b>                                                                                                                                                                                                                                                         |
| Values      | <i>bool</i>    | A boolean                                                                                                                                                                                                                                                                |
| Description |                | The function <b>mailbox-not-empty-p</b> returns <b>nil</b> if the given <b>mailbox</b> is empty and <b>t</b> otherwise.                                                                                                                                                  |
| See also    |                | <a href="#">mailbox-count</a><br><a href="#">mailbox-empty-p</a><br><a href="#">mailbox-send</a><br><a href="#">mailbox-peek</a><br><a href="#">mailbox-read</a><br><a href="#">make-mailbox</a><br>“Communication between processes and synchronization”<br>on page 283 |

|           |                | <i>Function</i>                                                      |
|-----------|----------------|----------------------------------------------------------------------|
| Summary   |                | Returns the first object in a <b>mailbox</b> .                       |
| Package   |                | <b>mp</b>                                                            |
| Signature |                | <b>mailbox-peek</b> <i>mailbox</i> => <i>result</i> , <i>value-p</i> |
| Arguments | <i>mailbox</i> | A <b>mailbox</b> .                                                   |
| Values    | <i>result</i>  | Any object or <b>nil</b> .                                           |
|           | <i>value-p</i> | <b>t</b> or <b>nil</b> .                                             |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The function <code>mailbox-peek</code> returns the first object in the mailbox without removing it. If the mailbox is empty, <code>nil</code> is returned.</p> <p>If the mailbox <i>mailbox</i> is not empty, the function <code>mailbox-peek</code> returns the first object in the mailbox without removing it. The second returned value <i>value-p</i> is <code>t</code>.</p> <p>If <i>mailbox</i> is empty, both return values <i>result</i> and <i>value-p</i> are <code>nil</code>.</p>                                                        |
| Notes       | <ol style="list-style-type: none"> <li>1. Since another process may modify the mailbox at any point, the result is not necessarily the next object that the next call to <code>mailbox-read</code> will read, unless no other process is reading from the mailbox.</li> <li>2. <code>mailbox-peek</code> needs to lock the mailbox, which means it is significantly slower than <code>mailbox-not-empty-p</code>, and also may affect other processes. In most cases, <code>mailbox-not-empty-p</code> is sufficient and hence is preferable.</li> </ol> |
| See also    | <p><code>mailbox-empty-p</code><br/> <code>mailbox-not-empty-p</code><br/> <code>mailbox-send</code><br/> <code>mailbox-read</code><br/> <code>make-mailbox</code><br/> “Communication between processes and synchronization” on page 283</p>                                                                                                                                                                                                                                                                                                            |

|           | <i>Function</i>                                                                        |
|-----------|----------------------------------------------------------------------------------------|
| Summary   | Reads the next object in a <code>mailbox</code> .                                      |
| Package   | <code>mp</code>                                                                        |
| Signature | <code>mailbox-read mailbox &amp;optional wait-reason timeout =&gt; object, flag</code> |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                        |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|
| Arguments   | <i>mailbox</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | A <code>mailbox</code> .                               |
|             | <i>wait-reason</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | A string or <code>nil</code> .                         |
|             | <i>timeout</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | A non-negative <code>real</code> or <code>nil</code> . |
| Values      | <i>object</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | An object.                                             |
|             | <i>flag</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | A boolean.                                             |
| Description | <p>The function <code>mailbox-read</code> returns the next object from the mailbox <i>mailbox</i>, or <code>nil</code>.</p> <p>If <i>mailbox</i> is empty and <i>timeout</i> is <code>nil</code>, then <code>mailbox-read</code> blocks until an object is placed in <i>mailbox</i>. If <i>mailbox</i> is empty and <i>timeout</i> is a non-negative <code>real</code>, then <code>mailbox-read</code> blocks until an object is placed in <i>mailbox</i> or <i>timeout</i> seconds have passed. If the timeout occurs, then <code>mailbox-read</code> returns <code>nil</code> as the first value and also <i>flag</i> is <code>nil</code>. If an object is actually read from the mailbox, then <i>flag</i> is <code>t</code>.</p> <p>The <i>wait-reason</i> argument defaults to "Waiting for message in #&lt;Mailbox...&gt;" and will be the value returned by <code>process-whostate</code> while <code>mailbox-read</code> is blocking.</p> <p>The default value of <i>timeout</i> is <code>nil</code>.</p> |                                                        |
| See also    | <p><code>mailbox-empty-p</code><br/> <code>mailbox-peek</code><br/> <code>mailbox-send</code><br/> <code>mailbox-wait-for-event</code><br/> <code>make-mailbox</code><br/>           "Communication between processes and synchronization"<br/>           on page 283</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                        |

## mailbox-reader-process *Function*

Summary      Returns the reader process of a `mailbox`.

|             |                                                           |                                                                                                       |
|-------------|-----------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| Package     | <code>mp</code>                                           |                                                                                                       |
| Signature   | <code>mailbox-reader-process mailbox =&gt; process</code> |                                                                                                       |
| Arguments   | <code>mailbox</code>                                      | A <b>mailbox</b> .                                                                                    |
| Values      | <code>process</code>                                      | A process or <code>nil</code> .                                                                       |
| Description |                                                           | The function <code>mailbox-reader-process</code> returns the reader process of <code>mailbox</code> . |

|             |                                                | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------|------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     |                                                | Adds an object to a <b>mailbox</b> .                                                                                                                                                                                                                                                                                                                                                              |
| Package     | <code>mp</code>                                |                                                                                                                                                                                                                                                                                                                                                                                                   |
| Signature   | <code>mailbox-send mailbox object =&gt;</code> |                                                                                                                                                                                                                                                                                                                                                                                                   |
| Arguments   | <code>mailbox</code>                           | A <b>mailbox</b> .                                                                                                                                                                                                                                                                                                                                                                                |
|             | <code>object</code>                            | An object.                                                                                                                                                                                                                                                                                                                                                                                        |
| Description |                                                | <p>The function <code>mailbox-send</code> sends <code>object</code> to <code>mailbox</code>. The object is queued in the mailbox for retrieval by the reader.</p> <p>When objects are read from from the mailbox (using <code>mailbox-read</code> or higher level functions such as <code>mailbox-wait-for-event</code>), they are read in the order in which they were added to the mailbox.</p> |
| Notes       |                                                | If <code>mailbox</code> is full, <code>mailbox-send</code> expands it. In situations where the mailbox can grow too much, you can use <code>mailbox-send-limited</code> instead.                                                                                                                                                                                                                  |
| See also    |                                                | <code>mailbox-empty-p</code><br><code>mailbox-peek</code>                                                                                                                                                                                                                                                                                                                                         |

```

mailbox-read
mailbox-send-limited
mailbox-count
mailbox-size
process-send
make-mailbox
“Communication between processes and synchronization”
on page 283

```

|             |                                                                                                                | <i>Function</i>                                                                                                                                                         |
|-------------|----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Adds an object to a <b>mailbox</b> if it is not full                                                           |                                                                                                                                                                         |
| Package     | <b>mp</b>                                                                                                      |                                                                                                                                                                         |
| Signature   |                                                                                                                | <b>mailbox-send-limited</b> <i>mailbox object limit &amp;optional timeout</i><br><i>wait-reason wait-function &amp;rest args =&gt; success</i>                          |
| Arguments   | <p><i>mailbox</i></p> <p><i>object</i></p> <p><i>limit</i></p> <p><i>timeout</i></p> <p><i>wait-reason</i></p> | <p>A <b>mailbox</b>.</p> <p>An object.</p> <p>An integer.</p> <p>A non-negative <b>real</b> or <b>nil</b>.</p> <p>A string or <b>nil</b>.</p>                           |
|             | <i>wait-function, args</i>                                                                                     | A function and its arguments.                                                                                                                                           |
| Values      | <b>success</b>                                                                                                 | A boolean.                                                                                                                                                              |
| Description |                                                                                                                | The function <b>mailbox-send-limited</b> adds <i>object</i> to <i>mailbox</i> in the same way as <b>mailbox-send</b> , except in the case where <i>mailbox</i> is full. |

If `mailbox` is full and has a size less than `limit` then `mailbox` is enlarged to have a size that is at most `limit` and `object` is added to `mailbox`.

Otherwise, if `mailbox` is full and has a size not less than `limit` then `mailbox-send-limited` waits until `mailbox` becomes not full before adding `object`. While waiting, `mailbox-send-limited` will return without adding `object` to `mailbox` if `timeout` is non-nil and `timeout` seconds has elapsed or if `wait-function` is non-nil and applying `wait-function` to `args` returns true.

`wait-reason` is used as the wait-reason while waiting.

`success` is true if the object was added to the mailbox and false otherwise (`timeout` reached or `wait-function` returned true).

## Notes

`mailbox-send-limited` only prevents the mailbox from expanding to more than `limit`: if it is already bigger than the limit, and there is still a space in it, `mailbox-send-limited` add the object to the mailbox even if that means that the mailbox has more objects than `limit`. As long as all of the sending calls on a `mailbox` are limited, the mailbox may grow until it reaches the largest limit, and if it was made with the `:size` argument equal or larger than the largest limit, it will never grow. However, if `mailbox-send` is called then that may enlarge it.

`process-send` uses `mailbox-send`, so may expand the mailbox too. It also has a `limit` argument.

`mailbox-send-limited` waits like `process-wait-with-timeout`. As a result, there may be some latency between the time the mailbox becomes non-full and the waiting returns, because it depends on the scheduler. The `wait-reason`, `timeout`, `wait-function` and `args` are analogous to the arguments of `process-wait-with-timeout`. `wait-function` is applied within the wait-function that `mailbox-send-limited` uses, so has the same limitations as the wait-function of `process-wait-with-timeout`.

When *timeout* is 0 **mailbox-send-limited** never waits.

See also

**mailbox-send**  
**mailbox-read**  
**process-send**  
**mailbox-count**  
**mailbox-size**  
**mailbox-full-p**

“Communication between processes and synchronization”  
on page 283

## **mailbox-size**

## *Function*

Summary      Returns the size of a **mailbox**.

Package      **mp**

Signature      **mailbox-size** *mailbox* => *size*

Arguments      *mailbox*      A **mailbox**.

Values      *size*      An non-negative integer.

Description      The function **mailbox-size** returns the size of *mailbox*, which is the number of objects that can be added without it growing.

**mailbox-send** automatically expands the mailbox indefinitely when it is full, but **mailbox-send-limited** and **process-send** will expand it up to some specified *limit*.

See also

**mailbox-send**  
**mailbox-send-limited**  
**process-send**  
**make-mailbox**

“Communication between processes and synchronization”  
on page 283

| <b>mailbox-wait</b> | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                |                          |                    |                                |                |                                                        |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------------------------|--------------------|--------------------------------|----------------|--------------------------------------------------------|
| Summary             | Waits until there is an object in the mailbox                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                |                          |                    |                                |                |                                                        |
| Package             | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                |                          |                    |                                |                |                                                        |
| Signature           | <code>mailbox-wait mailbox &amp;optional wait-reason timeout =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                |                          |                    |                                |                |                                                        |
| Arguments           | <table> <tr> <td><i>mailbox</i></td><td>A <code>mailbox</code>.</td></tr> <tr> <td><i>wait-reason</i></td><td>A string or <code>nil</code>.</td></tr> <tr> <td><i>timeout</i></td><td>A non-negative <code>real</code> or <code>nil</code>.</td></tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <i>mailbox</i> | A <code>mailbox</code> . | <i>wait-reason</i> | A string or <code>nil</code> . | <i>timeout</i> | A non-negative <code>real</code> or <code>nil</code> . |
| <i>mailbox</i>      | A <code>mailbox</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                |                          |                    |                                |                |                                                        |
| <i>wait-reason</i>  | A string or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                |                          |                    |                                |                |                                                        |
| <i>timeout</i>      | A non-negative <code>real</code> or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                |                          |                    |                                |                |                                                        |
| Values              | <table> <tr> <td><i>result</i></td><td>A boolean.</td></tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <i>result</i>  | A boolean.               |                    |                                |                |                                                        |
| <i>result</i>       | A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                |                          |                    |                                |                |                                                        |
| Description         | <p>The function <code>mailbox-wait</code> waits until there is an object in the mailbox <i>mailbox</i>. If <i>mailbox</i> is empty and <i>timeout</i> is <code>nil</code>, then <code>mailbox-wait</code> blocks until an object is placed in <i>mailbox</i>. If <i>mailbox</i> is empty and <i>timeout</i> is a non-negative <code>real</code>, then <code>mailbox-wait</code> blocks until an object is placed in <i>mailbox</i> or <i>timeout</i> seconds have passed. If there is no object after <i>timeout</i> seconds, then <code>mailbox-wait</code> returns <code>nil</code>. Once there is an object in <i>mailbox</i>, <code>mailbox-wait</code> returns <code>t</code>.</p> <p>Note that <code>mailbox-wait</code> does not remove the object from the <i>mailbox</i>, in contrast to <code>mailbox-read</code> which does.</p> <p>Note that if there are multiple processes reading from <i>mailbox</i>, another process may read the object from it, so the <i>result</i> of <code>mailbox-wait</code> is reliable only if you know that the current process is the only process that may read from the mailbox.</p> <p>The <i>wait-reason</i> argument defaults to a string</p> <pre>"Waiting for message in #&lt;Mailbox...&gt;"</pre> <p>and will be the value returned by <code>process-whostate</code> while <code>mailbox-wait</code> is blocking.</p> |                |                          |                    |                                |                |                                                        |

The default value of *timeout* is `nil`.

`mailbox-wait` arranges for immediate notification when an object is placed in *mailbox* (unless other processes were waiting too, in which case one of the processes is notified immediately). It is therefore better than using `process-wait` with `mailbox-not-empty-p` because it does not rely on the scheduler to wake it up. It is also less expensive because does not add work to the scheduler.

See also

`mailbox-not-empty-p`  
`mailbox-empty-p`  
`mailbox-peek`  
`mailbox-send`  
`mailbox-wait-for-event`  
`mailbox-read`  
 “Communication between processes and synchronization”  
 on page 283

## mailbox-wait-for-event *Function*

Summary      Waits for an event in a "windowing friendly" way.

Package      `mp`

Signature      `mailbox-wait-for-event mailbox &key wait-reason wait-function process-other-messages-p no-hang-p stop-at-user-operation-p => result`

|           |                                       |                                |
|-----------|---------------------------------------|--------------------------------|
| Arguments | <code>mailbox</code>                  | A <code>mailbox</code> .       |
|           | <code>wait-reason</code>              | A string or <code>nil</code> . |
|           | <code>wait-function</code>            | A function designator.         |
|           | <code>process-other-messages-p</code> | A generalized boolean.         |
|           | <code>no-hang-p</code>                | A generalized boolean.         |

*stop-at-user-operation-p*

A generalized boolean.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| Values      | <i>result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | An event or <code>nil</code> . |
| Description | <p>The function <code>mailbox-wait-for-event</code> waits for an event in a <code>mailbox</code> in a "windowing friendly" way. It reads an event from the mailbox <i>mailbox</i>. If there is no event in the mailbox, it waits for an event (unless <i>no-hang-p</i> is true).</p> <p>The value <i>result</i> is any object that was put in the mailbox, or <code>nil</code> if the mailbox is empty, possibly after waiting.</p> <p><code>mailbox-wait-for-event</code> is the appropriate way to wait for an event in a <code>mailbox</code> in an application with a graphical user interface, because it interacts correctly with the windowing system. Most importantly, on Microsoft Windows, when <i>process-other-messages-p</i> is true it processes Windows messages while it is waiting. The default value of <i>process-other-messages-p</i> is <code>t</code>.</p> <p>If <i>wait-function</i> is non-<code>nil</code>, then is it called as a Process Wait function (see “Generic Process Wait functions” on page 281) with the mailbox <i>mailbox</i> as its argument while waiting for an event. If the call returns true before any events arrive, then <code>mailbox-wait-for-event</code> will return <code>nil</code>.</p> <p><i>wait-reason</i> is used as the wait reason if it needs to wait. The default value of <i>wait-reason</i> is "Waiting for an event".</p> <p><i>process-other-messages-p</i> controls processing of other messages. On Microsoft Windows this means Windows messages. On other platforms it has no effect.</p> <p><i>no-hang-p</i> controls whether <code>mailbox-wait-for-event</code> should really wait. If <i>no-hang-p</i> is true and there is no event, it returns immediately except on Microsoft Windows, where it may first process all Windows messages (depending on the value of <i>process-other-messages-p</i>). The default value of <i>no-hang-p</i> is <code>nil</code>.</p> |                                |

`stop-at-user-operation-p` on Microsoft Windows causes `mailbox-wait-for-event` to return if it received a user operation message (meaning keyboard or mouse input). It has no effect on other platforms. The default value of `stop-at-user-operation-p` is `nil`.

If `mailbox-wait-for-event` is called when not Lisp is not multiprocessing, it returns immediately. The return value is an event or `nil`.

See also

`mailbox-read`  
`mailbox-send`  
`make-mailbox`  
`process-wait-for-event`  
“Communication between processes and synchronization”  
on page 283

## \*main-process\*

### Variable

Summary      The process associated with the main thread.

Package      `mp`

Description    This special variable contains the process associated with the main thread of the application. On Mac OS X with the Cocoa GUI, this is the thread that runs the Cocoa event loop. On other platforms, this variable is always `nil`.

## make-barrier

### Function

Summary    Returns a new `barrier`.

Package    `mp`

Signature    `make-barrier count &key discount-on-abort discount-on-timeout  
callback disable-on-unblock name => barrier`

|             |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arguments   | <i>count</i>   | A positive fixnum or <code>t</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|             | <i>name</i>    | A string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Values      | <i>barrier</i> | A <code>barrier</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Description |                | <p>The function <code>make-barrier</code> returns a new <code>barrier</code> with count <i>count</i>.</p> <p><i>count</i> can be <code>t</code>, which is interpreted as <code>most-positive-fixnum</code>.</p> <p><code>barrier</code> has the name <i>name</i>, which is useful for debugging but is not used otherwise. If <i>name</i> is omitted, then a default name is generated that is unique among all such default names.</p> <p><i>discount-on-timeout</i> and <i>discount-on-abort</i> determine the default behavior when a thread times out or aborts while in the function <code>barrier-wait</code>. See the documentation for <code>barrier-wait</code>.</p> <p>If <code>disable-on-unblock</code> is true, then <code>barrier-wait</code> will disable <code>barrier</code> by default when it unblocks it. See <code>disable-on-unblock</code> in the documentation for <code>barrier-wait</code>.</p> <p><code>callback</code> is called by <code>barrier-wait</code> just before it unblocks <code>barrier</code>. It is called with a single argument, <code>barrier</code>, while holding an internal lock in <code>barrier</code> that will prevent other operations on <code>barrier</code> from running. The callback is guaranteed to happen before <code>barrier-wait</code> allows any of the other threads to continue.</p> |
| Notes       |                | <p>Because the callback is called inside a lock, you should ensure that it is relatively short to prevent congestion if another thread tries to access <code>barrier</code>. Allocating a few objects is reasonable. If there is a more expensive operation that has to be done by only one of the threads, it can be done by the thread that returned <code>:unblocked</code> from <code>barrier-wait</code>. The advantage of using the callback is that it is called before any of the waiting threads pass the barrier.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

## See also

**barrier**  
**barrier-arriver-count**  
**barrier-block-and-wait**  
**barrier-change-count**  
**barrier-count**  
**barrier-disable**  
**barrier-enable**  
**barrier-name**  
**barrier-pass-through**  
**barrier-unblock**  
**barrier-wait**  
“Synchronization barriers” on page 287

**make-condition-variable***Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                       |  |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Summary     | Makes a <b>condition-variable</b> .                                                                                                                                                                                                                                                                                                                                                                                   |  |
| Package     | <b>mp</b>                                                                                                                                                                                                                                                                                                                                                                                                             |  |
| Signature   | <b>make-condition-variable</b> &key <b>name</b> => <b>condvar</b>                                                                                                                                                                                                                                                                                                                                                     |  |
| Arguments   | <b>name</b> A string naming the <b>condition-variable</b> .                                                                                                                                                                                                                                                                                                                                                           |  |
| Values      | <b>condvar</b> A <b>condition-variable</b> .                                                                                                                                                                                                                                                                                                                                                                          |  |
| Description | The function <b>make-condition-variable</b> makes a <b>condition-variable</b> for use with <b>condition-variable-wait</b> , <b>condition-variable-signal</b> and <b>condition-variable-broadcast</b> .<br><br><b>name</b> is used when printing the <b>condition-variable</b> , and is useful for debugging. If <b>name</b> is omitted, then a default name is generated that is unique among all such default names. |  |
| See also    | <b>condition-variable</b><br><b>condition-variable-wait</b><br><b>condition-variable-signal</b>                                                                                                                                                                                                                                                                                                                       |  |

**condition-variable-broadcast**  
“Condition variables” on page 285

| make-lock   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <i>Function</i>                                                                                                   |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| Summary     | Makes a <b>lock</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                   |
| Package     | <b>mp</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                   |
| Signature   | <b>make-lock &amp;key name important-p safep recursivep sharing =&gt; lock</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                   |
| Arguments   | <b>name</b><br><b>important-p</b><br><b>safep</b><br><b>recursivep</b><br><b>sharing</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | A string.<br>A generalized boolean.<br>A generalized boolean.<br>A generalized boolean.<br>A generalized boolean. |
| Values      | <b>lock</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | A <b>lock</b> .                                                                                                   |
| Description | The function <b>make-lock</b> creates a <b>lock</b> . See “Locks” on page 277 for a general description of locks.<br><br><i>name</i> names <i>lock</i> and can be queried with <b>lock-name</b> . The default value of <i>name</i> is "Anon".<br><br><i>important-p</i> controls whether <i>lock</i> is automatically freed when the holder process finishes. When <i>important-p</i> is true, the system notes that <i>lock</i> is important, and automatically frees it when the holder process finishes. <i>important-p</i> should be <b>nil</b> for locks which are managed completely by the application, as it is wasteful to record all locks in a global list if there is no need to free them automatically. This might be appropriate when two processes sharing a lock must both be running for the system to be consistent. If one process dies, then the other one kills itself. Thus the system does not need to worry about |                                                                                                                   |

freeing the lock because no process could be waiting on it forever after the first process dies. The default value of *important-p* is `nil`.

*safep* controls whether *lock* is safe. A safe lock gives an error if `process-unlock` is called on it when it is not locked by the current process, and potentially in other 'dangerous' circumstances. An unsafe lock does not signal these errors. The default value of *safep* is `t`.

*recursivep*, when true, allows *lock* to be locked recursively. Trying to lock a lock that is already locked by the current thread just increments its lock count. If *lock* is created with *recursivep nil* then trying to lock again causes an error. This is useful for debugging code where *lock* is never expected to be claimed recursively. The default value of *recursivep* is `t`.

*sharing*, when true, causes *lock* to be a "sharing" lock object, which supports sharing and exclusive locking. At any given time, a sharing lock may be free, or it may be locked for sharing by any number of threads or locked for exclusive use by a single thread. Sharing locks are handled by different functions and methods from non-sharing locks.

#### Example

```
CL-USER 3 > (setq *my-lock* (mp:make-lock
   :name "my-lock"))
#<MP:LOCK "my-lock" Unlocked 2008CAC7>

CL-USER 4 > (mp:process-lock *my-lock*)
T

CL-USER 5 > *my-lock*
#<MP:LOCK "my-lock" Locked once by "CAPI Execution
Listener 1" 2008CAC7>

CL-USER 6 > (mp:process-lock *my-lock*)
T

CL-USER 7 > *my-lock*
#<MP:LOCK "my-lock" Locked 2 times by "CAPI Execution
Listener 1" 2008CAC7>
```

See also **lock**  
**\*current-process\***  
**lock-recursive-p**  
**process-lock**  
**process-unlock**  
**schedule-timer**  
**with-lock**  
“Locks” on page 277

## make-mailbox *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                  |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| Summary     | Makes a new mailbox.                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                  |
| Package     | <b>mp</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                  |
| Signature   | <b>make-mailbox &amp;key size name =&gt; mailbox</b>                                                                                                                                                                                                                                                                                                                                                                                                                      |                  |
| Arguments   | <b>size</b> An integer<br><b>name</b> A Lisp object                                                                                                                                                                                                                                                                                                                                                                                                                       |                  |
| Values      | <b>mailbox</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                            | A <b>mailbox</b> |
| Description | <p>The function <b>make-mailbox</b> returns a new mailbox. <b>size</b> specifies the initial size of the mailbox <i>mailbox</i>. The reader process is set to <b>nil</b>.</p> <p><i>name</i> does not affect the functionality of <i>mailbox</i>, but can be very useful for debugging. It appears in the printed representation of <i>mailbox</i>, and also in the <b>process-whostate</b> of any process that waits for <i>mailbox</i> (using <b>mailbox-read</b>).</p> |                  |
| See also    | <b>mailbox</b><br><b>mailbox-empty-p</b><br><b>mailbox-peek</b><br><b>mailbox-read</b>                                                                                                                                                                                                                                                                                                                                                                                    |                  |

**mailbox-send**  
**process-whostate**  
**make-unlocked-queue**  
 “Communication between processes and synchronization”  
 on page 283

|                  | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |                    |                 |            |                  |                                       |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------|-----------------|------------|------------------|---------------------------------------|
| Summary          | Creates and returns a named timer.                                                                                                                                                                                                                                                                                                                                                                                                                      |             |                    |                 |            |                  |                                       |
| Package          | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |                    |                 |            |                  |                                       |
| Signature        | <code>make-named-timer name function &amp;rest arguments =&gt; timer</code>                                                                                                                                                                                                                                                                                                                                                                             |             |                    |                 |            |                  |                                       |
| Arguments        | <table border="0"> <tr> <td><i>name</i></td><td>A string or symbol</td></tr> <tr> <td><i>function</i></td><td>A function</td></tr> <tr> <td><i>arguments</i></td><td>A set of arguments to <i>function</i></td></tr> </table>                                                                                                                                                                                                                           | <i>name</i> | A string or symbol | <i>function</i> | A function | <i>arguments</i> | A set of arguments to <i>function</i> |
| <i>name</i>      | A string or symbol                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |                    |                 |            |                  |                                       |
| <i>function</i>  | A function                                                                                                                                                                                                                                                                                                                                                                                                                                              |             |                    |                 |            |                  |                                       |
| <i>arguments</i> | A set of arguments to <i>function</i>                                                                                                                                                                                                                                                                                                                                                                                                                   |             |                    |                 |            |                  |                                       |
| Values           | <i>timer</i> A timer                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |                    |                 |            |                  |                                       |
| Description      | <p>The function <code>make-named-timer</code> creates and returns a named timer. The first argument is a string or symbol naming the timer. The second argument is a function to be applied to the remaining arguments when the timer expires. Use the function <code>schedule-timer</code> or <code>schedule-timer-relative</code> to set an expiration time.</p> <p>In comparison, the function <code>make-timer</code> creates an unnamed timer.</p> |             |                    |                 |            |                  |                                       |
| Example          | <pre>(setq timer (mp:make-named-timer 'timer-1 'print 10  *standard-output*))</pre> <pre>#&lt;Time Event TIMER-1 : PRINT&gt;</pre>                                                                                                                                                                                                                                                                                                                      |             |                    |                 |            |                  |                                       |

|                       |                                                                                                                                                                                                                                                                                                                                                                                   |             |            |              |                        |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|------------|--------------|------------------------|
| See also              | <code>make-timer</code><br><code>schedule-timer</code><br><code>schedule-timer-milliseconds</code><br><code>schedule-timer-relative</code><br><code>schedule-timer-relative-milliseconds</code><br><code>timer-expired-p</code><br><code>timer-name</code><br><code>unschedule-timer</code>                                                                                       |             |            |              |                        |
| <b>make-semaphore</b> | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                   |             |            |              |                        |
| Summary               | Makes a semaphore.                                                                                                                                                                                                                                                                                                                                                                |             |            |              |                        |
| Package               | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                   |             |            |              |                        |
| Signature             | <code>make-semaphore &amp;key name count =&gt; sem</code>                                                                                                                                                                                                                                                                                                                         |             |            |              |                        |
| Arguments             | <table border="0"> <tr> <td><i>name</i></td><td>An object.</td></tr> <tr> <td><i>count</i></td><td>A non-negative fixnum.</td></tr> </table>                                                                                                                                                                                                                                      | <i>name</i> | An object. | <i>count</i> | A non-negative fixnum. |
| <i>name</i>           | An object.                                                                                                                                                                                                                                                                                                                                                                        |             |            |              |                        |
| <i>count</i>          | A non-negative fixnum.                                                                                                                                                                                                                                                                                                                                                            |             |            |              |                        |
| Values                | <i>sem</i> A <b>semaphore</b> .                                                                                                                                                                                                                                                                                                                                                   |             |            |              |                        |
| Description           | The function <code>make-semaphore</code> returns a new <b>semaphore</b> for use with <code>semaphore-acquire</code> and <code>semaphore-release</code> . The unit count is initialized to <i>count</i> , which defaults to 1. If <i>name</i> is supplied, the semaphore will have that name. If <i>name</i> is not supplied, the semaphore will be given a unique anonymous name. |             |            |              |                        |
| See also              | <code>semaphore</code><br><code>semaphore-acquire</code><br><code>semaphore-count</code><br><code>semaphore-name</code><br><code>semaphore-release</code><br><code>semaphore-wait-count</code><br>“Counting semaphores” on page 287                                                                                                                                               |             |            |              |                        |

|             |                  | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| make-timer  |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Summary     |                  | Creates and returns an unnamed timer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Package     |                  | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Signature   |                  | <code>make-timer <i>function</i> &amp;rest <i>arguments</i> =&gt; <i>timer</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Arguments   | <i>function</i>  | A function                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|             | <i>arguments</i> | A set of arguments to <i>function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Values      | <i>timer</i>     | A timer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Description |                  | <p>The function <code>make-timer</code> creates and returns an unnamed timer. The <i>function</i> argument is a function to be applied to the remaining arguments when the timer expires. Use the function <code>schedule-timer</code> or <code>schedule-timer-relative</code> to set an expiration time.</p> <p>If <i>function</i> returns the keyword <code>:stop</code>, then <i>timer</i> is unscheduled (as if by <code>unschedule-timer</code>). This allows you to schedule a repeating timer (by passing <i>repeat-time</i> to <code>schedule-timer</code>, <code>schedule-timer-relative</code>, <code>schedule-timer-milliseconds</code> or <code>schedule-timer-relative-milliseconds</code>) that unschedules itself when some condition is true. Otherwise the values returned by <i>function</i> are ignored.</p> <p>Note that the function <code>make-named-timer</code> creates a named timer.</p> |
| Example     |                  | <pre>(setq timer       (mp:make-timer 'print 10 *standard-output*)) =&gt; #&lt;Time Event : PRINT&gt;</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| See also    |                  | <code>make-named-timer</code><br><code>make-timer</code><br><code>schedule-timer</code><br><code>schedule-timer-milliseconds</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

`schedule-timer-relative`  
`schedule-timer-relative-milliseconds`  
`timer-expired-p`  
`timer-name`  
`unschedule-timer`  
“Timers” on page 293

## **map-all-processes** *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                 |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| Summary     | Calls a predicate function on processes in turn until a true value is returned.                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                 |
| Package     | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                 |
| Signature   | <code>map-all-processes</code> <i>function</i> => <i>result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                 |
| Arguments   | <i>function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | A function taking one argument  |
| Values      | <i>result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | A process or <code>nil</code> . |
| Description | <p>The function <code>map-all-processes</code> calls <i>function</i> on processes..</p> <p><i>function</i> is passed each process in turn as its single argument.</p> <p>For a process argument <i>p</i>, if <i>function</i> returns <code>nil</code> then <code>map-processes</code> continues by calling <i>function</i> on the next process, but if function returns true then <code>map-processes</code> returns <i>p</i> immediately and stops calling <i>function</i> (so <i>function</i> may not get called on all processes).</p> |                                 |
| See also    | <code>map-processes</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                 |

## **map-all-processes-backtrace** *Function*

|         |                                               |
|---------|-----------------------------------------------|
| Summary | Produces a backtrace for every known process. |
|---------|-----------------------------------------------|

|             |                                                                                                                                                                              |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>mp</code>                                                                                                                                                              |
| Signature   | <code>map-all-processes-backtrace &amp;optional function</code>                                                                                                              |
| Arguments   | <i>function</i> A function taking one argument                                                                                                                               |
| Values      | None.                                                                                                                                                                        |
| Description | The function <code>map-all-processes-backtrace</code> calls <i>function</i> , which defaults to <code>print</code> , for every known process and each line of its backtrace. |
| See also    | <code>map-process-backtrace</code>                                                                                                                                           |

|             | <i>Function</i>                                                                                                                                                                                      |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Produces a backtrace for a process                                                                                                                                                                   |
| Package     | <code>mp</code>                                                                                                                                                                                      |
| Signature   | <code>map-process-backtrace process function</code>                                                                                                                                                  |
| Arguments   | <i>process</i> A process<br><i>function</i> A function taking one argument                                                                                                                           |
| Values      | None.                                                                                                                                                                                                |
| Description | The function <code>map-process-backtrace</code> collects a backtrace for the process specified by <i>process</i> , and the function <i>function</i> is called on each line of the backtrace in turn. |

Example

```
CL-USER 1 > (mp:map-process-backtrace mp:*current-
process* 'print)

DBG:::GET-CALL-FRAME
MP:MAP-PROCESS-BACKTRACE
SYSTEM::%INVOKE
SYSTEM::%EVAL
EVAL
SYSTEM::DO-EVALUATION
SYSTEM::%TOP-LEVEL-INTERNAL
SYSTEM::%TOP-LEVEL
SYSTEM::LISTENER-TOP-LEVEL
CAPI::CAPI-TOP-LEVEL-FUNCTION
CAPI::INTERACTIVE-PANE-TOP-LOOP
(SUBFUNCTION MP::PROCESS-SG-FUNCTION MP::INITIALIZE-
PROCESS-STACK)
SYSTEM::%%FIRST-CALL-TO-STACK
NIL
```

See also

[map-all-processes-backtrace](#)

## map-processes

## *Function*

Summary

Calls a predicate function on processes in turn until a true value is returned.

Package

`mp`

Signature

`map-processes function -> result`

Arguments

`function`

A function taking one argument

Values

`result`

A process or `nil`.

Description

The function `map-processes` calls `function` on processes.

`function` is passed each live process (as determined by `process-alive-p`) in turn as its single argument.

For a process argument `p`, if `function` returns `nil` then `map-processes` continues by calling `function` on another process,

but if function returns true then `map-processes` returns *p* immediately and stops calling *function* (so *function* may not get called on all processes).

See also [map-all-processes](#)

## **notice-fd** *Function*

|             |                                                                                                                                                                                                       |                        |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Summary     | Add a file descriptor to the set of interesting input file descriptors.                                                                                                                               |                        |
| Package     | <code>mp</code>                                                                                                                                                                                       |                        |
| Signature   | <code>notice-fd fd</code>                                                                                                                                                                             |                        |
| Arguments   | <code>fd</code>                                                                                                                                                                                       | A UNIX file descriptor |
| Values      | None.                                                                                                                                                                                                 |                        |
| Description | <p>The function <code>notice-fd</code> adds the given <i>fd</i> to the set of fds that cause LispWorks to wake up when they contain input. This function is not implemented on Microsoft Windows.</p> |                        |

See also [unnotice-fd](#)

## **process-alive-p** *Function*

|           |                                                 |           |
|-----------|-------------------------------------------------|-----------|
| Summary   | Determines if a process is alive.               |           |
| Package   | <code>mp</code>                                 |           |
| Signature | <code>process-alive-p process =&gt; bool</code> |           |
| Arguments | <code>process</code>                            | A process |

|             |                                                                                                                                                                                                                                                                                        |           |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Values      | <i>bool</i>                                                                                                                                                                                                                                                                            | A boolean |
| Description | The function <code>process-alive-p</code> returns <code>t</code> if <code>process</code> is alive, that is, if <code>process-terminate</code> has not been called on the process.                                                                                                      |           |
| Example     | ( <code>mp:process-alive-p mp:*current-process*</code> )<br><br><code>=&gt; T</code><br><br><code>(let ((process (mp:process-run-function "test" nil 'identity nil)))</code><br><code>  (sleep 2)</code><br><code>  (mp:process-alive-p process))</code><br><br><code>=&gt; NIL</code> |           |

## process-all-events *Function*

|             |                                                                                                                                                                                                                                                                                    |            |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Summary     | Processes the events in the mailbox of the current process.                                                                                                                                                                                                                        |            |
| Package     | <code>mp</code>                                                                                                                                                                                                                                                                    |            |
| Signature   | <code>process-all-events =&gt; processedp</code>                                                                                                                                                                                                                                   |            |
| Values      | <i>processedp</i>                                                                                                                                                                                                                                                                  | A boolean. |
| Description | The function <code>process-all-events</code> processes all the events in the mailbox of the current process, by calling <code>general-handle-event</code> on each one of them.<br><br><code>process-all-events</code> returns a boolean indicating whether it processed any event. |            |
| See also    | <code>general-handle-event</code><br><code>process-mailbox</code><br><code>process-send</code>                                                                                                                                                                                     |            |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <i>Function</i>    |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
|             | <b>process-allow-scheduling</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                    |
| Summary     | Allows scheduling within a process, so that the process is interruptible.                                                                                                                                                                                                                                                                                                                                                                                                                                  |                    |
| Package     | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                    |
| Signature   | <code>process-allow-scheduling =&gt;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                    |
| Arguments   | None.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                    |
| Values      | None.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                    |
| Description | This gives other Lisp processes a chance to run.                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                    |
|             | <b>process-arrest-reasons</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <i>Function</i>    |
| Summary     | Returns a list of the reasons why a Lisp process has stopped.                                                                                                                                                                                                                                                                                                                                                                                                                                              |                    |
| Package     | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                    |
| Signature   | <code>process-arrest-reasons process =&gt; reasons</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                    |
| Arguments   | <code>process</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | A process.         |
| Values      | <code>reasons</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | A list of reasons. |
| Description | The function <code>process-arrest-reasons</code> returns a list of the reasons why a Lisp process has stopped. A process is inactive if it has any arrest reasons.<br><br>Use of <code>(setf mp:process-arrest-reasons)</code> is deprecated. You should use <code>process-stop</code> instead. If you set the arrest reasons of the current process, this causes the current process to stop immediately, before returning from <code>mp:process-arrest-reasons</code> (like <code>process-stop</code> ). |                    |

Compatibility notes The immediate stopping behavior of (`setf mp:process-arrest-reasons`) is different from LispWorks 5.0 and previous versions.

See also `process-run-reasons`  
`process-stop`

## process-break *Function*

Summary Breaks a Lisp process and enters the debugger.

Package `mp`

Signature `process-break process =>`

Arguments `process` A process.

Values None.

Description The function `process-break` forces the process `process` to break and enter the debugger.

See also `debug-other-process`

## process-continue *Function*

Summary Wakes up a process.

Package `mp`

Signature `process-continue process => nil`

Arguments `process` A `mp:process` object.

|                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                     |                 |                 |                                                                                        |                |                                                        |
|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-----------------|-----------------|----------------------------------------------------------------------------------------|----------------|--------------------------------------------------------|
| Description                   | The function <code>process-continue</code> wakes up the process <i>process</i> , regardless of whether it is sleeping, stopped or waiting.<br><br><code>process-continue</code> returns <code>nil</code> .                                                                                                                                                                                                                                                        |                     |                 |                 |                                                                                        |                |                                                        |
| <b>process-exclusive-lock</b> | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                     |                 |                 |                                                                                        |                |                                                        |
| Summary                       | Like <code>process-lock</code> , but on a "sharing" lock.                                                                                                                                                                                                                                                                                                                                                                                                         |                     |                 |                 |                                                                                        |                |                                                        |
| Package                       | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                     |                 |                 |                                                                                        |                |                                                        |
| Signature                     | <code>process-exclusive-lock <i>sharing-lock</i> &amp;optional <i>whostate</i> <i>timeout</i></code>                                                                                                                                                                                                                                                                                                                                                              |                     |                 |                 |                                                                                        |                |                                                        |
| Arguments                     | <table> <tr> <td><i>sharing-lock</i></td><td>A sharing lock.</td></tr> <tr> <td><i>whostate</i></td><td>The status of the process while <i>lock</i> is locked, as seen in the Process Browser.</td></tr> <tr> <td><i>timeout</i></td><td>A non-negative <code>real</code> or <code>nil</code>.</td></tr> </table>                                                                                                                                                 | <i>sharing-lock</i> | A sharing lock. | <i>whostate</i> | The status of the process while <i>lock</i> is locked, as seen in the Process Browser. | <i>timeout</i> | A non-negative <code>real</code> or <code>nil</code> . |
| <i>sharing-lock</i>           | A sharing lock.                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                     |                 |                 |                                                                                        |                |                                                        |
| <i>whostate</i>               | The status of the process while <i>lock</i> is locked, as seen in the Process Browser.                                                                                                                                                                                                                                                                                                                                                                            |                     |                 |                 |                                                                                        |                |                                                        |
| <i>timeout</i>                | A non-negative <code>real</code> or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                 |                 |                                                                                        |                |                                                        |
| Description                   | <p>The function <code>process-exclusive-lock</code> is the same as <code>process-lock</code>, but on a "sharing" lock. It waits until <i>sharing-lock</i> is free before locking it in exclusive mode.</p> <p>Calls to <code>process-exclusive-lock</code> should be paired with <code>process-exclusive-unlock</code> calls. In most cases the macro <code>with-exclusive-lock</code> the best way to achieve this.</p>                                          |                     |                 |                 |                                                                                        |                |                                                        |
| Notes                         | <p>It is not possible to use exclusive lock in the scope of a sharing lock on the same lock, and trying to do this will cause the process to hang. Whether it is possible to use an exclusive lock inside an exclusive lock of the same lock is determined by the <i>recursivep</i> argument in <code>make-lock</code>.</p> <p><code>process-exclusive-lock</code> is guaranteed to return if it locked <i>sharing-lock</i>, but may throw before locking, as</p> |                     |                 |                 |                                                                                        |                |                                                        |

described in “Guarantees and limitations when locking and unlocking” on page 278.

See also

`make-lock`  
`process-lock`  
`with-exclusive-lock`  
“Locks” on page 277

**process-exclusive-unlock** *Function*

Summary      Like `process-unlock`, but on a "sharing" lock.

Package      `mp`

Signature      `process-exclusive-unlock sharing-lock`

Arguments      `sharing-lock`      A sharing lock.

Description      The function `process-exclusive-unlock` is the same as `process-unlock` but for a "sharing" lock.

Calls to `process-exclusive-unlock` should be paired with `process-exclusive-lock` calls. In most cases the macro `with-exclusive-lock` the best way to achieve this.

Notes      `process-exclusive-unlock` is guaranteed to successfully unlock `sharing-lock`, but is not guaranteed to return, as described in “Guarantees and limitations when locking and unlocking” on page 278.

See also

`process-exclusive-lock`  
`process-unlock`  
`with-exclusive-lock`  
“Locks” on page 277

| <b>process-idle-time</b> | <i>Function</i>                                                                                                                                                                                                                |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary                  | Returns the time for which a process has been idle.                                                                                                                                                                            |
| Package                  | <code>mp</code>                                                                                                                                                                                                                |
| Signature                | <code>process-idle-time process =&gt; time</code>                                                                                                                                                                              |
| Arguments                | <code>process</code> A process.                                                                                                                                                                                                |
| Values                   | <code>time</code> A non-negative integer.                                                                                                                                                                                      |
| Description              | The function <code>process-idle-time</code> returns the length of time in internal time units that <code>process</code> has been idle. If the process is running (for example the current process) then the return value is 0. |
| See also                 | <code>process-run-time</code>                                                                                                                                                                                                  |

| <b>*process-initial-bindings*</b> | <i>Variable</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary                           | Specifies the variables initially bound in a new process.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Package                           | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Description                       | This specifies the variables that are initially bound in a Lisp process when that process is created. This variable is an association list of symbols and initial value forms. The initial value forms are processed by a simple evaluation that handles symbols and function call forms, but not special operators. As a special case, if the value form is the same as the symbol and that symbol is unbound, then the symbol will be unbound in the new process.<br><br>When <code>process-run-function</code> is called, it performs the evaluation in the dynamic environment of the call. It is therefore possible to bind <code>*process-initial-bindings*</code> dynami- |

cally around the call, as shown in the examples below, and that is the preferred way of using `*process-initial-bindings*` (rather than setting the global value).

The initial value forms in `*process-initial-bindings*` are also evaluated in outer calls on foreign threads, which are threads that were made by foreign code rather than by Lisp. See “Foreign callbacks on threads not created by Lisp” on page 297 for discussion. Note that in this case, the evaluation occurs in a dynamic environment where the variables in `*process-initial-bindings*` are not bound yet. That is different from calls to `process-run-function`, where all the variables that were in `*process-initial-bindings*` at the time that the calling process was created are already bound.

|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | <p>Changing the global value of <code>*process-initial-bindings*</code> affects all new processes in the system, including processes that will be associated with foreign threads. Unless that is what you want, you should not set the global value. When you do set it, you should take care to avoid errors.</p> <p>Errors in the evaluation are signaled in the standard way when they occur due to <code>process-run-function</code>. When LispWorks creates processes for its own use, it just ignores such errors and binds the corresponding variable to <code>nil</code>. When the evaluation is for a foreign thread, the error is signaled as usual, wrapped with a restart that allows you to use <code>nil</code> as the value.</p> |
| Examples | <p>This example shows a typical use with a bound symbol:</p> <pre>(defvar *binding-1* 10)</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

```
(let ((mp:*process-initial-bindings*
      (cons '(*binding-1* . 20)
            mp:*process-initial-bindings*)))
  (mp:process-run-function
   "binding-1"
   '()
   #'(lambda (stream)
        (format stream "~&Binding 1 is ~S.~%" *binding-1*))
   *standard-output*)
  (sleep 1))
=>
Binding 1 is 20.
```

This example shows the special case with an unbound symbol:

```
(defvar *binding-2*)

(let ((mp:*process-initial-bindings*
      (cons '(*binding-2* . *binding-2*)
            mp:*process-initial-bindings*)))
  (flet ((check-binding-2 ())
         (mp:process-run-function
          "binding-2"
          '()
          #'(lambda (stream)
              (if (boundp '*binding-2*)
                  (format stream "~&Binding 2 is ~S.~%" *binding-2*)
                  (format stream "~&Binding 2 is
unbound.~%")))
          *standard-output*)
         (sleep 1)))
    (check-binding-2)
    (let ((*binding-2* 123))
      (check-binding-2))))
=>
Binding 2 is unbound.
Binding 2 is 123.
```

## process-internal-server-p

## *Function*

Summary      Tests whether a process is an internal server.

|             |                                                                                                                                                                          |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>mp</code>                                                                                                                                                          |
| Signature   | <code>process-internal-server-p process =&gt; result</code>                                                                                                              |
| Arguments   | <code>process</code> A <code>mp:process</code> object.                                                                                                                   |
| Values      | <code>result</code> A boolean.                                                                                                                                           |
| Description | The function <code>process-internal-server-p</code> is the predicate for whether a process is marked as "internal server".                                               |
| Notes       | Processes are marked as "internal server" by a true value for <code>:internal-server</code> amongst the <i>keywords</i> in a call to <code>process-run-function</code> . |
| See also    | <code>process-run-function</code><br><code>any-other-process-non-internal-server-p</code>                                                                                |

## **process-interrupt** *Function*

|             |                                                                                                                                                                                                                                         |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Interrupts a process.                                                                                                                                                                                                                   |
| Package     | <code>mp</code>                                                                                                                                                                                                                         |
| Signature   | <code>process-interrupt process function &amp;rest arguments =&gt;</code>                                                                                                                                                               |
| Arguments   | <code>process</code> A process.<br><code>function</code> A function to apply on resuming <code>process</code> .<br><code>arguments</code> Arguments to supply to <code>function</code> .                                                |
| Values      | None.                                                                                                                                                                                                                                   |
| Description | The function <code>process-interrupt</code> causes the Lisp process <code>process</code> to apply <code>function</code> to <code>arguments</code> when it is next resumed. Afterwards the process resumes its normal execution, as long |

as *function* does not throw. A waiting process is temporarily woken up.

**Notes** Interrupts should be used only for simple operations such as setting a variable. Any more complex interrupt *function* is potentially dangerous and should be avoided. The problem is that even simple code like:

```
(let ((message (read-message)))
  (process-message message))
```

may lose the message if an interrupt ends up throwing between the two lines. In addition, the code in the interrupt may be executed while some tree of pointers is in an inconsistent state (while the message is incompletely processed, for example).

**See also** `process-interrupt-list`

## process-interrupt-list *Function*

**Summary** Interrupts a process.

**Package** `mp`

**Signature** `process-interrupt-list process function arguments =>`

**Arguments** `process` A process.

`function` A function to apply on resuming *process*.

`arguments` A list of the arguments to supply to *function*.

**Values** None.

**Description** The function `process-interrupt-list` causes the Lisp process *process* to apply *function* to *arguments* when it is next

resumed. It is just like `process-interrupt` except that the *arguments* are supplied as a list.

See also `process-interrupt`

## `process-join` *Function*

Summary Waits until a specified process dies, or a *timeout* is reached.

Package `mp`

Signature `process-join process &key timeout => flag`

Arguments `process` A process.

`timeout` A non-negative `real` or `nil`.

Values `flag` A boolean.

Description The function `process-join` waits until the process *process* dies, or *timeout* seconds passed.

If the process dies then `process-join` returns `t`. If the timeout passed it returns `nil`.

`process-join` can be used on dead processes, and in this case returns `t` immediately.

The effect of `process-join` is similar to

```
(mp:process-wait-with-timeout
  "Waiting for process to die" timeout
  #'(lambda (x)
      (not (mp:process-alive-p x))) process)
```

but the call above may not return until the next time the scheduler runs, possibly causing a delay. In contrast `process-join` returns immediately when the process dies.

See also `process-wait-with-timeout`

| <b>process-kill</b> | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary             | Kills the specified Lisp process. <code>process-kill</code> is deprecated.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Package             | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Signature           | <code>process-kill process =&gt;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Arguments           | <code>process</code> A process.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Values              | None.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Description         | The function <code>process-kill</code> kills the specified Lisp process.<br><br><code>process-kill</code> is deprecated. Use <code>process-terminate</code> instead.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Notes               | <ol style="list-style-type: none"> <li>1. <code>process-kill</code> kills the process by sending it an interrupt with <code>current-process-kill</code>, which will throw out of whatever it is doing. That means that any code that is executing without interrupts blocked may abort in the middle. It is wise in general to block interrupts around all sensitive places, so that <code>process-kill</code> may kill the process in a non-sensitive place.</li> <li>2. If <code>process-kill</code> is called while the process is in a no-interrupt context, the killing will actually happen when the process exits that no-interrupt context.</li> <li>3. If the killing happens inside the cleanup forms of <code>unwind-protect</code>, it may terminate a cleanup in the middle. It is possible to protect against this by doing all cleanups with interrupts disallowed, but that is not easy. Thus <code>process-kill</code> may be problematic, and should be avoided when possible. Whenever possible, make your processes check some flag that can be set by other threads and exit when the flag is set to some value.</li> </ol> |

See also      `ensure-process-cleanup`  
                `process-terminate`

## process-lock *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                      |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Locks a <code>lock</code> for the current process.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                      |
| Package     | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                      |
| Signature   | <code>process-lock lock &amp;optional whostate timeout =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                      |
| Arguments   | <code>lock</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | A <code>lock</code> .                                                                                                                                                                                                                |
|             | <code>whostate</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | The status of the current Lisp process, before <code>process-lock</code> returns, that is, the status while the current process is waiting to time-out. This can be seen in the Process Browser.                                     |
|             | <code>timeout</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | A timeout interval, in seconds. If this is <code>nil</code> (the default), <code>process-lock</code> waits until <code>lock</code> can be locked by the current Lisp process. A process can lock a <code>lock</code> more than once. |
| Values      | <code>result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | A boolean.                                                                                                                                                                                                                           |
| Description | <p>The function <code>process-lock</code> attempts to lock <code>lock</code> and returns <code>t</code> if successful, or <code>nil</code> if timed out.</p> <p>If <code>lock</code> is already locked and its owner is the value of <code>*current-process*</code>, then the value of <code>recursivep</code> in the <code>lock</code> (see <code>make-lock</code>) controls what happens. If <code>recursivep</code> is true, then <code>lock</code> remains locked and an internal count is incremented (this is called recursive locking). Otherwise, an error is signaled.</p> <p>The Lisp process sleeps until the lock can be locked or the timeout period specified by <code>timeout</code> expires.</p> <p><code>result</code> is <code>t</code> if <code>lock</code> was successfully locked, and <code>nil</code> otherwise.</p> |                                                                                                                                                                                                                                      |

|          |                                                                                                                                                                                            |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | <code>process-lock</code> is guaranteed to return if it locked process, but may throw before locking, as described in “Guarantees and limitations when locking and unlocking” on page 278. |
| Example  | <code>(process-lock *my-lock* "waiting to lock" 10)</code>                                                                                                                                 |
| See also | <code>make-lock</code><br><code>process-exclusive-lock</code><br><code>process-unlock</code><br><code>with-lock</code><br>“Locks” on page 277                                              |

## process-mailbox *Function*

|             |                                                                                                                               |                                              |
|-------------|-------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| Summary     | Accesses the mailbox associated with a process.                                                                               |                                              |
| Package     | <code>mp</code>                                                                                                               |                                              |
| Signature   | <code>process-mailbox process =&gt; result</code><br><code>(setf process-mailbox) result process =&gt; result</code>          |                                              |
| Arguments   | <code>process</code>                                                                                                          | A process.                                   |
| Values      | <code>result</code>                                                                                                           | A <code>mailbox</code> or <code>nil</code> . |
| Description | <code>process-mailbox</code> is an accessor function which returns or sets the mailbox associated with <code>process</code> . |                                              |
| Example     | <code>(setf (mp:process-mailbox mp:*current-process*)</code><br><code>(mp:make-mailbox))</code>                               |                                              |

## process-name *Function*

|         |                                          |
|---------|------------------------------------------|
| Summary | Returns the name of a specified process. |
|---------|------------------------------------------|

|             |                                              |                                                                                        |
|-------------|----------------------------------------------|----------------------------------------------------------------------------------------|
| Package     | <code>mp</code>                              |                                                                                        |
| Signature   | <code>process-name process =&gt; name</code> |                                                                                        |
| Arguments   | <code>process</code>                         | A process.                                                                             |
| Values      | <code>name</code>                            | The name of the process specified by <code>process</code> .                            |
| Description |                                              | The function <code>process-name</code> returns the name of the specified Lisp process. |

## **process-p** *Function*

|             |                                          |                                                                                                                                 |
|-------------|------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| Summary     | The predicate for processes.             |                                                                                                                                 |
| Package     | <code>mp</code>                          |                                                                                                                                 |
| Signature   | <code>process-p object =&gt; bool</code> |                                                                                                                                 |
| Arguments   | <code>object</code>                      | Any object                                                                                                                      |
| Values      | <code>bool</code>                        | A generalized boolean.                                                                                                          |
| Description |                                          | The function <code>process-p</code> returns <code>t</code> if <code>object</code> is a process, and <code>nil</code> otherwise. |

## **process-plist** *Function*

|           |                                                                           |  |
|-----------|---------------------------------------------------------------------------|--|
| Summary   | Returns the plist associated with a process. This function is deprecated. |  |
| Package   | <code>mp</code>                                                           |  |
| Signature | <code>process-plist process =&gt; plist</code>                            |  |

|             |                                                                                                                                                                                                                                                                                                   |           |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Arguments   | <i>process</i>                                                                                                                                                                                                                                                                                    | A process |
| Values      | <i>plist</i>                                                                                                                                                                                                                                                                                      | A plist   |
| Description | The function <code>process-plist</code> returns the plist associated with <i>process</i> .                                                                                                                                                                                                        |           |
| Notes       | It is not possible to manipulate the plist in a thread-safe manner, and <code>process-plist</code> may interact badly with other users of the plist, hence <code>process-plist</code> is deprecated. Use instead <code>process-property</code> and <code>get-process-private-property</code> etc. |           |

## process-poke *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Summary     | Makes a waiting process call its wait function.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |
| Package     | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |
| Signature   | <code>process-poke process =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |            |
| Arguments   | <i>process</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | A process. |
| Values      | <i>result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | A boolean. |
| Description | If the process <i>process</i> is waiting, the function <code>process-poke</code> causes it to run its <i>wait-function</i> as soon as possible, and if the wait function returns true, the process returns from the waiting function.<br><br><code>process-poke</code> is especially useful when using the <code>process-wait-local-*</code> functions. With <code>process-wait-local</code> and <code>process-wait-local-with-timeout</code> , it is the only way to ensure that the waiting process checks the wait function. The other functions also check periodically, but <code>process-poke</code> is still useful to make them wake up immediately. |            |

With a non-local wait function (that is, in `process-wait` and `process-wait-with-timeout`), `process-poke` is useful in SMP LispWorks to ensure that the process wakes and checks its *wait-function* immediately. `process-poke` has no effect on non-SMP LispWorks for `process-wait` and `process-wait-with-timeout`.

You can also use `process-poke` to wake up a process that waits using `current-process-pause`.

`process-poke` returns `t` if it actually poked the process or `nil` otherwise (when the process is not waiting or is stopped).

The process wait functions are designed to call the *wait-function* just before going to sleep, in a way that guards against a race condition between `process-poke` and the waiting function. In particular, they ensure that if a process goes to wait with a *wait-function* that checks some value, and another process sets this value and calls `process-poke` on the first process, the first either will check the value before going to sleep, or wake up and check the value. The first process is never going to get stuck because it went to sleep just as the other process set the value. Note that this is guaranteed only when the value is set before `process-poke` is called.

Functions that cause specific wait functions to be ready to run (for example `mailbox-send` which causes `mailbox-read` to be ready to run) implicitly pokes a process that waits, so there is no need to use `process-poke` when these functions are used.

## Example

Worker process function:

```
(defun worker-process-function (work-struct)
  (loop (mp:process-wait-local "Waiting for request"
                               'worker-struct-request
                               work-struct)
        (process-request
         (worker-struct-request work-struct)))
        (setf (worker-struct-request work-struct) nil)))
```

Another process distributes requests:

```
(dolist (work-struct *work-structs*)
  (unless (worker-struct-request work-struct)
    (setf (worker-struct-request work-struct) request)
    (mp:process-poke
      (worker-struct-process work-struct)))
  (return work-struct)))
```

This specific example can be implemented a little more simply by `mailbox-read` and `mailbox-send`, but if the wait function needs to check for something else it can be easily added.

See also

`current-process-pause`  
`process-wait`  
`process-wait-local`  
`process-wait-local-with-periodic-checks`  
`process-wait-local-with-timeout`  
`process-wait-local-with-timeout-and-periodic-
checks`  
`process-wait-with-timeout`

|             |                                                      | <i>Function</i>                                                                                                            |
|-------------|------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|
| Summary     | Returns the numerical priority of the Lisp process.  |                                                                                                                            |
| Package     | <code>mp</code>                                      |                                                                                                                            |
| Signature   | <code>process-priority process =&gt; priority</code> |                                                                                                                            |
| Arguments   | <code>process</code>                                 | A process.                                                                                                                 |
| Values      | <code>priority</code>                                | A fixnum, the priority of <code>process</code> .                                                                           |
| Description |                                                      | Returns the numerical priority of the Lisp process. This can be modified by calling <code>change-process-priority</code> . |

Example      `CL-USER 17 > (mp:process-priority mp:*current-process*)  
600000`

See also     `change-process-priority`

## process-private-property *Function*

Summary      Gets or sets the value of a private property of the current process.

Package     `mp`

Signature    `process-private-property indicator &optional default => result`

`(setf process-private-property) value indicator &optional default => result`

Arguments    `indicator`      A Lisp object.

`default`      A Lisp object.

Values       `result`      `value or default`

Description    The function `process-private-property` gets or sets the value that is associated with `indicator` in the private properties of the current process (that is, the result of calling `get-current-process`).

If `indicator` is not associated with a value in the private properties, `process-private-property` returns `default`.

`(setf process-private-property)` overwrites any existing value for `indicator`.

The default value of `default` is `nil`.

Notes        1. Private properties can be read from other processes using `get-process-private-property`, but cannot be set by other processes.

2. Process private property access is faster than than process property access in SMP LispWorks, because the implementation of the latter must deal with parallel setting.

See also

`remove-process-private-property`  
`pushnew-to-process-private-property`  
`remove-from-process-private-property`  
`get-process-private-property`

|             |                                                                                                                                                                                                                                                                                                                                                                     | <i>Function</i>               |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| Summary     | Gets and sets a general property for a process.                                                                                                                                                                                                                                                                                                                     |                               |
| Package     | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                     |                               |
| Signature   | $\begin{aligned} \text{process-property } &\text{ indicator } \& \text{optional } \text{process } \text{default } \Rightarrow \text{result} \\ (\text{setf } \text{process-property}) \text{ value } &\text{ indicator } \& \text{optional } \text{process } \\ &\text{default } \Rightarrow \text{result} \end{aligned}$                                           |                               |
| Arguments   | $\begin{aligned} \text{indicator} &\quad \text{A Lisp object.} \\ \text{process} &\quad \text{A process.} \\ \text{default} &\quad \text{A Lisp object.} \end{aligned}$                                                                                                                                                                                             |                               |
| Values      | $\text{result}$                                                                                                                                                                                                                                                                                                                                                     | A property value, or default. |
| Description | <p>The function <code>process-property</code> gets the value that is associated with <i>indicator</i> for the process <i>process</i>, and <code>(setf process-property)</code> sets this value.</p> <p>If <i>process</i> is not supplied or is <code>nil</code>, the current process (that is, the result of calling <code>get-current-process</code>) is used.</p> |                               |
| Notes       | <p>In the typical case when only the current process sets the property (even if other processes read it), private properties can be used, and are much faster in SMP LispWorks, because</p>                                                                                                                                                                         |                               |

they do not need to deal with parallel setting. See `process-private-property`.

Example

```
(process-property 'foo (get-current-process) 'bar)
=> BAR

(setf (process-property 'foo) 'foo-value)
=> FOO-VALUE

(process-property 'foo)
=> FOO-VALUE
```

See also

`process-private-property`  
`remove-process-property`  
`remove-from-process-property`  
`pushnew-to-process-property`

## process-reset

## *Function*

Summary

Resets a process by discarding its current state.

Package

`mp`

Signature

`process-reset process =>`

Arguments

`process` A process.

Values

None.

Description

`process-reset` interrupts the execution of `process` and “throws away” its current state. Upon resuming execution, the process calls its function with its initial argument and priority.

`process-reset` modifies the dynamic execution state of `process`. It performs a non-local exit from the currently run-

ning function, to cause the process's main function to return. `unwind-protect` forms will be run.

`process-reset` does not modify any of the attributes of the process, in particular its priority, items on the plist, or accumulated run-time.

|       |                                                                                                                                                                                                                                                                                                                    |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes | Since <code>process-reset</code> causes an asynchronous non-local exit, it is possible that it can occur within an <code>unwind-protect</code> cleanup form or before data used by an <code>unwind-protect</code> cleanup form has been initialized. In some cases, not all cleanups within that form will be run. |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                        | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                   |                   |                             |                       |                                                    |                       |                      |                        |                                              |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----------------------------|-----------------------|----------------------------------------------------|-----------------------|----------------------|------------------------|----------------------------------------------|
| Summary                | Create a new process, passing it a function to run.                                                                                                                                                                                                                                                                                                               |                   |                             |                       |                                                    |                       |                      |                        |                                              |
| Package                | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                   |                   |                             |                       |                                                    |                       |                      |                        |                                              |
| Signature              | <code>process-run-function name keywords function &amp;rest arguments =&gt; process</code>                                                                                                                                                                                                                                                                        |                   |                             |                       |                                                    |                       |                      |                        |                                              |
| Arguments              | <table> <tr> <td><code>name</code></td><td>A name for the new process.</td></tr> <tr> <td><code>keywords</code></td><td>Keywords specifying properties of the new process.</td></tr> <tr> <td><code>function</code></td><td>A function to apply.</td></tr> <tr> <td><code>arguments</code></td><td>Arguments to pass to <code>function</code>.</td></tr> </table> | <code>name</code> | A name for the new process. | <code>keywords</code> | Keywords specifying properties of the new process. | <code>function</code> | A function to apply. | <code>arguments</code> | Arguments to pass to <code>function</code> . |
| <code>name</code>      | A name for the new process.                                                                                                                                                                                                                                                                                                                                       |                   |                             |                       |                                                    |                       |                      |                        |                                              |
| <code>keywords</code>  | Keywords specifying properties of the new process.                                                                                                                                                                                                                                                                                                                |                   |                             |                       |                                                    |                       |                      |                        |                                              |
| <code>function</code>  | A function to apply.                                                                                                                                                                                                                                                                                                                                              |                   |                             |                       |                                                    |                       |                      |                        |                                              |
| <code>arguments</code> | Arguments to pass to <code>function</code> .                                                                                                                                                                                                                                                                                                                      |                   |                             |                       |                                                    |                       |                      |                        |                                              |
| Values                 | <code>process</code> The newly created process.                                                                                                                                                                                                                                                                                                                   |                   |                             |                       |                                                    |                       |                      |                        |                                              |
| Description            | This function creates a new Lisp process with name <code>name</code> . Other properties of <code>process</code> may be specified in keyword/value pairs in <code>keywords</code> :                                                                                                                                                                                |                   |                             |                       |                                                    |                       |                      |                        |                                              |

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>:priority</code>          | A <code>fixnum</code> representing the priority for the process. If <code>:priority</code> is not supplied, the process priority becomes the value of the variable <code>*default-process-priority*</code> .                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <code>:mailbox</code>           | A <code>mailbox</code> , a string, <code>t</code> or <code>nil</code> , used to initialize the <code>process-mailbox</code> of <code>process</code> .<br><br>True values specify that <code>process</code> should have a <code>mailbox</code> . A <code>mailbox</code> is used as-is; a string is used as the name of a new mailbox; and <code>t</code> causes it to create a <code>mailbox</code> with the same name as <code>process</code> , that is, <code>name</code> .<br><br>Note that both <code>process-send</code> and <code>process-wait-for-event</code> force the relevant process to have a <code>mailbox</code> . |
| <code>:internal-server</code>   | When true, this indicates that the process is an "internal server", which means that it responds to requests for work from other processes. The main effect of this is that if the only processes that remain are "internal servers", nothing is going to happen, so LispWorks quits. The system marks some of the processes that it creates as "internal server".                                                                                                                                                                                                                                                               |
| <code>:remote-terminator</code> | A function designator for a function of one argument.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <code>:local-terminator</code>  | A function designator for a function of no arguments.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <code>:terminate-by-send</code> | A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

The new process is preset to apply *function* to *arguments* and runs in parallel, while `process-run-function` returns immediately.

`:remote-terminator`, `:local-terminator` OR `:terminate-by-send` define the Terminate Method of the process, which is what `process-terminate` uses. If more than one of these keyword arguments is supplied, then `:remote-terminator` takes precedence over `:local-terminator` which takes precedence over `:terminate-by-send`.

If `remote-terminator` is supplied, it must be a function of one argument. When `process-terminate` is called, it funcalls `remote-terminator` on the process that `process-terminate` was called on, which normally will be another process. It should then terminate the process somehow. Typically the process itself will be frequently checking some flag which tells it to exit, and the function `remote-terminator` just sets this flag. `remote-terminator` should return non-nil when it is "successful", that is it did something that should cause the process to terminate. `process-terminate` checks the result of the call to `remote-terminator`, and if it is nil it also calls `process-kill` on the process.

If `local-terminator` is supplied, it must be a function of no arguments. When `process-terminate` is called it sends to the process a list with the `local-terminator` as the only element. That relies on the process itself processing what is sent to it and funcalling the function. This is what `general-handle-event` does, which is what system processes tend to use. In particular, all processes that are created by CAPI use it.

If `terminate-by-send` is supplied and non-nil, `process-terminate` sends the process a list containing `current-process-kill` (that is it is the same as `:local-terminator 'current-process-kill`). CAPI processes use this keyword.

**Example**

```
CL-USER 253 > (defvar *stream* *standard-output*)
*STREAM*

CL-USER 254 > (mp:process-run-function
                 "My process"
                 '(:priority 42)
                 #'(lambda (x)
                     (loop for i below x
                           do (and (print i *stream*)
                                    (sleep 1)))
                     finally
                     (print (mp:process-priority
                             mp::*current-process*)
                            *stream*)))
3)
#<MP:PROCESS Name "My process" Priority 850000 State
"Running">

0
1
2
42
CL-USER 255 >
```

**See also**

```
current-process-kill
*default-process-priority*
*initial-processes*
list-all-processes
map-processes
process-alive-p
process-join
process-terminate
process-whostate
ps
```

**process-run-reasons***Function***Summary**

Returns the reasons that a specified process is running.

**Package**`mp`

|             |                                                                                                                                                                                                                                                               |                        |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Signature   | <code>process-run-reasons <i>process</i> =&gt; <i>reasons</i></code><br><code>(setf process-run-reasons) <i>process</i> <i>reasons</i> =&gt; <i>reasons</i></code>                                                                                            |                        |
| Arguments   | <i>process</i>                                                                                                                                                                                                                                                | A process.             |
| Values      | <i>reasons</i>                                                                                                                                                                                                                                                | A list of run reasons. |
| Description | <p>The function <code>process-run-reasons</code> returns a list of reasons for the specified Lisp process running. These can be changed using <code>setf</code>.</p> <p>A process is only active if it has at least one run reason and no arrest reasons.</p> |                        |
| See also    | <code>process-arrest-reasons</code><br><code>process-run-function</code><br><code>process-whostate</code>                                                                                                                                                     |                        |

## **process-run-time** *Function*

|             |                                                                                                                                                                                                                                             |                                          |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| Summary     | Returns the current run time for a process.                                                                                                                                                                                                 |                                          |
| Package     | <code>mp</code>                                                                                                                                                                                                                             |                                          |
| Signature   | <code>process-run-time <i>process</i> =&gt; <i>time</i></code>                                                                                                                                                                              |                                          |
| Arguments   | <i>process</i>                                                                                                                                                                                                                              | A process.                               |
| Values      | <i>time</i>                                                                                                                                                                                                                                 | A positive integer or <code>nil</code> . |
| Description | <p>The function <code>process-run-time</code> returns the current run time for <i>process</i> in internal time units. If the value cannot be determined (currently this is only on FreeBSD), then the return value is <code>nil</code>.</p> |                                          |

|          |                                                                                                                                                              |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | The value returned by <code>get-internal-run-time</code> is similar, but on some operating systems it is the total time for all Lisp processes in the image. |
| See also | <code>process-idle-time</code>                                                                                                                               |

## process-send *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                        |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| Summary     | Sends an object to the mailbox of a given process.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                        |
| Package     | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                        |
| Signature   | <code>process-send process object &amp;key change-priority limit timeout<br/>error-if-dead-p =&gt; success</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                        |
| Arguments   | <code>process</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | A process                                                              |
|             | <code>object</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | An object                                                              |
|             | <code>change-priority</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | A fixnum, <code>nil</code> , <code>t</code> , or <code>:default</code> |
|             | <code>limit</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | An integer or <code>nil</code> .                                       |
|             | <code>timeout</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | A non-negative <code>real</code> or <code>nil</code> .                 |
|             | <code>error-if-dead-p</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | A generalized boolean.                                                 |
| Values      | <code>success</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | A boolean.                                                             |
| Description | <p>The function <code>process-send</code> queues <i>object</i> in the mailbox of the given process.</p> <p><i>object</i> can any kind of Lisp object, and it is up to the receiving process to interpret it.</p> <p><code>process-send</code> only sends the event: it is the responsibility of the receiving process to actually read the event and then interpret it. Reading is typically done by calling <code>process-wait-for-event</code>. Interpreting the event is up the caller of <code>process-wait-for-event</code>. In the "standard" situation, for</p> |                                                                        |

example in a process started by CAPI, the object will be processed as an event by calling `general-handle-event`.

`process-send` actually uses the `process-mailbox` of *process*, creating a `mailbox` for *process* if it does not already have one. In principle *object* can be read by another process, by calling `mailbox-read` (or `process-wait-for-event`) on the mailbox.

If `change-priority`, which has a default value of `:default`, is non-nil, it controls how the priority of that process is calculated as follows:

- `fixnum` — use the value of `change-priority` as the new priority.
- `t` — set the priority to the interactive priority.
- `:default` — set the priority to the normal running priority.

`error-if-dead-p` defaults to `nil`, which means that if `process-send` is called with a dead process, it just returns false. If `error-if-dead-p` is non-nil, when `process-send` is called on a dead process it signals a continuable error.

`limit` defaults to `nil`. If it is non-nil, it must be a positive integer that specifies the maximum size to which `process-send` may expand the mailbox of the process. When `limit` is non-nil, `process-send` adds the object to the mailbox as if by

```
(mailbox-send-limited mailbox object limit timeout)
```

See `mailbox-send-limited` for details.

`timeout` defaults to `nil` and is used when `limit` is non-nil as described above, otherwise it is ignored.

`process-send` returns true if it put the object in the mailbox of the process and false otherwise. The latter can happen either because the process is dead, or because the process's mailbox is full and reached the size specified by `limit` and `timeout` is non-nil.

See also `general-handle-event`  
`mailbox-send`  
`mailbox-send-limited`  
`process-wait-for-event`  
“Communication between processes and synchronization”  
on page 283

|                                  | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                  |                 |                              |                                                                                           |                             |                                                        |
|----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|-----------------|------------------------------|-------------------------------------------------------------------------------------------|-----------------------------|--------------------------------------------------------|
| <b>process-sharing-lock</b>      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                  |                 |                              |                                                                                           |                             |                                                        |
| Summary                          | Like <code>process-lock</code> , but on a "sharing" lock.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                  |                 |                              |                                                                                           |                             |                                                        |
| Package                          | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                  |                 |                              |                                                                                           |                             |                                                        |
| Signature                        | <code>process-sharing-lock <i>sharing-lock</i> &amp;optional <i>whostate timeout</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                  |                 |                              |                                                                                           |                             |                                                        |
| Arguments                        | <table><tr><td><code><i>sharing-lock</i></code></td><td>A sharing lock.</td></tr><tr><td><code><i>whostate</i></code></td><td>The status of the process while <i>lock</i> is locked,<br/>as seen in the Process Browser.</td></tr><tr><td><code><i>timeout</i></code></td><td>A non-negative <code>real</code> or <code>nil</code>.</td></tr></table>                                                                                                                                                                                                                                                                  | <code><i>sharing-lock</i></code> | A sharing lock. | <code><i>whostate</i></code> | The status of the process while <i>lock</i> is locked,<br>as seen in the Process Browser. | <code><i>timeout</i></code> | A non-negative <code>real</code> or <code>nil</code> . |
| <code><i>sharing-lock</i></code> | A sharing lock.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                  |                 |                              |                                                                                           |                             |                                                        |
| <code><i>whostate</i></code>     | The status of the process while <i>lock</i> is locked,<br>as seen in the Process Browser.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                  |                 |                              |                                                                                           |                             |                                                        |
| <code><i>timeout</i></code>      | A non-negative <code>real</code> or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                  |                 |                              |                                                                                           |                             |                                                        |
| Description                      | <p>This is like <code>process-lock</code>, but <i>sharing-lock</i> must be a "sharing" lock and it will be locked in shared mode. That means that other threads can also lock it in shared mode.</p> <p>Before locking, <code>process-sharing-lock</code> waits for <i>sharing-lock</i> to be free of any exclusive lock, but it does not check for other shared mode use of the same lock.</p> <p>Calls to <code>process-sharing-lock</code> should be matched by calls to <code>process-sharing-unlock</code> with <i>sharing-lock</i>. Normally <code>with-sharing-lock</code> is the best way to achieve this.</p> |                                  |                 |                              |                                                                                           |                             |                                                        |
| Notes                            | <p>It is possible to lock for sharing inside the scope of a sharing lock and inside the scope of an exclusive lock.</p> <p><code>process-sharing-lock</code> is guaranteed to return if it locked <i>sharing-lock</i>, but may throw before locking, as described in</p>                                                                                                                                                                                                                                                                                                                                               |                                  |                 |                              |                                                                                           |                             |                                                        |

“Guarantees and limitations when locking and unlocking”  
on page 278.

See also      `process-lock`  
                 `process-sharing-unlock`  
                 `with-sharing-lock`  
                 “Locks” on page 277

## process-sharing-unlock *Function*

|             |                                                                                                                                                                                                                                                                                                                                                           |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Removes a sharing lock.                                                                                                                                                                                                                                                                                                                                   |
| Package     | <code>mp</code>                                                                                                                                                                                                                                                                                                                                           |
| Signature   | <code>process-sharing-unlock sharing-lock</code>                                                                                                                                                                                                                                                                                                          |
| Arguments   | <code>sharing-lock</code> A sharing lock.                                                                                                                                                                                                                                                                                                                 |
| Description | <p>The function <code>process-sharing-unlock</code> is the same as <code>process-unlock</code> but for a “sharing” lock.</p> <p>Calls to <code>process-sharing-unlock</code> should be matched by calls to <code>process-sharing-lock</code> with <code>sharing-lock</code>. Normally <code>with-sharing-lock</code> is the best way to achieve this.</p> |
| Notes       | <code>process-sharing-unlock</code> is guaranteed to successfully unlock <code>sharing-lock</code> , but is not guaranteed to return, as described in “Guarantees and limitations when locking and unlocking” on page 278.                                                                                                                                |
| See also    | <code>process-unlock</code><br><code>with-sharing-lock</code><br>“Locks” on page 277                                                                                                                                                                                                                                                                      |

| <b>process-stop</b> | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary             | Stops a process.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Package             | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Signature           | <code>process-stop process</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Arguments           | <code>process</code> A <code>mp:process</code> object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Description         | <p>The function <code>process-stop</code> stops the process <i>process</i>. <i>process</i> must be a full process (that is, not one created by <code>*current-process*</code>).</p> <p><code>process-stop</code> causes <i>process</i> to stop until some other process explicitly wakes it up. If it is called on the current process, the current process stops during the call, and returns from <code>process-stop</code> after the process gets woken up.</p> <p>In SMP LispWorks, if <i>process</i> is not the current process, <code>process-stop</code> returns immediately and the execution of <i>process</i> stops at some point, possibly after <code>process-stop</code> returned. In non-SMP LispWorks if <i>process</i> is not the current process, <i>process</i> stops before <code>process-stop</code> returns.</p> <p>You can wake up a stopped process (that is, make it runnable) by calling <code>process-terminate</code>, <code>process-unstop</code> or <code>process-continue</code>.</p> <p><code>process-interrupt</code> does not wake up a stopped process.</p> <p>There is a discussion of a typical use of <code>process-stop</code> in the section “Stopping and unstopping processes” on page 296.</p> <p><code>process-stop</code> does not return any useful value.</p> |
| See also            | <code>process-arrest-reasons</code><br><code>process-stopped-p</code><br><code>process-unstop</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

| <b>process-stopped-p</b> | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary                  | The predicate for stopped processes.                                                                                                                                                                                                                                                                                                                                                                                        |
| Package                  | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                             |
| Signature                | <code>process-stopped-p process =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                         |
| Arguments                | <code>process</code> A <code>mp:process</code> object.                                                                                                                                                                                                                                                                                                                                                                      |
| Values                   | <code>result</code> A boolean.                                                                                                                                                                                                                                                                                                                                                                                              |
| Description              | The function <code>process-stopped-p</code> queries whether the process <code>process</code> is stopped or not.<br><br>If <code>process</code> stopped because it called <code>process-stop</code> on itself, then <code>process-stopped-p</code> <code>result</code> is <code>t</code> only if <code>process-stop</code> really stopped it (that is, a later call to <code>process-unstop</code> will unstop the process). |
| See also                 | <code>process-stop</code><br><code>process-unstop</code>                                                                                                                                                                                                                                                                                                                                                                    |

| <b>process-terminate</b> | <i>Function</i>                                                                                                                                                                                                                         |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary                  | Kills a process "nicely".                                                                                                                                                                                                               |
| Package                  | <code>mp</code>                                                                                                                                                                                                                         |
| Signature                | <code>process-terminate process &amp;key join-timeout force-timeout</code>                                                                                                                                                              |
| Arguments                | <code>process</code> A <code>mp:process</code> object.<br><br><code>join-timeout</code> A non-negative <code>real</code> or <code>nil</code> .<br><br><code>force-timeout</code> A non-negative <code>real</code> or <code>nil</code> . |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The function <code>process-terminate</code> terminates the process <code>process</code>, which means killing it "nicely". <code>process-terminate</code> invokes the Terminate Method of <code>process</code>, if it has one, otherwise it calls <code>process-kill</code>.</p> <p>The terminate is set either by supplying one of <i>local-terminator</i>, <i>remote-terminator</i> or <i>terminate-by-send</i> in the call to <code>process-run-function</code>, or by a call to <code>current-process-set-terminate-method</code> on the process. See the entry for <code>process-run-function</code> for details.</p> <p>If the process does not have a Terminate Method, <code>process-terminate</code> calls <code>process-kill</code>.</p> <p>If <i>force-timeout</i> is non-nil then <code>process-terminate</code> sets a timer that kills the process after <i>force-timeout</i> seconds.</p> <p>If <i>join-timeout</i> is non-nil then it is the time in seconds to "join" the process, that is waiting for it to die. When <i>join-timeout</i> is non-nil, after invoking the Terminate Method or calling <code>process-kill</code>, <code>process-terminate</code> calls <code>process-join</code> using <i>join-timeout</i> as the timeout, and returns the result.</p> <p><code>process-terminate</code> returns the result of <code>process-join</code> if <i>join-timeout</i> is non-nil, otherwise it returns 0.</p> |
| Notes       | <ol style="list-style-type: none"> <li>1. <code>process-terminate</code> is the appropriate way to kill processes, because it gives the process the option to decide when to exit. <code>process-kill</code> kills the process whenever it is not blocking interrupts, which may still be sensitive in some sense.</li> <li>2. When multiprocessing stops (for example when quitting, or saving a session), the system uses first <code>process-terminate</code> and then <code>process-kill</code>, so processes that exit with <code>process-terminate</code> have the chance to clean up as needed.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

3. `process-terminate` is better than `process-kill` only when the process has a Terminate Method. When the process does not have a Terminate Method, `process-terminate` can cause the other to exit in the middle of some sensitive piece of code.

## See also

`process-run-function`  
`current-process-set-terminate-method`  
`current-process-kill`

**process-unlock***Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                              |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Unlocks a <code>lock</code> held by the current process.                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                              |
| Package     | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                              |
| Signature   | <code>process-unlock lock &amp;optional errorp =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                              |
| Arguments   | <code>lock</code>                                                                                                                                                                                                                                                                                                                                                                                                    | The <code>lock</code> .                                                                                                                                      |
|             | <code>errorp</code>                                                                                                                                                                                                                                                                                                                                                                                                  | When this is <code>t</code> , an error is signaled if <code>*current-process*</code> is not the owner of <code>lock</code> . The default is <code>t</code> . |
| Values      | <code>result</code>                                                                                                                                                                                                                                                                                                                                                                                                  | A boolean.                                                                                                                                                   |
| Description | <p>Attempts to unlock <code>lock</code>. If <code>lock</code> is owned by <code>*current-process*</code>, then <code>process-unlock</code> decrements an internal count. If this count is then zero, <code>lock</code> is unlocked. Note that <code>process-unlock</code> relates only on Lisp processes.</p> <p><code>result</code> is <code>t</code> if the lock was released, and <code>nil</code> otherwise.</p> |                                                                                                                                                              |
| Notes       | <p><code>process-sharing-unlock</code> is guaranteed to successfully unlock <code>lock</code>, but is not guaranteed to return, as described in “Guarantees and limitations when locking and unlocking” on page 278.</p>                                                                                                                                                                                             |                                                                                                                                                              |

See also      **lock**  
                **make-lock**  
                **process-exclusive-unlock**  
                **process-lock**  
                **with-lock**  
                “Locks” on page 277

## process-unstop *Function*

Summary      Unstops a process.

Package      **mp**

Signature     **process-unstop** *process* => *result*

Arguments    *process*      A **mp:process** object.

Values        *result*      A boolean.

Description    The function **process-unstop** unstops the process *process* if it is stopped.  
  
*process* must be a full process (that is, not one created by **\*current-process\***).  
  
If *process* was stopped (by **process-stop**), it is unstopped and resumes execution.  
  
*result* is **t** if *process* was stopped, and **nil** otherwise.  
  
There is a discussion of a typical use of **process-unstop** in the section “Stopping and unstopping processes” on page 296.

See also      **process-stop**  
                **process-stopped-p**

|                     | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>process-wait</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Summary             | Suspends the current process until a condition is true.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Package             | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Signature           | <code>process-wait <i>wait-reason</i> <i>wait-function</i> &amp;rest <i>wait-arguments</i> =&gt;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Arguments           | <p><i>wait-reason</i> A string describing the reason that the process is waiting.</p> <p><i>wait-function</i> A function designator.</p> <p><i>wait-arguments</i> The arguments that <i>wait-function</i> is applied to.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Values              | None.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Description         | <p>The function <code>process-wait</code> suspends the current Lisp process until the predicate <i>wait-function</i> applied to <i>wait-arguments</i> returns true. This is tested periodically by the scheduler, but in situations where you want more control over the timing you should consider using <code>process-wait-local</code> instead of <code>process-wait</code> and then call <code>process-poke</code> in the process that is expected to make the <i>wait-function</i> return true.</p> <p><i>wait-function</i> has several limitations: it must not do a non-local exit, it should not have side effects and (since it is called frequently) it should be efficient.</p> <p>Also, <i>wait-function</i> is called with interrupts blocked. It should therefore not allow interrupts, because this could cause deadlocks.</p> <p><i>wait-reason</i> allows you to find out why a process is waiting via the function <code>process-whostate</code>.</p> |
| See also            | <code>process-poke</code><br><code>process-wait-local</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

**process-wait-with-timeout**  
**process-whostate**  
“Process Waiting and communication between processes” on  
page 280

## **process-wait-for-event** *Function*

|             |                                                                                                                                                                                                                                                                                                    |                                |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| Summary     | Waits for an event in a "windowing friendly" way.                                                                                                                                                                                                                                                  |                                |
| Package     | <code>mp</code>                                                                                                                                                                                                                                                                                    |                                |
| Signature   | <code>process-wait-for-event &amp;key wait-reason wait-function</code><br><code>process-other-messages-p no-hang-p stop-at-user-operation-p =&gt; event</code>                                                                                                                                     |                                |
| Arguments   | <i>wait-reason</i>                                                                                                                                                                                                                                                                                 | A string or <code>nil</code> . |
|             | <i>wait-function</i>                                                                                                                                                                                                                                                                               | A function designator.         |
|             | <i>process-other-messages-p</i>                                                                                                                                                                                                                                                                    |                                |
|             |                                                                                                                                                                                                                                                                                                    | A generalized boolean.         |
|             | <i>no-hang-p</i>                                                                                                                                                                                                                                                                                   | A generalized boolean.         |
|             | <i>stop-at-user-operation-p</i>                                                                                                                                                                                                                                                                    |                                |
|             |                                                                                                                                                                                                                                                                                                    | A generalized boolean.         |
| Values      | <i>result</i>                                                                                                                                                                                                                                                                                      | An event or <code>nil</code> . |
| Description | The function <code>process-wait-for-event</code> calls <code>mailbox-wait-for-event</code> on the mailbox of the current process, after ensuring that the current process has a <code>mailbox</code> .<br><br>The arguments and value are interpreted as for <code>mailbox-wait-for-event</code> . |                                |
| See also    | <code>mailbox-wait-for-event</code>                                                                                                                                                                                                                                                                |                                |

## process-wait-function Function

|             |                                                                                                                                                                                                                                                                                                                                                                                               |                        |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Summary     | Returns a function that determines whether a process should continue to wait.                                                                                                                                                                                                                                                                                                                 |                        |
| Package     | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                               |                        |
| Signature   | <code>process-wait-function process =&gt; wait-function</code>                                                                                                                                                                                                                                                                                                                                |                        |
| Arguments   | <i>process</i>                                                                                                                                                                                                                                                                                                                                                                                | A process.             |
| Values      | <i>wait-function</i>                                                                                                                                                                                                                                                                                                                                                                          | A function designator. |
| Description | <p>The function <code>process-wait-function</code> returns the function that determines whether the Lisp process waits. The system periodically calls <i>wait-function</i> to decide whether to wake the process up.</p> <p><i>wait-function</i> is applied to <i>wait-arguments</i>, where both <i>wait-function</i> and <i>wait-arguments</i> were passed to <code>process-wait</code>.</p> |                        |
| See also    | <code>process-wait</code>                                                                                                                                                                                                                                                                                                                                                                     |                        |

## process-wait-local Function

|           |                                                                                                 |                               |
|-----------|-------------------------------------------------------------------------------------------------|-------------------------------|
| Summary   | Has the same semantics as <code>process-wait</code> , but does not interact with the scheduler. |                               |
| Package   | <code>mp</code>                                                                                 |                               |
| Signature | <code>process-wait-local wait-reason function &amp;rest args =&gt; t</code>                     |                               |
| Arguments | <i>wait-reason</i>                                                                              | A string.                     |
|           | <i>function</i>                                                                                 | A function designator.        |
|           | <i>args</i>                                                                                     | Arguments passed to function. |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The function <code>process-wait-local</code> suspends the current Lisp process until the predicate <i>function</i> applied to <i>args</i> returns true.</p> <p><code>process-wait-local</code> has same semantics as <code>process-wait</code>, but is "local", which here means that it does not interact with the scheduler. The scheduler does not call the wait function and hence never wakes the waiting process</p> <p>The wait function <i>function</i> is called only by the calling process, before going to sleep, and whenever it is "poked". A process is typically "poked" by calling <code>process-poke</code>, but all the other process managing functions (<code>process-unstop</code>, <code>process-interrupt</code>, <code>process-terminate</code>) also "poke" the process. Returning from any of the generic Process Waiting functions (see "Generic Process Wait functions" on page 281) or <code>c1:sleep</code> also implicitly pokes the process. A process may be also poked internally.</p> <p>Because the wait function is checked only when the process is poked, it is the responsibility of the application to poke the process when it should check the wait function. This is the disadvantage of <code>process-wait-local</code> and <code>process-wait-local-with-timeout</code>.</p> <p><b>Note:</b> See <code>process-wait-local-with-periodic-checks</code> and <code>process-wait-local-with-timeout-and-periodic-checks</code> for functions that periodically check the wait functions.</p> <p>One advantage of using the "local" waiters is that the wait function is called only by the waiting process. This means that the wait function does not have any of the restrictions that the wait function of <code>process-wait</code> has. In particular:</p> <ol style="list-style-type: none"> <li>1. It does not matter if the wait function is not very fast.<br/>Note however, that it may be called several times, and not always in a predictable way, so it is better not to make it too slow or allocate much. You also cannot rely on any</li> </ol> |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

side effect that is cumulative inside the wait function, except in the call that returns true (because this happens at most once).

2. If there is an unhandled error in the wait function it enters the debugger like normal Lisp code, so it is easier to debug.
3. The wait function is in the dynamic scope of the calling process, and so it sees all the dynamic bindings and can throw to all the catchers. That also means that all the handlers and restarts of the calling process are applicable in the wait function.
4. The wait function can itself call Process Waiting functions or `c1:sleep`, with a small caveat: since these functions may implicitly "poke" the process, if the wait function calls any of them and then returns false, it may be immediately called again (if it returns true then `process-wait-local` itself returns). Normally this is not a problem, because it is still waiting, but it does mean that the wait function is called more times than expected.
5. The wait function, because it can call Process Waiting functions, can use locks without causing errors. Note, however, that if the lock is held, it will cause an internal call to a Process Waiting function, which will "poke" the process and hence cause another call of the wait function (unless it returns true).
6. The wait function is visible in the output of the profiler.

Another advantage of the "local" functions is that they do not interact with the scheduler and so they reduce the overhead of the scheduler.

`process-wait-local` always returns `t`.

See also

`process-poke`  
`process-wait-local-with-periodic-checks`  
`process-wait-local-with-timeout`

“Process Waiting and communication between processes” on page 280

|                    | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                    |           |               |                         |                 |                        |             |                                       |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-----------|---------------|-------------------------|-----------------|------------------------|-------------|---------------------------------------|
| Summary            | Like <code>process-wait-local</code> , but also calls the wait function periodically.                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                    |           |               |                         |                 |                        |             |                                       |
| Package            | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                    |           |               |                         |                 |                        |             |                                       |
| Signature          | <code>process-wait-local-with-periodic-checks wait-reason period function &amp;rest args</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                    |           |               |                         |                 |                        |             |                                       |
| Arguments          | <table><tr><td><i>wait-reason</i></td><td>A string.</td></tr><tr><td><i>period</i></td><td>A positive real number.</td></tr><tr><td><i>function</i></td><td>A function designator.</td></tr><tr><td><i>args</i></td><td>Arguments passed to <i>function</i>.</td></tr></table>                                                                                                                                                                                                                                                                      | <i>wait-reason</i> | A string. | <i>period</i> | A positive real number. | <i>function</i> | A function designator. | <i>args</i> | Arguments passed to <i>function</i> . |
| <i>wait-reason</i> | A string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                    |           |               |                         |                 |                        |             |                                       |
| <i>period</i>      | A positive real number.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                    |           |               |                         |                 |                        |             |                                       |
| <i>function</i>    | A function designator.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                    |           |               |                         |                 |                        |             |                                       |
| <i>args</i>        | Arguments passed to <i>function</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                    |           |               |                         |                 |                        |             |                                       |
| Description        | <p>The function <code>process-wait-local-with-periodic-checks</code> is like <code>process-wait-local</code>, but also calls the wait function periodically.</p> <p>The <i>period</i> is in seconds.</p> <p>After each call to the function <i>wait-function</i>, the process sleeps at most <i>period</i> seconds, and then checks the wait function. If the process is poked while sleeping, it wakes up, checks the wait function, and then (if the wait function returns <code>nil</code>), sleeps again for at most <i>period</i> seconds.</p> |                    |           |               |                         |                 |                        |             |                                       |
| Notes              | The resolution of the period is dependent on the underlying operating system. Many systems give time-slices of few milliseconds, so the actual period may be out by a few milliseconds. In general, periods of 0.1 seconds or more are reasonably reliable, though not exact. Shorter periods become less and less reliable.                                                                                                                                                                                                                        |                    |           |               |                         |                 |                        |             |                                       |

If the period is short, the wait function is called frequently, and hence there is more overhead for the system. With a reasonable wait function and a period of 0.1 or more, this overhead is probably insignificant. If you use shorter periods, or an expensive wait function, you may want to check what the overhead is. The easiest way to check is to make sure your system is such that the wait function returns `nil`, then run

```
(ignore-errors ; just in case
  (sys:with-other-threads-disabled
    (time (mp:process-wait-local-with-timeout-and-
periodic-checks
      "Timing" 5 period function args))))
```

When this form returns, compare the user and system times (which is what it actually used) to the elapsed time (which should be approximately 5 seconds). That will tell you what fraction of a "CPU" is used by the call. If the user and system time are less than 0.01 seconds, you may want to increase the time to get a more accurate number.

Warning: inside the scope of `with-other-threads-disabled`, the rest of the threads are disabled. So if your wait function ends up waiting for something that has to happen on another thread, your system will be deadlocked.

#### See also

`process-poke`  
`process-wait-local`  
`process-wait-local-with-timeout-and-periodic-
checks`  
“Process Waiting and communication between processes” on  
page 280

## **process-wait-local-with-timeout**

## *Function*

#### Summary

Has the same semantics as `process-wait-with-timeout`, but does not interact with the scheduler.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                        |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|
| Package     | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                        |
| Signature   | <code>process-wait-local-with-timeout <i>wait-reason</i> <i>timeout</i> <i>function</i></code><br><code>&amp;rest <i>args</i> =&gt; <i>result</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                        |
| Arguments   | <i>wait-reason</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | A string.                                              |
|             | <i>timeout</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | A non-negative <code>real</code> or <code>nil</code> . |
|             | <i>function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | A function designator.                                 |
|             | <i>args</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Arguments passed to function.                          |
| Values      | <i>result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | A boolean.                                             |
| Description | <p>The function <code>process-wait-local-with-timeout</code> has same semantics as <code>process-wait-with-timeout</code>, but is "local", which here means that it does not interact with the scheduler. The scheduler does not call the wait function and hence never wakes the waiting process.</p> <p>The <i>timeout</i> is in seconds.</p> <p>The circumstances in which the function <i>wait-function</i> is called, and the restrictions on it, are as documented for <code>process-wait-local</code> except that the wait function can additionally be called when it times out.</p> <p><code>process-wait-local-with-timeout</code> returns <code>t</code> if a call to the wait function returns true. It returns <code>nil</code> if it times out.</p> |                                                        |
| See also    | <code>process-poke</code><br><code>process-wait-local</code><br>“Process Waiting and communication between processes” on page 280                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                        |

## `process-wait-local-with-timeout-and-periodic-checks` *Function*

|         |                                                                                                    |
|---------|----------------------------------------------------------------------------------------------------|
| Summary | Like <code>process-wait-local-with-timeout</code> , but also calls the wait function periodically. |
|---------|----------------------------------------------------------------------------------------------------|

|             |                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                |
| Signature   | <code>process-wait-local-with-timeout-and-periodic-checks<br/>wait-reason timeout period function &amp;rest args</code>                                                                                                                                                                                                                                                                        |
| Arguments   | <p><code>wait-reason</code> A string.</p> <p><code>timeout</code> A non-negative <code>real</code> or <code>nil</code>.</p> <p><code>period</code> A positive real number.</p> <p><code>function</code> A function designator.</p> <p><code>args</code> Arguments passed to <code>function</code>.</p>                                                                                         |
| Description | <p>The function <code>process-wait-local-with-timeout-and-periodic-checks</code> is like <code>process-wait-local-with-timeout</code>, but also calls the <code>wait</code> function periodically.</p> <p>The <code>timeout</code> and <code>period</code> are both in seconds.</p> <p>For information about the periodic calls, see <code>process-wait-local-with-periodic-checks</code>.</p> |
| See also    | <p><code>process-poke</code></p> <p><code>process-wait-local-with-periodic-checks</code></p> <p><code>process-wait-local-with-timeout</code></p> <p>“Process Waiting and communication between processes” on page 280</p>                                                                                                                                                                      |

|           | <i>Function</i>                                                                                                                |
|-----------|--------------------------------------------------------------------------------------------------------------------------------|
| Summary   | Suspend the current process until certain conditions are true, or until a timeout expires.                                     |
| Package   | <code>mp</code>                                                                                                                |
| Signature | <code>process-wait-with-timeout wait-reason timeout &amp;optional<br/>wait-function &amp;rest wait-arguments =&gt; bool</code> |

|             |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arguments   | <i>wait-reason</i>    | A string describing the reason that the process is waiting.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|             | <i>timeout</i>        | A non-negative <code>real</code> or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|             | <i>wait-function</i>  | A function to test.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|             | <i>wait-arguments</i> | The arguments to apply to <i>wait-function</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Values      | <i>bool</i>           | A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Description |                       | <p>This function uses <code>process-wait</code> to suspend the current Lisp process until the predicate <i>wait-function</i> applied to <i>wait-arguments</i> returns true, or until <i>timeout</i> seconds have passed.</p> <p><i>wait-function</i> is called periodically by the scheduler, but in situations where you want more control over the timing you should consider using <code>process-wait-local</code> instead of <code>process-wait</code> and then call <code>process-poke</code> in the process that is expected to make the <i>wait-function</i> return true.</p> <p><i>wait-function</i> is called with interrupts blocked. It should therefore not allow interrupts, because this could cause deadlocks.</p> <p><i>bool</i> is <code>nil</code> if the timeout occurred before <i>wait-function</i> returned true. <i>bool</i> is true otherwise.</p> |
| See also    |                       | <p><code>process-join</code><br/> <code>process-poke</code><br/> <code>process-wait</code><br/> <code>process-wait-local-with-timeout</code><br/> <code>process-wait-local-with-timeout-and-periodic-checks</code><br/> “Process Waiting and communication between processes” on page 280</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

| <b>process-whostate</b> | <i>Function</i>                                                                                                                                                                      |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary                 | Returns the state of a process.                                                                                                                                                      |
| Package                 | <code>mp</code>                                                                                                                                                                      |
| Signature               | <code>process-whostate process =&gt; reason</code>                                                                                                                                   |
| Arguments               | <code>process</code> A process.                                                                                                                                                      |
| Values                  | <code>reason</code> A string.                                                                                                                                                        |
| Description             | The function <code>process-whostate</code> returns a string describing the state of the process.<br><br>Depending on the state of <i>process</i> , <i>reason</i> can be:             |
|                         | <ul style="list-style-type: none"> <li>• "Dead"</li> <li>• "Stopped"</li> <li>• "Sleeping"</li> <li>• "Running"</li> <li>• "Running (preempted)"</li> </ul>                          |
|                         | <i>reason</i> can also be the <i>wait-reason</i> of the process, as passed to <code>wait-processing-events</code> , <code>process-wait</code> , <code>mailbox-read</code> and so on. |
|                         | <i>reason</i> can also be a string containing the <i>run-reasons</i> , as set by <code>(setf process-run-reasons)</code> .                                                           |
| See also                | <code>wait-processing-events</code><br><code>process-wait</code><br><code>process-run-reasons</code>                                                                                 |

| <b>processes-count</b> | <i>Function</i>                                                |
|------------------------|----------------------------------------------------------------|
| Summary                | Returns the number of Lisp processes that are currently alive. |

|             |                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------|------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>mp</code>                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Signature   | <code>processes-count =&gt; count</code> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Values      | <code>count</code>                       | A non-negative integer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Description |                                          | The function <code>processes-count</code> returns the number of Lisp processes that are currently alive.<br><br>The <code>count</code> includes all processes that are alive, that is started executing and did not die. It does not include any thread that was started by foreign code, unless it calls into Lisp, in which case Lisp automatically generates a matching Lisp process which is included in the count.<br><br>In general processes can start and die so the real count may change by the time the function has returned. The only guarantee is that the count was accurate at some point between the time <code>processes-count</code> was called and the time it returns. |
| See also    |                                          | <code>list-all-processes</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

| <b>pushnew-to-process-private-property</b> |                        | <i>Function</i>                                                                             |
|--------------------------------------------|------------------------|---------------------------------------------------------------------------------------------|
| Summary                                    |                        | Pushes a new value to a private property of the current process.                            |
| Package                                    | <code>mp</code>        |                                                                                             |
| Signature                                  |                        | <code>pushnew-to-process-private-property indicator value &amp;key test =&gt; result</code> |
| Arguments                                  | <code>indicator</code> | A Lisp object.                                                                              |
|                                            | <code>value</code>     | A Lisp object.                                                                              |
|                                            | <code>test</code>      | A function designator for a function of two arguments.                                      |

|             |                                                                                                                                                                                                                                                         |         |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| Values      | <i>result</i>                                                                                                                                                                                                                                           | A list. |
| Description | The function <code>pushnew-to-process-private-property</code> pushes <i>value</i> to the value of the private property associated with <i>indicator</i> for the current process.<br><br>It behaves just like <code>pushnew-to-process-property</code> . |         |
| See also    | <code>process-private-property</code><br><code>pushnew-to-process-property</code><br><code>remove-process-private-property</code><br><code>get-process-private-property</code>                                                                          |         |

## **pushnew-to-process-property** *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                  |                                                        |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|
| Summary     | Pushes a new value to a general property of a process.                                                                                                                                                                                                                                                                                                           |                                                        |
| Package     | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                  |                                                        |
| Signature   | <code>pushnew-to-process-property <i>indicator</i> <i>value</i> &amp;key <i>process</i> <i>test</i><br/>=&gt; <i>result</i></code>                                                                                                                                                                                                                               |                                                        |
| Arguments   | <i>indicator</i>                                                                                                                                                                                                                                                                                                                                                 | A Lisp object.                                         |
|             | <i>value</i>                                                                                                                                                                                                                                                                                                                                                     | A Lisp object.                                         |
|             | <i>process</i>                                                                                                                                                                                                                                                                                                                                                   | A process, or <code>nil</code> .                       |
|             | <i>test</i>                                                                                                                                                                                                                                                                                                                                                      | A function designator for a function of two arguments. |
| Values      | <i>result</i>                                                                                                                                                                                                                                                                                                                                                    | A list.                                                |
| Description | The function <code>pushnew-to-process-property</code> pushes <i>value</i> to the value of the property associated with <i>indicator</i> for the process <i>process</i> . It uses the function <i>test</i> to compare existing property values of <i>process</i> with <i>value</i> and does not push if one matches, in the same way as <code>cl:pushnew</code> . |                                                        |

The default value of *test* is `#'eql`.

If there is a property associated with *indicator*, the value of the property must be a list.

If *process* is not supplied or is `nil`, the current process (that is, the result of calling `get-current-process`) is used.

*result* is the new value of the process property.

The modification is done in a thread-safe way.

|          |                                                                                                                                                                                                                                                                                  |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | In the typical case when only the current process sets the property (even if other processes read it), private properties can be used, and are much faster in SMP LispWorks, because they do not need to deal with parallel setting. See <code>process-private-property</code> . |
| See also | <code>process-property</code><br><code>process-private-property</code><br><code>remove-process-property</code>                                                                                                                                                                   |

## ps

## *Function*

|             |                                                                                                                                       |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Prints the processes in the system                                                                                                    |
| Package     | <code>mp</code>                                                                                                                       |
| Signature   | <code>ps =&gt;</code>                                                                                                                 |
| Arguments   | None.                                                                                                                                 |
| Values      | None.                                                                                                                                 |
| Description | Prints a list of the processes in the system, ordered by priority. (This function is analogous to the UNIX command <code>ps</code> .) |

| <b>remove-from-process-private-property</b> |                                                                                                                                                                                                                                                              | <i>Function</i> |
|---------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Summary                                     | Removes a value from a private property of the current process.                                                                                                                                                                                              |                 |
| Package                                     | <code>mp</code>                                                                                                                                                                                                                                              |                 |
| Signature                                   | <code>remove-from-process-private-property <i>indicator value</i> &amp;key<br/><i>test</i> =&gt; <i>result</i></code>                                                                                                                                        |                 |
| Arguments                                   | <i>indicator</i><br>A Lisp object.<br><br><i>value</i><br>A Lisp object.                                                                                                                                                                                     |                 |
| Values                                      | <i>result</i><br>A list.                                                                                                                                                                                                                                     |                 |
| Description                                 | The function <code>remove-from-process-private-property</code> removes <i>value</i> from the value of the private property associated with <i>indicator</i> for the current process.<br><br>It behaves just like <code>remove-from-process-property</code> . |                 |
| See also                                    | <code>process-private-property</code><br><code>remove-from-process-property</code><br><code>remove-process-private-property</code><br><code>get-process-private-property</code>                                                                              |                 |

| <b>remove-from-process-property</b> |                                                                                                                              | <i>Function</i> |
|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Summary                             | Removes a value from a general property of a process.                                                                        |                 |
| Package                             | <code>mp</code>                                                                                                              |                 |
| Signature                           | <code>remove-from-process-property <i>indicator value</i> &amp;key <i>process</i><br/><i>test</i> =&gt; <i>result</i></code> |                 |
| Arguments                           | <i>indicator</i><br>A Lisp object.<br><br><i>value</i><br>A Lisp object.                                                     |                 |

|             |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <i>process</i> | A process, or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|             | <i>test</i>    | A function designator for a function of two arguments.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Values      | <i>result</i>  | A list.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Description |                | <p>The function <code>remove-from-process-property</code> removes <i>value</i> from the value of the property associated with <i>indicator</i> for the process <i>process</i>. It uses the function <i>test</i> to compare <i>value</i> with existing values, in the same way as <code>cl:remove</code>.</p> <p>The default value of <i>test</i> is <code>#'eql</code>.</p> <p>If there is a property associated with <i>indicator</i>, the value of the property must be a list.</p> <p>If <i>process</i> is not supplied or is <code>nil</code>, the current process (that is, the result of calling <code>get-current-process</code>) is used.</p> <p><i>result</i> is the new value of the process property.</p> <p>The modification is done in a thread-safe way.</p> |
| Notes       |                | In the typical case when only the current process sets the property (even if other processes read it), private properties can be used, and are much faster in SMP LispWorks, because they do not need to deal with parallel setting. See <code>process-private-property</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| See also    |                | <p><code>process-property</code></p> <p><code>process-private-property</code></p> <p><code>remove-process-property</code></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

|         | <b>remove-process-private-property</b>                                 | <i>Function</i> |
|---------|------------------------------------------------------------------------|-----------------|
| Summary | Removes a property from the private properties of the current process. |                 |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Signature   | <code>remove-process-private-property indicator =&gt; removedp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Arguments   | <i>indicator</i> A Lisp object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Values      | <i>removedp</i> A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Description | <p>The function <code>remove-process-private-property</code> removes the property associated with <i>indicator</i> from the private properties of the current process.</p> <p>Note that removing a property is different from setting its value to <code>nil</code>, because when <code>process-private-property</code> is called with a <i>default</i> for a property that was removed, it returns the <i>default</i>, but for a property that was set to <code>nil</code> it returns <code>nil</code>.</p> |
| See also    | <code>process-private-property</code><br><code>pushnew-to-process-private-property</code><br><code>remove-from-process-private-property</code><br><code>get-process-private-property</code>                                                                                                                                                                                                                                                                                                                  |

|           | <i>Function</i>                                                                     |
|-----------|-------------------------------------------------------------------------------------|
| Summary   | Removes a general property from a process.                                          |
| Package   | <code>mp</code>                                                                     |
| Signature | <code>remove-process-property indicator &amp;optional process =&gt; removedp</code> |
| Arguments | <i>indicator</i> A Lisp object.<br><i>process</i> A process.                        |
| Values    | <i>removedp</i> A generalized boolean.                                              |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The function <code>remove-process-property</code> removes the general property associated with <i>indicator</i> from the process <i>process</i>.</p> <p>If <i>process</i> is not supplied or is <code>nil</code>, the current process (that is, the result of calling <code>get-current-process</code>) is used.</p> <p>Note that removing a property is different from setting its value to <code>nil</code>, because when <code>process-property</code> is called with a default for a property that was removed, it returns the default, but for a property that was set to <code>nil</code> it returns <code>nil</code>.</p> <p><i>removedp</i> is true if the property was removed.</p> |
| Notes       | In the typical case when only the current process sets the property (even if other processes read it), private properties can be used, and are much faster in SMP LispWorks, because they do not need to deal with parallel setting. See <code>process-private-property</code> .                                                                                                                                                                                                                                                                                                                                                                                                                |
| See also    | <code>pushnew-to-process-property</code><br><code>remove-from-process-property</code><br><code>process-property</code><br><code>process-private-property</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

|              | <i>Function</i>                                                                                                                                                                |              |          |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------|
| Summary      | Schedules a timer to expire at a given time after the start of the program.                                                                                                    |              |          |
| Package      | <code>mp</code>                                                                                                                                                                |              |          |
| Signature    | <code>schedule-timer timer absolute-expiration-time &amp;optional repeat-time =&gt; timer</code>                                                                               |              |          |
| Arguments    | <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;"><i>timer</i></td> <td style="width: 70%; text-align: right;">A timer.</td> </tr> </table> | <i>timer</i> | A timer. |
| <i>timer</i> | A timer.                                                                                                                                                                       |              |          |

|             |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------------|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <i>absolute-expiration-time</i> | A non-negative real number.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|             | <i>repeat-time</i>              | A non-negative real number.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Values      | <i>timer</i>                    | A timer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Description |                                 | <p>The function <code>schedule-timer</code> schedules a timer to expire at a given time after the start of the program. The <i>timer</i> argument is a timer, returned by <code>make-timer</code> or <code>make-named-timer</code>. The <i>absolute-expiration-time</i> argument is a non-negative real number of seconds since the start of the program at which the timer is to expire. If <i>repeat-time</i> is specified, it is a non-negative real number of seconds that specifies a repeat interval. Each time the timer expires, it is rescheduled to expire after this repeat interval.</p> <p>If the timer is already scheduled to expire at the time this function is called, it is rescheduled to expire at the time specified by the <i>absolute-expiration-time</i> argument. If that argument is <code>nil</code>, the timer is not rescheduled, but the repeat interval is set to the interval specified by the <i>repeat-time</i> argument.</p> <p>The function <code>schedule-timer-relative</code> schedules a timer to expire at a time relative to the call to that function.</p> |
| Example     |                                 | <p>The following example schedules a timer to expire 15 minutes after the start of the program and every 5 minutes thereafter.</p> <pre>(setq timer       (mp:make-timer 'print 10 *standard-output*))  #&lt;Time Event : PRINT&gt;  (mp:schedule-timer timer 900 300)  #&lt;Time Event : PRINT&gt;</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

See also `make-named-timer`  
`make-timer`  
`schedule-timer-milliseconds`  
`schedule-timer-relative`  
`schedule-timer-relative-milliseconds`  
`timer-expired-p`  
`timer-name`  
`unschedule-timer`  
“Timers” on page 293

## **schedule-timer-milliseconds** *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                             |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|
| Summary     | Schedules a timer to expire after a given amount of time.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                             |
| Package     | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                             |
| Signature   | <code>schedule-timer-milliseconds</code> <i>timer absolute-expiration-time</i><br><i>&amp;optional repeat-time =&gt; timer</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                             |
| Arguments   | <i>timer</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | A timer.                    |
|             | <i>absolute-expiration-time</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | A non-negative real number. |
|             | <i>repeat-time</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | A non-negative real number. |
| Values      | <i>timer</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | A timer.                    |
| Description | The function <code>schedule-timer-milliseconds</code> schedules a timer to expire at a given time after the start of the program. The <i>timer</i> argument is a timer returned by <code>make-timer</code> or <code>make-named-timer</code> . The <i>absolute-expiration-time</i> argument is a non-negative real number of milliseconds since the start of the program at which the timer is to expire. If <i>repeat-time</i> is specified, it is a non-negative real number of milliseconds that specifies a repeat interval. Each time the timer expires, it is rescheduled to expire after this repeat interval. |                             |

If the timer is already scheduled to expire at the time this function is called, it is rescheduled to expire at the time specified by the *absolute-expiration-time* argument. If that argument is `nil`, the timer is not rescheduled, but the repeat interval is set to the interval specified by the *repeat-time* argument.

The function `schedule-timer-relative-milliseconds` schedules a timer to expire at a time relative to the call to that function.

Notes `schedule-timer-milliseconds` has the same precision as `schedule-timer`, but may avoid some allocation when computing the time.

Example The following example schedules a timer to expire 15 minutes after the start of the program and every 5 minutes thereafter.

```
(setq timer
      (mp:make-timer 'print 10 *standard-output*))

#<Time Event : PRINT>

(mp:schedule-timer-milliseconds timer 900000 300000)

#<Time Event : PRINT>
```

See also `make-named-timer`  
`make-timer`  
`schedule-timer`  
`schedule-timer-relative`  
`schedule-timer-relative-milliseconds`  
`timer-expired-p`  
`timer-name`  
`unschedule-timer`

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <i>Function</i>                                                                                                                           |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Schedules a timer to expire at a given time after this function is called.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                           |
| Package     | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                           |
| Signature   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <code>schedule-timer-relative <i>timer</i> <i>relative-expiration-time</i><br/>&amp;optional <i>repeat-time</i> =&gt; <i>timer</i></code> |
| Arguments   | <p><i>timer</i>                    A timer</p> <p><i>relative-expiration-time</i><br/>                              A non-negative real</p> <p><i>repeat-time</i>            A non-negative real</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                           |
| Values      | <i>timer</i> A timer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                           |
| Description | <p>The function <code>schedule-timer-relative</code> schedules a timer to expire at a given time after the call to the function. The <i>timer</i> argument is a timer returned by <code>make-timer</code> or <code>make-named-timer</code>. The <i>relative-expiration-time</i> argument is a non-negative real number of seconds after the call to the function at which the timer is to expire. If <i>repeat-time</i> is specified, it is a non-negative real number of seconds that specifies a repeat interval. Each time the timer expires, it is rescheduled to expire after this repeat interval.</p> <p>If the timer is already scheduled to expire at the time this function is called, it is rescheduled to expire at the time specified by the <i>relative-expiration-time</i> argument. If that argument is <code>nil</code>, the timer is not rescheduled, but the repeat interval is set to the interval specified by the <i>repeat-time</i> argument.</p> <p>The function <code>schedule-timer</code> schedules a timer to expire at a time relative to the start of the program.</p> |                                                                                                                                           |

**Example** The following example schedules a timer to expire 5 seconds after the call to `schedule-timer-relative` and every 5 seconds thereafter.

```
(setq timer
      (mp:make-timer 'print 10 *standard-output*))

#<Time Event : PRINT>

(mp:schedule-timer-relative timer 5 5)

#<Time Event : PRINT>
```

**See also** `make-named-timer`  
`make-timer`  
`schedule-timer`  
`schedule-timer-milliseconds`  
`schedule-timer-relative-milliseconds`  
`timer-expired-p`  
`timer-name`  
`unschedule-timer`

## **schedule-timer-relative-milliseconds**

*Function*

**Summary** Schedules a timer to expire at a given time after this function is called.

**Package** `mp`

**Signature** `schedule-timer-relative-milliseconds timer relative-expiration-time &optional repeat-time => timer`

**Arguments** `timer` A timer.

`relative-expiration-time` A non-negative real.

`repeat-time` A non-negative real.

**Values** `timer` A timer.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The function <code>schedule-timer-relative-milliseconds</code> schedules a timer to expire at a given time after the call to the function. The <code>timer</code> argument is a timer returned by <code>make-timer</code> or <code>make-named-timer</code>. The <code>relative-expiration-time</code> argument is a non-negative real number of milliseconds after the call to the function at which the timer is to expire. If <code>repeat-time</code> is specified, it is a non-negative real number of milliseconds that specifies a repeat interval. Each time the timer expires, it is rescheduled to expire after this repeat interval.</p> <p>If the timer is already scheduled to expire at the time this function is called, it is rescheduled to expire at the time specified by the <code>relative-expiration-time</code> argument. If that argument is <code>nil</code>, the timer is not rescheduled, but the repeat interval is set to the interval specified by the <code>repeat-time</code> argument.</p> <p>The function <code>schedule-timer-milliseconds</code> schedules a timer to expire at a time relative to the start of the program.</p> |
| Notes       | <code>schedule-timer-relative-milliseconds</code> has the same precision as <code>schedule-timer-relative</code> , but may avoid some allocation when computing the time.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Example     | <p>The following example schedules a timer to expire 5 seconds after the call to <code>schedule-timer-relative-milliseconds</code> and every 5 seconds thereafter.</p> <pre>(setq timer       (mp:make-timer 'print 10 *standard-output*))  #&lt;Time Event : PRINT&gt;  (mp:schedule-timer-relative-milliseconds timer 5000   5000)  #&lt;Time Event : PRINT&gt;</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| See also    | <code>make-named-timer</code><br><code>make-timer</code><br><code>schedule-timer</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

```

schedule-timer-milliseconds
schedule-timer-relative
timer-expired-p
timer-name
unschedule-timer

```

**semaphore***System Class*

|              |                                                                                                                                                                                                                                                                                         |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary      | A class of objects for synchronizing access to a shared resource that contains some number of available units.                                                                                                                                                                          |
| Package      | <code>mp</code>                                                                                                                                                                                                                                                                         |
| Superclasses | <code>t</code>                                                                                                                                                                                                                                                                          |
| Description  | Instances of the system class <code>semaphore</code> are used for synchronizing access to a shared resource that contains some number of available units. They are made by <code>make-semaphore</code> and are used <code>semaphore-acquire</code> and <code>semaphore-release</code> . |
| See also     | <code>make-semaphore</code><br><code>semaphore-acquire</code><br><code>semaphore-release</code><br>“Counting semaphores” on page 287                                                                                                                                                    |

**semaphore-acquire***Function*

|           |                                                                                  |
|-----------|----------------------------------------------------------------------------------|
| Summary   | Acquires units from a <code>semaphore</code> .                                   |
| Package   | <code>mp</code>                                                                  |
| Signature | <code>semaphore-acquire sem &amp;key timeout wait-reason count =&gt; flag</code> |
| Arguments | <code>sem</code> A <code>semaphore</code> .                                      |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                        |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|
|             | <i>timeout</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | A non-negative <code>real</code> or <code>nil</code> . |
|             | <i>wait-reason</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | A string or <code>nil</code> .                         |
|             | <i>count</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | A non-negative fixnum.                                 |
| Values      | <i>flag</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | A generalized boolean.                                 |
| Description | <p>The function <code>semaphore-acquire</code> acquires <i>count</i> units from the <code>semaphore</code> <i>sem</i>.</p> <p>It attempts to atomically decrement the semaphore's unit count by <i>count</i>. If this gives a non negative result, then it changes the semaphore's unit count accordingly and returns true. The default value of <i>count</i> is 1.</p> <p>However, if decrementing the semaphore's unit count would result in a negative number then <code>semaphore-acquire</code> waits until the semaphore's unit count is larger than <i>count</i> and tries again. If <i>wait-reason</i> is true, then it is used as the thread's <i>wait-reason</i> when waiting for the semaphore.</p> <p>If <i>timeout</i> is <code>nil</code>, <code>semaphore-acquire</code> can wait forever. Otherwise, if the semaphore count cannot be decremented within <i>timeout</i> seconds, then <code>semaphore-acquire</code> returns false and the semaphore is unaffected. Pass <i>timeout</i> 0 if you do not want to wait at all.</p> |                                                        |
| Notes       | <p>You can get the current unit count of a semaphore by calling <code>semaphore-count</code>.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                        |
| See also    | <p><code>semaphore</code><br/> <code>make-semaphore</code><br/> <code>semaphore-count</code><br/> <code>semaphore-release</code><br/> <code>semaphore-wait-count</code><br/> “Counting semaphores” on page 287</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                        |

|             |                        | <i>Function</i>                                                                                                                                                       |
|-------------|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <b>semaphore-count</b> |                                                                                                                                                                       |
| Summary     |                        | Gets the current unit count of a <b>semaphore</b> .                                                                                                                   |
| Package     |                        | <b>mp</b>                                                                                                                                                             |
| Signature   |                        | <b>semaphore-count sem =&gt; count</b>                                                                                                                                |
| Arguments   | <i>sem</i>             | A <b>semaphore</b> .                                                                                                                                                  |
| Values      | <i>count</i>           | A non negative fixnum.                                                                                                                                                |
| Description |                        | The function <b>semaphore-count</b> returns the current unit count of the <b>semaphore</b> <i>sem</i> . The value is 0 if the semaphore has no unit remaining.        |
| Notes       |                        | The current unit count value can change in the semaphore after calling <b>semaphore-count</b> .<br>The value returned by <b>semaphore-count</b> is never negative.    |
| See also    |                        | <b>semaphore</b><br><b>make-semaphore</b><br><b>semaphore-acquire</b><br><b>semaphore-release</b><br><b>semaphore-wait-count</b><br>“Counting semaphores” on page 287 |

|           |                       | <i>Function</i>                       |
|-----------|-----------------------|---------------------------------------|
|           | <b>semaphore-name</b> |                                       |
| Summary   |                       | Gets the name of a <b>semaphore</b> . |
| Package   |                       | <b>mp</b>                             |
| Signature |                       | <b>semaphore-name sem =&gt; name</b>  |
| Arguments | <i>sem</i>            | A <b>semaphore</b> .                  |

|             |                                                                                                                     |            |
|-------------|---------------------------------------------------------------------------------------------------------------------|------------|
| Values      | <i>name</i>                                                                                                         | An object. |
| Description | The function <b>semaphore-name</b> returns the name that <b>semaphore</b> <i>sem</i> was given when it was created. |            |
| See also    | <b>semaphore</b><br><b>make-semaphore</b><br>“Counting semaphores” on page 287                                      |            |

## semaphore-release

## *Function*

|             |                                                                                                                                                                                                                                                                                                                             |                        |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Summary     | Releases units back to a <b>semaphore</b> .                                                                                                                                                                                                                                                                                 |                        |
| Package     | <b>mp</b>                                                                                                                                                                                                                                                                                                                   |                        |
| Signature   | <b>semaphore-release</b> <i>sem</i> & <b>key</b> <i>count</i> => <i>flag</i>                                                                                                                                                                                                                                                |                        |
| Arguments   | <i>sem</i>                                                                                                                                                                                                                                                                                                                  | A <b>semaphore</b> .   |
|             | <i>count</i>                                                                                                                                                                                                                                                                                                                | A non negative fixnum. |
| Values      | <i>flag</i>                                                                                                                                                                                                                                                                                                                 | A generalized boolean. |
| Description | The function <b>semaphore-release</b> releases <i>count</i> units back to the <b>semaphore</b> <i>sem</i> .<br><br>It atomically increments the semaphore's unit count by <i>count</i> (which defaults to 1).<br><br>The returned <i>flag</i> is true if any other thread was waiting for the semaphore and false otherwise |                        |
| See also    | <b>semaphore</b><br><b>make-semaphore</b><br><b>semaphore-acquire</b><br><b>semaphore-count</b><br><b>semaphore-wait-count</b><br>“Counting semaphores” on page 287                                                                                                                                                         |                        |

|             |                             | <i>Function</i>                                                                                                                                                                                                                                  |
|-------------|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <b>semaphore-wait-count</b> |                                                                                                                                                                                                                                                  |
| Summary     |                             | Get the current wait count of a <b>semaphore</b> .                                                                                                                                                                                               |
| Package     |                             | <b>mp</b>                                                                                                                                                                                                                                        |
| Signature   |                             | <b>semaphore-wait-count</b> <i>sem</i> => <i>wait-count</i>                                                                                                                                                                                      |
| Arguments   | <i>sem</i>                  | A <b>semaphore</b> .                                                                                                                                                                                                                             |
| Values      | <i>wait-count</i>           | A non negative fixnum.                                                                                                                                                                                                                           |
| Description |                             | The function <b>semaphore-wait-count</b> returns the current number of units that other threads are waiting for from the <b>semaphore</b> <i>sem</i> . The value <i>wait-count</i> is 0 if the semaphore has no thread waiting for it.           |
| Notes       |                             | The value can change in the semaphore after calling <b>semaphore-wait-count</b> .                                                                                                                                                                |
| See also    |                             | <a href="#"><b>semaphore</b></a><br><a href="#"><b>make-semaphore</b></a><br><a href="#"><b>semaphore-acquire</b></a><br><a href="#"><b>semaphore-count</b></a><br><a href="#"><b>semaphore-release</b></a><br>“Counting semaphores” on page 287 |

|           |                                | <i>Function</i>                                                  |
|-----------|--------------------------------|------------------------------------------------------------------|
|           | <b>set-funcall-async-limit</b> |                                                                  |
| Summary   |                                | Limit the number of parallel asynchronous calls.                 |
| Package   |                                | <b>mp</b>                                                        |
| Signature |                                | <b>set-funcall-async-limit</b> <i>new-limit</i> => <i>result</i> |

|             |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arguments   | <i>new-limit</i> | An integer in the exclusive range (0,1000000) or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Values      | <i>result</i>    | An integer in the exclusive range (0,1000000).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Description |                  | The function <code>set-funcall-async-limit</code> limits the number of asynchronous calls (by <code>funcall-async</code> or <code>funcall-async-list</code> ) which can run in parallel. Further asynchronous calls are queued, and when a running call finishes another call starts.<br><br>When <i>new-limit</i> is an integer the limit is set to <i>new-limit</i> , and <i>result</i> is the previous limit.<br><br>When <i>new-limit</i> is <code>nil</code> , the limit is not changed and <i>result</i> is the current limit.<br><br>The default limit is 5, which is adequate if <code>funcall-async</code> and/or <code>funcall-async-list</code> are only used occasionally. If you use them often, you may want to increase this limit to between 10 and 30. A larger limit probably does not make sense. |
| See also    |                  | <code>funcall-async</code><br><code>funcall-async-list</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

| <b>simple-lock-and-condition-variable-wait</b> |                     | <i>Function</i>                                                                                                                      |
|------------------------------------------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| Summary                                        |                     | A variant of <code>lock-and-condition-variable-wait</code> with a simpler lambda list.                                               |
| Package                                        |                     | <code>mp</code>                                                                                                                      |
| Signature                                      |                     | <code>simple-lock-and-condition-variable-wait lock lock-timeout condvar condvar-timeout predicate &amp;rest args =&gt; result</code> |
| Arguments                                      | <i>lock</i>         | A <code>lock</code> .                                                                                                                |
|                                                | <i>lock-timeout</i> | A non-negative <code>real</code> or <code>nil</code> .                                                                               |

|             |                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <i>condvar</i>         | A condition-variable.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|             | <i>condvar-timeout</i> | A non-negative <code>real</code> or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|             | <i>predicate</i>       | A function designator.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|             | <i>args</i>            | Arguments to <i>predicate</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Values      | <i>result</i>          | See below.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Description |                        | The function <code>simple-lock-and-condition-variable-wait</code> is a variant of <code>lock-and-condition-variable-wait</code> that does not take keyword arguments. Also it takes the arguments of the <i>predicate</i> as <code>&amp;rest</code> . It interprets and acts on the arguments just like <code>lock-and-condition-variable-wait</code> .<br><br><code>simple-lock-and-condition-variable-wait</code> returns the result of calling <i>predicate</i> or the wait, like <code>lock-and-condition-variable-wait</code> when <i>return-function</i> is not supplied. |
| Notes       |                        | <code>simple-lock-and-condition-variable-wait</code> does not take wait reason arguments, so you should give names to the <code>lock</code> <i>lock</i> and the <code>condition-variable</code> <i>condvar</i> for debugging (by passing <i>name</i> in <code>make-lock</code> and <code>make-condition-variable</code> ).                                                                                                                                                                                                                                                      |
| See also    |                        | <code>condition-variable-wait</code><br><code>lock-and-condition-variable-wait</code><br><code>lock-and-condition-variable-signal</code><br><code>lock-and-condition-variable-broadcast</code><br><code>condition-variable-signal</code><br><code>condition-variable-broadcast</code><br>“Condition variables” on page 285<br>“Locks” on page 277                                                                                                                                                                                                                               |

|             | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Reads the value of symbol which is dynamically bound in a given process.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Package     | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Signature   | <code>symeval-in-process symbol process =&gt; value, flag</code><br><code>(setf symeval-in-process) value symbol process =&gt; value</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Arguments   | <code>symbol</code> A symbol<br><code>process</code> A process                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Values      | <code>value</code> A Lisp object<br><code>flag</code> One of <code>t</code> , <code>nil</code> or the keyword <code>:unbound</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Description | <p>The function <code>symeval-in-process</code> reads the value of the symbol <i>symbol</i> in the process <i>process</i> if it is bound dynamically. The global value of <i>symbol</i> is never returned.</p> <p>If <i>symbol</i> is not bound in <i>process</i>, then <i>value</i> and <i>flag</i> are both <code>nil</code>. If <i>symbol</i> is bound in <i>process</i> but <code>makunbound</code> has been called within the dynamic scope of the binding, <i>value</i> is <code>nil</code> and <i>flag</i> is <code>:unbound</code>. Otherwise, <i>value</i> is the value of <i>symbol</i> and <i>flag</i> is <code>t</code>.</p> <p>In addition, the form</p> <pre>(setf (symeval-in-process symbol process) value)</pre> <p>sets the value of <i>symbol</i> to <i>value</i> in <i>process</i>. It is an error if <i>process</i> has no binding for <i>symbol</i>. This <code>setf</code> form returns <i>value</i> as specified by Common Lisp.</p> |
| Notes       | <code>symeval-in-process</code> is mostly intended for debugging. It is OK to call it on a thread known to be idle, or in <code>process-wait</code> or <code>process-stop</code> , but it should not be called while the thread is running.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

|              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <i>Function</i> |         |              |                     |  |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|---------|--------------|---------------------|--|
| Summary      | Returns <i>t</i> if a given timer has expired or is about to expire.                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                 |         |              |                     |  |
| Package      | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                 |         |              |                     |  |
| Signature    | <code>timer-expired-p <i>timer</i> &amp;optional <i>delta</i> =&gt; <i>bool</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |         |              |                     |  |
| Arguments    | <table border="0"> <tr> <td><i>timer</i></td><td>A timer</td></tr> <tr> <td><i>delta</i></td><td>A non-negative real</td></tr> </table>                                                                                                                                                                                                                                                                                                                                                                              | <i>timer</i>    | A timer | <i>delta</i> | A non-negative real |  |
| <i>timer</i> | A timer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                 |         |              |                     |  |
| <i>delta</i> | A non-negative real                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |         |              |                     |  |
| Values       | <i>bool</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | A boolean       |         |              |                     |  |
| Description  | The function <code>timer-expired-p</code> returns <i>t</i> if the specified timer is not scheduled to expire or is scheduled to expire within the number of seconds specified by the <i>delta</i> argument after the call to <code>timer-expired-p</code> . Otherwise, the function returns <code>nil</code> .<br><br>The <i>timer</i> argument is a timer, returned by <code>make-timer</code> or <code>make-named-timer</code> . The <i>delta</i> argument, if supplied, is a non-negative real number of seconds. |                 |         |              |                     |  |
| Example      | <pre>(setq timer       (mp:make-timer 'print 10 *standard-output*))  #&lt;Time Event : PRINT&gt;  (mp:schedule-timer-relative timer 5)  #&lt;Time Event : PRINT&gt;  (mp:timer-expired-p timer)  NIL</pre>                                                                                                                                                                                                                                                                                                           |                 |         |              |                     |  |
| See also     | <code>make-named-timer</code><br><code>make-timer</code><br><code>schedule-timer</code><br><code>schedule-timer-milliseconds</code>                                                                                                                                                                                                                                                                                                                                                                                  |                 |         |              |                     |  |

```
schedule-timer-relative  
timer-name  
unschedule-timer
```

|                   |                 |
|-------------------|-----------------|
| <b>timer-name</b> | <i>Function</i> |
|-------------------|-----------------|

Summary      Returns the name of a specified timer.

Package      `mp`

Signature     `timer-name timer => name`

Signature     `(setf timer-name) name timer => name`

Arguments    `timer`      A timer

Values       `name`      A string

Description     The function `timer-name` returns the name of the specified `timer`. The `timer` argument is a timer returned by `make-timer` or `make-named-timer`. If the timer has no name, `timer-name` returns `nil`.

The name of a timer created by either `make-timer` or `make-named-timer` can be set by means of the following syntax:

```
(setf (mp:timer-name timer) name)
```

Example      

```
(setq timer
      (mp:make-timer 'print 10 *standard-output*))

#<Time Event : PRINT>

(mp:timer-name timer)

NIL

(setf (mp:timer-name timer) 'timer-1)

TIMER-1
```

```
(mp:timer-name timer)
  TIMER-1

See also      make-named-timer
              make-timer
              schedule-timer
              schedule-timer-milliseconds
              schedule-timer-relative
              timer-expired-p
              unschedule-timer
```

## **unnotice-fd** *Function*

|             |                                                                                                                                                                                                                 |                   |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| Summary     | Removes a file descriptor from the set of interesting input file descriptors.                                                                                                                                   |                   |
| Package     | <code>mp</code>                                                                                                                                                                                                 |                   |
| Signature   | <code>unnotice-fd fd</code>                                                                                                                                                                                     |                   |
| Arguments   | <code>fd</code>                                                                                                                                                                                                 | A file descriptor |
| Values      | None.                                                                                                                                                                                                           |                   |
| Description | <p>The function <code>unnotice-fd</code> removes <code>fd</code> from the set of fds that cause LispWorks to wake up when they contain input.</p> <p>This function is not implemented on Microsoft Windows.</p> |                   |
| See also    | <code>notice-fd</code>                                                                                                                                                                                          |                   |

## **unschedule-timer** *Function*

|         |                               |
|---------|-------------------------------|
| Summary | Unschedules a scheduled timer |
|---------|-------------------------------|

|             |                                                                                                                                                                                                                                                                                                                                      |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>mp</code>                                                                                                                                                                                                                                                                                                                      |
| Signature   | <code>unschedule-timer timer =&gt; result</code>                                                                                                                                                                                                                                                                                     |
| Arguments   | <code>timer</code> A timer                                                                                                                                                                                                                                                                                                           |
| Values      | <code>result</code> A timer or <code>nil</code>                                                                                                                                                                                                                                                                                      |
| Description | If the specified timer has been scheduled to expire at a time after the call to <code>unschedule-timer</code> , this function unschedules the timer and returns the timer. Otherwise, the function returns <code>nil</code> .<br><br>The argument is a timer, returned by <code>make-timer</code> or <code>make-named-timer</code> . |
| Example     | <pre>(setq timer       (mp:make-timer 'print 10 *standard-output*))  #&lt;Time Event : PRINT&gt;  (mp:schedule-timer-relative timer 60)  #&lt;Time Event : PRINT&gt;  (mp:unschedule-timer timer)  #&lt;Time Event : PRINT&gt;  (mp:timer-expired-p timer)  T</pre>                                                                  |
| See also    | <code>make-named-timer</code><br><code>make-timer</code><br><code>schedule-timer</code><br><code>schedule-timer-milliseconds</code><br><code>schedule-timer-relative</code><br><code>timer-expired-p</code><br><code>timer-name</code>                                                                                               |

|             |                               | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <b>wait-processing-events</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Summary     |                               | Waits processing events.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Package     |                               | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Signature   |                               | <code>wait-processing-events timeout &amp;key wait-reason wait-function<br/>wait-args =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Arguments   | <i>timeout</i>                | A non-negative <code>real</code> or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|             | <i>wait-reason</i>            | A string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|             | <i>wait-function</i>          | A function designator.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|             | <i>wait-args</i>              | A list.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Values      | <i>result</i>                 | <code>t</code> or <code>nil</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Description |                               | <p>The function <code>wait-processing-events</code> does not return until one of two conditions is met:</p> <ul style="list-style-type: none"> <li>• <i>timeout</i> is non-nil and <i>timeout</i> seconds have passed.<br/>In this case, <i>result</i> is <code>nil</code>.</li> <li>• <i>wait-function</i> returns a true value.<br/>In this case, <i>result</i> is <code>t</code>.</li> </ul> <p><i>wait-reason</i> provides the value returned by <code>process-whos-state</code> when called on the current process.</p> <p><i>wait-function</i> is called periodically with arguments <i>wait-args</i>. <i>wait-function</i> may be called many times and in several places. Therefore <i>wait-function</i> should be fast and make no assumptions about its dynamic context.</p> <p><code>wait-processing-events</code> processes all events sent to the current process, including system events such as window messages on Microsoft Windows, and objects sent by other processes via <code>process-send</code>. In the latter case, the objects must be lists of the form <code>(function . arguments)</code>, which cause <i>function</i> to be applied to <i>arguments</i> (the values are discarded).</p> |

`wait-processing-events` is a useful alternative to `sleep` in a situation where you want to process events to see window updates and so on.

See also      `process-send`  
                `process-whostate`

## with-exclusive-lock *Macro*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Summary     | Holds a sharing <code>lock</code> in exclusive mode while evaluating its body, and then unlocks the lock.                                                                                                                                                                                                                                                                                                                                                                                                            |  |
| Package     | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
| Signature   | <code>with-exclusive-lock (sharing-lock &amp;optional whostate timeout) &amp;body body =&gt; results</code>                                                                                                                                                                                                                                                                                                                                                                                                          |  |
| Arguments   | <p><i>sharing-lock</i>      A sharing <code>lock</code>.<br/><i>whostate</i>      The status of the process while <i>sharing-lock</i> is locked, as seen in the Process Browser.<br/><i>timeout</i>      A non-negative <code>real</code> or <code>nil</code>.<br/><i>body</i>      The forms to execute</p>                                                                                                                                                                                                         |  |
| Values      | <i>results</i> The values returned from evaluating <code>body</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |
| Description | The macro <code>with-exclusive-lock</code> is the same as <code>with-lock</code> , except that <i>sharing-lock</i> must be a "sharing" <code>lock</code> , that is, created with the argument <i>sharing</i> true in <code>make-lock</code> . It waits until <i>sharing-lock</i> is completely free, that is, not locked in a sharing mode and is not locked in exclusive mode by another thread. It then locks <i>sharing-lock</i> in exclusive mode, evaluates <code>body</code> and unlocks <i>sharing-lock</i> . |  |
| Notes       | It is not possible to hold an exclusive lock in the scope of a <i>sharing-lock</i> on the same <code>lock</code> , and trying to do it will cause                                                                                                                                                                                                                                                                                                                                                                    |  |

the process to hang. Whether it is possible to hold an exclusive lock inside an exclusive-lock of the same `lock` is determined by the `recursivelp` argument in `make-lock`.

## See also

`make-lock`  
`with-lock`  
“Locks” on page 277

**with-interrupts-blocked***Macro*

Summary      Evaluates code with interrupts blocked.

Package      `mp`

Signature      `with-interrupts-blocked &body body => results`

Arguments      `body`                  Code

Values      `results`                  Values returned by evaluating `body`.

Description      Evaluates `body` with interrupts blocked. This actually expands to

`(mp:allowing-block-interrupts t ,@body)`

which means it also allows you to change the blocking of interrupts.

See the entry for `allowing-block-interrupts` for full details.

See also      `allowing-block-interrupts`

**with-lock***Macro*

Summary      Executes a body of code while holding a lock.

|             |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>mp</code>       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Signature   |                       | <code>with-lock (lock &amp;optional whostate timeout) &amp;body body =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Arguments   | <code>lock</code>     | The <code>lock</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|             | <code>whostate</code> | The status of the process while <code>lock</code> is locked, as seen in the Process Browser.                                                                                                                                                                                                                                                                                                                                                                                                                         |
|             | <code>timeout</code>  | A non-negative <code>real</code> or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|             | <code>body</code>     | The forms to execute.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Values      | <code>result</code>   | The result of executing <code>body</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Description |                       | <code>with-lock</code> executes <code>body</code> while holding <code>lock</code> , and unlocks <code>lock</code> when <code>body</code> exits. This is the recommended way of using a <code>lock</code> . The value of <code>body</code> is returned normally. <code>body</code> is not executed if <code>lock</code> could not be locked, in which case, <code>with-lock</code> returns <code>nil</code> . The <code>timeout</code> and <code>whostate</code> are used as specified by <code>process-lock</code> . |
| See also    |                       | <code>make-lock</code><br><code>process-lock</code><br><code>process-unlock</code><br><code>with-exclusive-lock</code><br><code>with-sharing-lock</code><br>“Locks” on page 277                                                                                                                                                                                                                                                                                                                                      |

## with-sharing-lock *Macro*

|           |                                                                                                           |
|-----------|-----------------------------------------------------------------------------------------------------------|
| Summary   | Holds a <code>lock</code> in shared mode while executing a body of code.                                  |
| Package   | <code>mp</code>                                                                                           |
| Signature | <code>with-sharing-lock (sharing-lock &amp;optional whostate timeout) &amp;body body =&gt; results</code> |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| Arguments   | <i>sharing-lock</i>                                                                                                                                                                                                                                                                                                                                                                                                        | A sharing lock.                                                                                |
|             | <i>whostate</i>                                                                                                                                                                                                                                                                                                                                                                                                            | The status of the process while <i>sharing-lock</i> is locked, as seen in the Process Browser. |
|             | <i>timeout</i>                                                                                                                                                                                                                                                                                                                                                                                                             | A non-negative <code>real</code> or <code>nil</code> .                                         |
|             | <i>body</i>                                                                                                                                                                                                                                                                                                                                                                                                                | The forms to execute                                                                           |
| Values      | <i>results</i>                                                                                                                                                                                                                                                                                                                                                                                                             | The values returned from evaluating body.                                                      |
| Description | <p>The macro <code>with-sharing-lock</code> is like <code>with-lock</code>, but <i>sharing-lock</i> must be a "sharing" lock and will be locked in shared mode. That means that other threads can also lock it in shared mode.</p> <p>Before locking, <code>with-sharing-lock</code> waits for <i>sharing-lock</i> to be free of any exclusive lock, but it does not check for other shared mode use of the same lock.</p> |                                                                                                |
| Notes       | <p>It is possible to lock for sharing inside the scope of sharing lock and inside the scope of an exclusive lock.</p>                                                                                                                                                                                                                                                                                                      |                                                                                                |
| See also    | <p><code>make-lock</code><br/> <code>with-lock</code><br/> <a href="#">"Locks" on page 277</a></p>                                                                                                                                                                                                                                                                                                                         |                                                                                                |

| <b>without-interrupts</b> |                                                                                                                         | <i>Macro</i>                                      |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|
| Summary                   | <p>Causes any interrupts that occur during the execution of a body of code to be queued, in non-SMP LispWorks only.</p> |                                                   |
| Package                   | <code>mp</code>                                                                                                         |                                                   |
| Signature                 | <code>without-interrupts &amp;rest <i>body</i> =&gt; <i>result</i></code>                                               |                                                   |
| Arguments                 | <i>body</i>                                                                                                             | The forms to execute while interrupts are queued. |

|             |               |                                                                                                                                                                                                                                                                                                       |
|-------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Values      | <i>result</i> | The result of executing <i>body</i> .                                                                                                                                                                                                                                                                 |
| Description |               | While <i>body</i> is executing, all interrupts (for example, preemption, keyboard break etc.) are queued. They are executed when <i>body</i> exits.                                                                                                                                                   |
| Notes       |               | <code>without-interrupts</code> is not supported in SMP LispWorks, that is on Microsoft Windows, Mac OS X, Linux, FreeBSD, AIX and x86/x64 Solaris platforms.                                                                                                                                         |
| Example     |               | To ensure that the seconds and milliseconds slots are always consistent in non-SMP LispWorks, you can use <code>without-interrupts</code> within the function which sets them.                                                                                                                        |
|             |               | <pre>(defstruct elapsed-time   seconds   milliseconds)  (defun update-elapsed-time-atomically   (elapsed-time seconds milliseconds)   (mp:without-interrupts     (setf (elapsed-time-seconds elapsed-time) seconds           (elapsed-time-milliseconds elapsed-time)           milliseconds)))</pre> |
| See also    |               | <code>without-preemption</code>                                                                                                                                                                                                                                                                       |

|           |               | <i>Macro</i>                                                                               |
|-----------|---------------|--------------------------------------------------------------------------------------------|
| Summary   |               | Identifies forms which should not be preempted during execution, in non-SMP LispWorks only |
| Package   |               | <code>mp</code>                                                                            |
| Signature |               | <code>without-preemption &amp;rest body =&gt; result</code>                                |
| Arguments | <i>body</i>   | The forms to be evaluated atomically.                                                      |
| Values    | <i>result</i> | The result of executing <i>body</i> .                                                      |

|             |                                                                                                                                                               |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | Identifies forms which should not be preempted during execution.                                                                                              |
| Notes       | <code>without-preemption</code> is not supported in SMP LispWorks, that is on Microsoft Windows, Mac OS X, Linux, FreeBSD, AIX and x86/x64 Solaris platforms. |

|             | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Allows preemption to happen in low safety code.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Package     | <code>mp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Signature   | <code>yield</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Arguments   | None.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Values      | None.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Description | Normally code compiled at safety 0 cannot be preempted because the necessary checks are omitted. This can be overcome by calling <code>yield</code> at regular intervals. Usually there is no need to call this if you use functions from the <code>common-lisp</code> package because these are not compiled at safety 0, but for example if you find that preemption is not working in a loop with no function calls, <code>yield</code> can be useful. Note that <code>process-allow-scheduling</code> also allows preemption, but also checks the wait functions of other processes. |
| See also    | <code>process-allow-scheduling</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

# 45

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## The PARSERGEN Package

This chapter describes symbols available in the **PARSERGEN** package, the Lisp-Works parser generator.

This functionality is discussed in detail in Chapter 21, “The Parser Generator”.

| defparser | <i>Macro</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary   | Creates a parsing function of the given name for the grammar defined.                                                                                                                                                                                                                                                                                                                                                                                                     |
| Package   | <code>parsergen</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Signature | <pre>defparser <i>name-and-options</i> {<i>rule</i>}* =&gt; <i>parsing-function</i> <i>name-and-options</i> ::= <i>name</i>   (<i>name</i> [[<i>option</i>]]) <i>option</i> ::= :accept-without-eoi-p accept-without-eoi-p <i>rule</i> ::= <i>normal-rule</i>   <i>error-rule</i>   <i>combined-rule</i> <i>normal-rule</i> ::= ((<i>non-terminal</i> {<i>grammar-symbol</i>}*) {<i>form</i>}*) <i>error-rule</i> ::= ((<i>non-terminal</i> :error) {<i>form</i>}*)</pre> |

```

combined-rule ::= (non-terminal {combined-rule-clause}*)
combined-rule-clause ::= (combined-rule-lhs {form}*)
combined-rule-lhs ::= ({grammar-symbol}*) | (:error)

```

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arguments   | <p><b>name</b>                    The name of the parser.</p> <p><b>accept-without-eoi-p</b><br/>A generalized boolean.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|             | <p>The rules define the productions of the grammar and the associated forms define the semantic actions for the rules.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Values      | <p><b>parsing-function</b> The symbol name of the parsing function.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Description | <p><b>defparser</b> creates a parsing function of the given name for the grammar defined. The parsing function is defined as if by:</p> <pre>(defun &lt;name&gt; (lexer &amp;optional (symbol-to-string #'<b>identify</b>))</pre> <p>The <i>lexer</i> parameter is a function of no arguments that returns two values: the next grammar token on the input and the associated semantic value.</p> <p>The optional <i>symbol-to-string</i> function can be used to define a printed representation of the grammar tokens. The function should take a grammar symbol as its single argument and returns an object to be used as a print representation for the grammar token.</p> <p>When <i>accept-without-eoi-p</i> is true, the parser accepts the input as soon as the top level rule matches completely rather than waiting for end of input (eoi). The default value of <i>accept-without-eoi-p</i> is false.</p> <p>For a full description and examples, see Chapter 21, “The Parser Generator”.</p> |

# 46

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## The SERIAL-PORT Package

This chapter describes the symbols available in the **SERIAL-PORT** package.

The Serial Port functionality is loaded into LispWorks by evaluating

```
(require "serial-port")
```

See **open-serial-port** for platform-specific details.

|           | <i>Function</i>                                                                                                                                                                                                                                                                    |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary   | Attempts to open the named serial port and return a <b>serial-port</b> object.                                                                                                                                                                                                     |
| Package   | <b>serial-port</b>                                                                                                                                                                                                                                                                 |
| Signature | <b>open-serial-port</b> <i>name</i> &rest <i>args</i> &key <i>baud-rate data-bits stop-bits parity cts-flow-p dsr-flow-p dtr rts read-interval-timeout read-total-base-timeout read-total-byte-timeout write-total-base-timeout write-total-byte-timeout</i> => <b>serial-port</b> |
| Arguments | <i>name</i> A string naming a serial port.                                                                                                                                                                                                                                         |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                      |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
|             | <b>args</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | See in the Description below for details of the remaining arguments. |
| Values      | <b>serial-port</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | A <b>serial-port</b> object.                                         |
| Description | <p>The function <b>open-serial-port</b> attempts to open the serial port <i>name</i> and return a <b>serial-port</b> object.</p> <p>On Windows, <i>name</i> is passed directly to <b>CreateFile()</b>. For ports COM<i>n</i> where <i>n</i> &gt; 9, you must take care to pass the real port name expected by Windows. At the time of writing this issue is documented at <a href="http://support.microsoft.com/kb/115831">http://support.microsoft.com/kb/115831</a>.</p> <p>On non-Windows platforms, <i>name</i> should be the device file name (for example <code>"/dev/cu.usbmodem14111"</code>).</p> <p>If any of <i>baud-rate</i>, <i>data-bits</i>, <i>stop-bits</i> and <i>parity</i> are supplied then the corresponding serial port settings are changed. The values of <i>baud-rate</i> and <i>data-bits</i> should each be an appropriate integer. The value of <i>stop-bits</i> should be 1, 1.5 (Windows only) or 2. The value of <i>parity</i> should be one of the keywords <b>:even</b>, <b>:none</b> or <b>:odd</b>, or on Windows, <b>:mark</b> or <b>:space</b>.</p> <p>The arguments <i>cts-flow-p</i> and <i>dsr-flow-p</i> control whether write operations respond to CTS and DSR flow control. A non-nil value means that the corresponding flow control is used. Note that <i>dsr-flow-p</i> is only supported on Windows.</p> <p>The arguments <i>dtr</i> and <i>rts</i> control whether read operations generate DTR or RTS flow control. If the value is <b>:handshake</b> then the corresponding flow control signal is generated automatically. If the value is <b>nil</b> or <b>t</b> then the initial state of the flow control signal is set and automatic flow control is not used. See <b>set-serial-port-state</b> for manual flow control. Note: the value <b>:handshake</b> for <i>dtr</i> is only supported on Windows.</p> <p>The argument <i>read-interval-timeout</i> can be used to control the maximum time to wait between each input character. The</p> |                                                                      |

`value :none` means that reading will not wait for characters at all, only returning whatever is already in the input buffer

The arguments `read-total-base-timeout` and `read-total-byte-timeout` can be used to control the maximum time to wait for a sequence of characters. The arguments `write-total-base-timeout` and `write-total-byte-timeout` can be used to control the maximum time to wait when transmitting a sequence of characters. For both reading and writing the timeout is given by the expression:

```
base_timeout + nchars * byte_timeout
```

The default value of each of `read-total-base-timeout`, `read-total-byte-timeout`, `write-total-base-timeout` and `write-total-byte-timeout` is `nil` and this means that the corresponding parameter in the OS is left unchanged and there is zero timeout. Otherwise the value should be a non-negative real number specifying a timeout in seconds.

See also      **`close-serial-port`**  
                  **`set-serial-port-state`**

## **close-serial-port** *Function*

|             |                                                                                                                                                                                                           |                                    |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| Summary     | Closes a serial port                                                                                                                                                                                      |                                    |
| Package     | <code>serial-port</code>                                                                                                                                                                                  |                                    |
| Signature   | <code>close-serial-port serial-port</code>                                                                                                                                                                |                                    |
| Arguments   | <code>serial-port</code>                                                                                                                                                                                  | A <code>serial-port</code> object. |
| Description | The function <code>close-serial-port</code> closes the serial port associated with the given <code>serial-port</code> object.<br><br>If <code>serial-port</code> is already closed, an error is signaled. |                                    |

See also [open-serial-port](#)

## get-serial-port-state Function

Summary Queries various aspects of the state of a serial port.

Package [serial-port](#)

Signature `get-serial-port-state serial-port keys => state`

Arguments `serial-port` A `serial-port` object.

`keys` A list of keywords.

Values `state` A list.

Description The function `get-serial-port-state` queries various aspects of the state of the serial port associated with `serial-port`.

The argument `keys` should be a list of one or more of the keywords `:dsr` and `:cts`. These cause `get-serial-port-state` to check the DSR and CTS lines respectively.

The result `state` is a list giving the state of each line in the same order as they appear in the argument `keys`.

## serial-port Class

Summary The class of objects representing serial ports.

Package [serial-port](#)

Description The class `serial-port` is the class of objects representing serial ports. These are constructed by `open-serial-port` - do not create them directly.

See also      **open-serial-port**

**read-serial-port-char**                          *Function*

Summary      Reads a character from a serial port.

Package      **serial-port**

Signature      **read-serial-port-char** *serial-port* &optional *timeout-error-p*  
*timeout-char* => *char*

Arguments      *serial-port*      A **serial-port** object.

*timeout-error-p*    A boolean.

*timeout-char*     A character.

Values      *char*      A character.

Description      The function **read-serial-port-char** reads and returns a character from the serial port associated with *serial-port*.

A timeout will occur if the character is not available before the read timeout (as specified by values given when the serial port was opened by **open-serial-port**).

When a timeout occurs, if *timeout-error-p* is non-nil, then an error of type **serial-port-timeout** is signaled, otherwise *timeout-char* is returned. The default value of *timeout-error-p* is t.

See also      **read-serial-port-string**

**read-serial-port-string**                          *Function*

Summary      Reads a string from a serial port.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                      |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|
| Package     | <code>serial-port</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                      |
| Signature   | <code>read-serial-port-string string serial-port &amp;optional timeout-error-p &amp;key start end =&gt; nread</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                      |
| Arguments   | <code>string</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | A string.                                            |
|             | <code>serial-port</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | A <code>serial-port</code> object.                   |
|             | <code>timeout-error-p</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | A boolean.                                           |
|             | <code>start, end</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Bounding index designators for <code>string</code> . |
| Values      | <code>nread</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | An integer.                                          |
| Description | <p>The function <code>read-serial-port-string</code> reads characters from the serial port associated with <code>serial-port</code> and places them in <code>string</code>, bounded by <code>start</code> and <code>end</code>.</p> <p>The default values of <code>start</code> and <code>end</code> are 0 and <code>nil</code> (interpreted as the length of <code>string</code>) respectively. The number of characters requested is the difference between <code>end</code> and <code>start</code>.</p> <p>If the number of characters actually read, <code>nread</code>, is less than the number requested, then if <code>timeout-error-p</code> is non-nil an error of type <code>serial-port-timeout</code> is signaled.</p> <p>If <code>nread</code> is the number of characters requested, or if <code>timeout-error-p</code> is <code>nil</code>, <code>nread</code> is returned.</p> <p>The default value of <code>timeout-error-p</code> is <code>t</code>.</p> |                                                      |
| See also    | <code>read-serial-port-char</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                      |

| <b>serial-port-input-available-p</b> | <i>Function</i>                                           |
|--------------------------------------|-----------------------------------------------------------|
| Summary                              | Checks whether a character is available on a serial port. |
| Package                              | <code>serial-port</code>                                  |

*This chapter applies only to LispWorks for Windows*

|             |                                                                                                                                                                                                                                                          |                                    |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| Signature   | <code>serial-port-input-available-p serial-port =&gt; result</code>                                                                                                                                                                                      |                                    |
| Arguments   | <code>serial-port</code>                                                                                                                                                                                                                                 | A <code>serial-port</code> object. |
| Values      | <code>result</code>                                                                                                                                                                                                                                      | A boolean.                         |
| Description | The function <code>serial-port-input-available-p</code> checks the serial port associated with <code>serial-port</code> to see if a character is available. <code>result</code> is <code>t</code> if input is available, and <code>nil</code> otherwise. |                                    |

|                              | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>set-serial-port-state</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Summary                      | Changes various aspects of the state of a serial port.                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Package                      | <code>serial-port</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Signature                    | <code>set-serial-port-state serial-port &amp;key dtr rts break</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Arguments                    | <code>serial-port</code> A <code>serial-port</code> object.<br><code>dtr</code> A boolean.<br><code>rts</code> A boolean.<br><code>break</code> A boolean.                                                                                                                                                                                                                                                                                                                                                                        |
| Description                  | The function <code>set-serial-port-state</code> changes various aspects of the state of the serial port associated with <code>serial-port</code> .<br><br>The argument <code>dtr</code> ; if supplied, controls the DTR line. A true value means set and <code>nil</code> means clear. If <code>dtr</code> is not supplied, the state is unchanged.<br><br>The argument <code>rts</code> controls the RTS line in the same way.<br><br>The argument <code>break</code> controls the break state of the data line in the same way. |

## wait-serial-port-state Function

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                    |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| Summary     | Waits for some aspect of the state of a serial port to change.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                    |
| Package     | <code>serial-port</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                    |
| Signature   | <code>wait-serial-port-state serial-port keys &amp;key timeout =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                    |
| Arguments   | <code>serial-port</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | A <code>serial-port</code> object. |
|             | <code>keys</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | A list of keywords.                |
|             | <code>timeout</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | A number.                          |
| Values      | <code>result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | A list.                            |
| Description | <p>The function <code>wait-serial-port-state</code> waits for some state in the serial port associated with <code>serial-port</code> to change.</p> <p>The argument <code>keys</code> should be a list of one or more of the keywords <code>:cts</code>, <code>:dsr</code>, <code>:err</code>, <code>:ring</code>, <code>:rlsd</code> and <code>:break</code>.</p> <p><code>result</code> is a list giving the keys for which the state has changed.</p> <p>If <code>timeout</code> is non-nil then the function will return <code>nil</code> after that many seconds even if the state has not changed.</p> |                                    |

## write-serial-port-char Function

|           |                                                                                               |                                    |
|-----------|-----------------------------------------------------------------------------------------------|------------------------------------|
| Summary   | Writes a character to a serial port.                                                          |                                    |
| Package   | <code>serial-port</code>                                                                      |                                    |
| Signature | <code>write-serial-port-char char serial-port &amp;optional timeout-error-p =&gt; char</code> |                                    |
| Arguments | <code>char</code>                                                                             | A character.                       |
|           | <code>serial-port</code>                                                                      | A <code>serial-port</code> object. |
|           | <code>timeout-error-p</code>                                                                  | A boolean.                         |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |              |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| Values      | <i>char</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | A character. |
| Description | The function <code>write-serial-port-char</code> writes the character <i>char</i> to the serial port associated with <i>serial-port</i> , and returns <i>char</i> .<br><br>A timeout will occur if the character cannot be written before the write timeout (as specified by values given when the serial port was opened by <code>open-serial-port</code> ).<br><br>When a timeout occurs, if <i>timeout-error-p</i> is non-nil, then an error of type <code>serial-port-timeout</code> is signaled, otherwise <code>nil</code> is returned. The default value of <i>timeout-error-p</i> is <code>t</code> . |              |
| See also    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |              |

|             |                        | <i>Function</i>                                                                                                                                                                                           |
|-------------|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     |                        | Writes a string to a serial port.                                                                                                                                                                         |
| Package     |                        | <code>serial-port</code>                                                                                                                                                                                  |
| Signature   |                        | <code>write-serial-port-string string serial-port &amp;optional<br/>timeout-error-p &amp;key start end -&gt; nwritten</code>                                                                              |
| Arguments   | <i>string</i>          | A string.                                                                                                                                                                                                 |
|             | <i>serial-port</i>     | A <code>serial-port</code> object.                                                                                                                                                                        |
|             | <i>timeout-error-p</i> | A boolean.                                                                                                                                                                                                |
|             | <i>start, end</i>      | Bounding index designators for <i>string</i> .                                                                                                                                                            |
| Values      | <i>result</i>          | The string <i>string</i> or <code>nil</code> .                                                                                                                                                            |
| Description |                        | The function <code>write-serial-port-string</code> writes characters from the subsequence of <i>string</i> bounded by <i>start</i> and <i>end</i> to the serial port associated with <i>serial-port</i> . |

The default values of *start* and *end* are 0 and `nil` (interpreted as the length of *string*) respectively.

If the characters are successfully written then *string* is returned.

A timeout will occur if the characters cannot be written before the write timeout (as specified by values given when the serial port was opened by `open-serial-port`).

When a timeout occurs, if *timeout-error-p* is non-nil, then an error of type `serial-port-timeout` is signaled, otherwise `nil` is returned. The default value of *timeout-error-p* is `t`.

See also

`write-serial-port-char`

# 47

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## The SQL Package

This chapter describes the symbols available in the `sql` package which implements Common SQL. You should use this chapter in conjunction with Chapter 23, “Common SQL”. In particular that chapter contains more information about the Oracle LOB interface (that is, those functions with names beginning `sql:ora-lob-`).

On Microsoft Windows, Linux, x86/x64 Solaris, FreeBSD, AIX and Mac OS X, Common SQL is included only in LispWorks Enterprise Edition.

| accepts-n-syntax | <i>Function</i>                                                                              |
|------------------|----------------------------------------------------------------------------------------------|
| Summary          | Return whether a database connection accepts or requires the N syntax for non-ASCII strings. |
| Package          | <code>sql</code>                                                                             |
| Signature        | <code>accepts-n-syntax &amp;key database =&gt; nil-t-required</code>                         |
| Arguments        | <code>database</code> A database object (default <code>*default-data-base*</code> ).         |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Values      | <code>nil-t-required</code> <code>t</code> , <code>nil</code> or <code>:required</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Description | The function <code>accepts-n-syntax</code> returns <code>nil-t-required</code> to indicate the behavior of the N syntax for string literals in the database specified by <i>database</i> . (The N syntax prefixes a string literal by the character N.)<br><br><code>nil-t-required</code> can be one of:<br><br><code>nil</code> the database will give an error.<br><code>T</code> the database accepts it but does not require it.<br><code>:required</code> the database requires it (at least in some cases).<br><br>Currently, Microsoft SQL Server (which can be used via ODBC) is the only supported database that requires the N syntax for non-ASCII strings. SQLite and Microsoft Access (via ODBC) give errors. The other supported databases accept the syntax but do not need it.<br><br>If you use the “Symbolic SQL syntax” on page 358, then you can use the <code>string</code> pseudo-operator, which is described in “SQL string literals” on page 366 to obtain the correct syntax. |
| See also    | <a href="#">“SQL string literals” on page 366</a><br><a href="#">“Using non-ASCII strings on Microsoft SQL Server” on page 391</a><br><code>string-needs-n-prefix</code><br><code>string-prefix-with-n-if-needed</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

|         | <b>Function</b>                                                          |
|---------|--------------------------------------------------------------------------|
| Summary | Adds a stream to the broadcast list for SQL commands or results traffic. |
| Package | <code>sql</code>                                                         |

*This chapter applies to the Enterprise Edition only*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                              |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| Signature   | <code>add-sql-stream <i>stream</i> &amp;key <i>type database</i> =&gt; <i>added-stream</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                              |
| Arguments   | <i>stream</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | A stream, or t.              |
|             | <i>type</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | A keyword.                   |
|             | <i>database</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | A database.                  |
| Values      | <i>added-stream</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | The argument <i>stream</i> . |
| Description | <p>The function <code>add-sql-stream</code> adds the stream <i>stream</i> to the list of streams which receive SQL commands traffic or results traffic.</p> <p>To add <code>*standard-output*</code> to the list, pass <i>stream</i> t.</p> <p>The argument <i>type</i> is one of <code>:commands</code>, <code>:results</code> or <code>:both</code>, and determines whether a stream for commands traffic, results traffic, or both is added.</p> <p>The argument <i>type</i> has a default value of <code>:commands</code>. The <i>database</i> is the value of <code>*default-database*</code> by default.</p> |                              |
| See also    | <code>*default-database*</code><br><code>delete-sql-stream</code><br><code>list-sql-streams</code><br><code>sql-recording-p</code><br><code>sql-stream</code><br><code>start-sql-recording</code><br><code>stop-sql-recording</code>                                                                                                                                                                                                                                                                                                                                                                               |                              |

|                       | <i>Function</i>                                                                                         |
|-----------------------|---------------------------------------------------------------------------------------------------------|
| <b>attribute-type</b> |                                                                                                         |
| Summary               | Returns the type of an attribute.                                                                       |
| Package               | <code>sql</code>                                                                                        |
| Signature             | <code>attribute-type <i>attribute table</i> &amp;key <i>database owner</i> =&gt; <i>datatype</i></code> |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                    |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|
| Arguments   | <i>table</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | A table.                                           |
|             | <i>attribute</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | An attribute from <i>table</i> .                   |
|             | <i>database</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | A database.                                        |
|             | <i>owner</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <i>nil</i> , <i>:all</i> or a string.              |
| Values      | <i>datatype</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | A keyword or list denoting a vendor-specific type. |
| Description | <p>The function <b>attribute-type</b> returns the type of the attribute specified by <i>attribute</i> in the table given by <i>table</i>. The database, in which <i>table</i> is found, has a default value of <b>*default-database*</b>.</p> <p>If <i>owner</i> is <i>nil</i>, only user-owned attributes are considered. This is the default.</p> <p>If <i>owner</i> is <i>:all</i>, all attributes are considered.</p> <p>If <i>owner</i> is a string, this denotes a username and only attributes owned by <i>owner</i> are considered.</p> <p><i>datatype</i> demotes a vendor-specific type. Examples in a MS Access database are <b>:integer</b>, <b>:longchar</b> and <b>:datetime</b>. When <i>datatype</i> is a list, the second element is the length of the type, for example <b>(:varchar 255)</b>.</p> |                                                    |
| Example     | <p>To print the type of every attribute in the database, do</p> <pre>(loop for tab in       (sql:list-tables)       do         (loop for att in               (sql:list-attributes tab)               do                 (format t "&amp;Table ~S Attribute ~S Type ~S"                         tab att                         (sql:attribute-type att tab))))</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                    |

*This chapter applies to the Enterprise Edition only*

See also      **\*default-database\***  
              **list-attribute-types**  
              **list-attributes**

| cache-table-queries |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Function                                                           |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|
| Summary             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Controls the caching of attribute type information.                |
| Package             | sql                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                    |
| Signature           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <code>cache-table-queries table &amp;key database action</code>    |
| Arguments           | <i>table</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | A string naming a table, <code>:default</code> or <code>t</code> . |
|                     | <i>database</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | A database.                                                        |
|                     | <i>action</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <code>t</code> , <code>nil</code> or <code>:flush</code> .         |
| Description         | <p>The function <code>cache-table-queries</code> provides per-table control on the caching in a particular database connection of attribute type information using during update operations.</p> <p>If <i>table</i> is a string, it is the name of the table for which caching is to be altered. If <i>table</i> is <code>t</code>, then the <i>action</i> applies to all tables. If <i>table</i> is <code>:default</code>, then the default caching action is set for those tables which do not have an explicit setting.</p> <p><i>database</i> specifies the database connection, its default value is the value of <code>*default-database*</code>.</p> <p><i>action</i> specifies the caching action. The value <code>t</code> means cache the attribute type information. The value <code>nil</code> means do not cache the attribute type information. If <i>table</i> is <code>:default</code>, the setting applies to all tables which do not have an explicit setup.</p> <p>The value <code>:flush</code> means remove any existing cache for <i>table</i> in <i>database</i>, but continue to cache.</p> |                                                                    |

`cache-table-queries` should be called with `action :flush` when the attribute specifications in `table` have changed.

See also      **\*cache-table-queries-default\***  
**\*default-database\***

### **\*cache-table-queries-default\***                                                                  *Variable*

Package      `sql`

Initial value      `nil`

Description      The variable **\*cache-table-queries-default\*** provides the default attribute type caching behavior.  
It allowed values are as described for the `action` argument of `cache-table-queries`.

See also      `cache-table-queries`

### **commit**                                                                  *Function*

Summary      Commits changes made to a database.

Package      `sql`

Signature      `commit &key database => nil`

Arguments      `database`      A database.

Values      `nil`

Description      The function `commit` commits changes made to the database specified by `database`, which is **\*default-database\*** by default.

*This chapter applies to the Enterprise Edition only*

Example      This example changes records in a database, and uses `commit` to make those changes permanent.

```
(insert-records :into [emp]
                    :attributes '(x y z)
                    :values '(a b c))
(update-records [emp]
                :attributes [dept]
                :values 50
                :where [= [dept] 40])
(delete-records :from [emp]
                :where [> [salary] 300000])
(commit)
```

See also      `*default-database*`  
`rollback`  
`with-transaction`

|                | <i>Function</i>                                                                                                                                                                                                                                                                                                                                             |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>connect</b> |                                                                                                                                                                                                                                                                                                                                                             |
| Summary        | Opens a connection to a database.                                                                                                                                                                                                                                                                                                                           |
| Package        | <code>sql</code>                                                                                                                                                                                                                                                                                                                                            |
| Signature      | <code>connect connection-spec &amp;key if-exists database-type interface name encoding signal-rollback-errors default-table-type default-table-extra-options date-string-format sql-mode prefetch-rows-number prefetch-memory sqlite-keywords =&gt; database</code>                                                                                         |
| Arguments      | <code>connection-spec</code> The connection specifications.<br><code>if-exists</code> A keyword.<br><code>database-type</code> A database type.<br><code>interface</code> A displayed CAPI element, or <code>nil</code> .<br><code>name</code> A Lisp object.<br><code>encoding</code> A keyword naming an encoding.<br><code>signal-rollback-errors</code> |

`nil`, the keyword `:default`, or a function designator.

`default-table-type` A string, the keyword  
`:support-transactions`, or `nil`.

`default-table-extra-options`

A string or `nil`.

`date-string-format` A string, or the keyword `:standard`, or `nil`.

`sql-mode` A string or `nil`.

`prefetch-rows-number`

An integer or the keyword `:default`.

`prefetch-memory` An integer or the keyword `:default`.

`sqlite-keywords` A property list of keywords and values specific to SQLite.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| Values      | <code>database</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | A database. |
| Description | <p>The function <code>connect</code> opens a connection to a database of type <code>database-type</code>.<br/> The allowed values for <code>database-type</code> are <code>:odbc</code>, <code>:odbc-driver</code>, <code>:mysql</code>, <code>:postgresql</code>, <code>:oracle8</code> and <code>:oracle</code>, though not all of these are supported on some platforms. See “Supported databases” on page 333 for details of per-platform database support.</p> <p>The default for <code>database-type</code> is the value of <code>*default-database-type*</code>.</p> <p><code>connect</code> sets the variable <code>*default-database*</code> to an instance of the database opened, and returns that instance.</p> <p>If <code>connection-spec</code> is a list it is interpreted as a plist of keywords and values. Some of the keywords are <code>database-type</code> specific: see “Connecting to Oracle”, “Connecting to ODBC”, “Connecting to MySQL” or “Connecting to PostgreSQL” as appropriate.</p> |             |

General *connection-spec* keywords are:

- |                    |                                                                                                                                                                                                                              |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>:username</b>   | User name                                                                                                                                                                                                                    |
| <b>:password</b>   | Password                                                                                                                                                                                                                     |
| <b>:connection</b> | A specification of the connection. In general, this is supposed to be sufficient information (other than the username and password) to open a connection. The precise meaning varies according to the <i>database-type</i> . |

If *connection-spec* is a string, it is interpreted canonically as:

*username/password@connection*

where *connection* can be omitted along with the '@' in cases when there is a default connection, *password* can be omitted along with the preceding '/', and *username* can be omitted if there is a default user. For example, if you have an Oracle user matching the current Unix username and that does not need a password to connect, you can call

```
(connect "/")
```

Specific *database-types* may allow more elaborate syntax, but conforming to the pattern above. See the section “Initialization” on page 334 for details.

Additionally for *database-types* :**odbc** and :**odbc-driver**, if *connection-spec* does not include the '@' character then the string is interpreted in a special way, for backward compatibility with LispWorks 4.4 and earlier versions. See the section “Connecting to ODBC” on page 339 for details.

*name* can be passed to explicitly specify the name of the connection. If *name* is supplied then it is used as-is for the connection name. Therefore it can be found by another call to **connect** and calls to **find-database**. Connection names are compared with **equalp**. If *name* is not supplied, then a unique database name is constructed from *connection-spec* and a counter.

If *name* is supplied then existing connections are found by comparing their name with *name* and then *if-exists* modifies the behavior of `connect` as follows:

|                        |                                                                                        |
|------------------------|----------------------------------------------------------------------------------------|
| <code>:new</code>      | Makes a new connection even if connections to the same database already exist.         |
| <code>:warn-new</code> | Makes a new connection but warns about existing connections.                           |
| <code>:error</code>    | Makes a new connection but signals an error for existing connections.                  |
| <code>:warn-old</code> | Selects an existing connection if there is one (and warns), or makes a new connection. |
| <code>:old</code>      | Selects an existing connection if there is one, or makes a new one.                    |

The default value of *if-exists* is the value of `*connect-if-exists*`.

*interface* is used if `connect` needs to display a dialog to ask the user for username and password. If *interface* is a CAPI element, this is used. If *interface* is any other value (the default value is `nil`), and `connect` is called in a process which is associated with a CAPI interface, then this CAPI interface is used. *interface* has been added because dialogs asking for passwords can fail otherwise. This depends on the driver that the datasource uses: the problem has only been observed using MS SQL on Microsoft Windows.

*encoding* specifies the encoding to use in the connection. The value should be a keyword naming an acceptable encoding, or `nil` (the default). The value `:unicode` is accepted for all *database-types*, and this will try to make a connection that can support sending and retrieving double-byte string values. Other values are *database-type* specific:

|                     |                                                                                                                                                                     |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>:mysql</code> | If <i>encoding</i> is <code>nil</code> or <code>:default</code> then the encoding is chosen according to the default character set of the connection (if available) |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|

and if that fails the encoding `:utf-8` is used. The other recognized values of *encoding* are `:unicode`, `:utf-8`, `:ascii`, `:latin-1`, `:euc` and `:sjis`.

`:unicode` uses `:utf-8` internally.

- `:postgresql` If *encoding* is `nil` or `:default` LispWorks does not set anything in the connection. If the connection character set is SQL\_ASCII, LispWorks uses `:latin-1` to convert to and from Lisp strings, otherwise it uses `:utf-8`. If *encoding* is one of the keywords listed below, LispWorks uses it as the external format for converting to and from Lisp strings, and LispWorks also sets the connection character set to the corresponding string:

| Keyword               | character-set | alias                   |
|-----------------------|---------------|-------------------------|
| <code>:utf-8</code>   | UTF-8         | <code>:unicode</code>   |
| <code>:latin-1</code> | SQL_ASCII     |                         |
| <code>:ascii</code>   | SQL_ASCII     |                         |
| <code>:gbk</code>     | GBK           |                         |
| <code>:euc-jp</code>  | EUC_JP        | <code>:euc</code>       |
| <code>:sjis</code>    | SJIS          | <code>:shift-jis</code> |

An alias maps to the corresponding keyword.

In addition, *encoding* can be a string or a cons of a keyword and a string. If it is a string LispWorks uses `:utf-8` as the external format, and sets the connection character set to the string. If it is a cons, the keyword (the car) is used as the external format, and the string (cdr) is used to set the character set.

See "character set support" in the PostgreSQL manual for known character sets.

- `:oracle` The only recognized values of *encoding* are `nil` and `:unicode`.

**:oracle8**      *encoding* is ignored.

**:odbc OR :odbc-driver**

The valid values of *encoding* are **:unicode** or **:nil**. When *encoding* is **:nil** it uses the default multibyte encoding.

**:sqlite**      If *encoding* is **:default**, **:unicode** or **:utf-8** then UTF-8 is used (by calling the C function `sqlite3_open_v2`). If *encoding* is **:utf-16** or **:utf-16-native**, then UTF-16 in the native byte order is used (by calling the C function `sqlite3_open16`). It is not obvious in what circumstances UTF-16 is better and it is made available only because the underlying library supports it.

*signal-rollback-errors* controls what happens when an attempted **rollback** causes an error, for databases that do not support rollback properly (for example MySQL with the default settings). For *database-types* other than **:mysql signal-rollback-errors** is ignored and such an error is always signaled. For *database-type* **:mysql signal-rollback-errors** is interpreted as follows:

**:nil**      Ignore the error.

**:default**      If *default-table-type* is **:support-transactions**, "innodb" or "bdb", then rollback errors are signaled. Otherwise rollback errors are not signaled.

#### Function designator

The function *signal-rollback-errors* should take two arguments: the database object and a string (for an error message). The function is called when a rollback signaled an error.

The default value of *signal-rollback-errors* is **:default**.

*default-table-type* specifies the default value of the `:type` argument to `create-table`. See `create-table` for details. The default value of *default-table-type* is `nil`.

*default-table-extra-options* specifies the default value of the `:extra-options` argument to `create-table`. See `create-table` for details. The default value of *default-table-extra-options* is `nil`.

*date-string-format* specifies which format to use to represent dates. If the value is a string, it should be appropriate for the *database-type*. The value `:standard` means that the standard SQL date format is used. If the value is `nil` (the default), then the date format is not changed. Currently only *database-type :oracle* uses the value of *date-string-format*, and in this case it must be a valid date format string for Oracle.

*sql-mode* specifies the mode of the SQL connection for *database-type :mysql*. By default (that is, when *sql-mode* is not supplied) `connect` sets the mode of the connection to ANSI, by executing this statement:

```
"set sql_mode='ansi'"
```

*sql-mode* can be supplied as `nil`, in which case no statement is executed. Otherwise it should be a string which is a valid setting for `sql_mode`, and then `connect` executes the statement:

```
set sql_mode='sql-mode'
```

When *database-type* is not `:mysql`, *sql-mode* is ignored.

*prefetch-rows-number* and *prefetch-memory* are used when *database-type* is `:oracle`, and specify the amount of data to prefetch when performing queries. *prefetch-rows-number* is the number of rows to prefetch, with default value 100. *prefetch-memory* is the maximum number of bytes to prefetch, with default value `#x100000`. *prefetch-rows-number* and *prefetch-memory* can both also have the value `:default`, which allows the database to choose the amount to prefetch.

`sqlite-keywords` is used only when connecting to SQLite (`database-type` is `:sqlite`) and is ignored otherwise. See “SQLite connection keywords” on page 344 for more details.

|                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes               | All the Common SQL functions that accept the keyword argument <code>:database</code> use <code>find-database</code> to find the database if the given value is not a database. Therefore these functions can now find only databases that were opened with an explicit <i>name</i> :                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                     | <pre>(connect ... :name name ...)</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Compatibility notes | <p>LispWorks 4.4 (and previous versions) use <i>connection-spec</i> passed to <code>connect</code> as the database name. <code>connect</code> checks whether a connection with this name already exists (according to the value of <code>if-exists</code>). <code>find-database</code> can be used to find a database using this name.</p> <p>LispWorks 5.0 (and later versions) does not use <i>connection-spec</i> as the name. Instead, by default it generates a name from the <i>connection-spec</i>. The name is intended to be unique (by including a counter). Thus normally <code>connect</code> will not find an existing connection even if it is called again with identical value of <i>connection-spec</i>.</p> |

Example The following example connects LispWorks to the `info` database.

```
(connect "info")
```

The next example connects to the ODBC database `personnel` using the username "admin" and the password "secret".

```
(connect "personnel/admin/secret" :database-type :odbc)
```

The next example opens a connection to MySQL which treats quotes as in ANSI but does not set other ANSI features:

```
(sql:connect "me/mypassword/mydb"
             :sql-mode "ANSI_QUOTES")
```

See also      **\*default-database\***  
                **\*default-database-type\***  
                **connected-databases**  
                **\*connect-if-exists\***  
                **database-name**  
                **disconnect**  
                **find-database**  
                **reconnect**  
                **status**

## **\*connect-if-exists\***

*Variable*

|                  |                                                                                                                                                                 |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary          | The default value for the <i>if-exists</i> keyword of the <b>connect</b> function.                                                                              |
| Package          | <b>sql</b>                                                                                                                                                      |
| Initial value    | <b>:error</b>                                                                                                                                                   |
| Description      | The variable <b>*connect-if-exists*</b> is the default value for the <i>if-exists</i> keyword of the <b>connect</b> function. It can take the following values: |
| <b>:new</b>      | Instructs <b>connect</b> to make a new connection even if connections to the same database already exist.                                                       |
| <b>:warn-new</b> | Instructs <b>connect</b> to make a new connection but warn about existing connections.                                                                          |
| <b>:error</b>    | Instructs <b>connect</b> to make a new connection but signal an error for existing connections.                                                                 |
| <b>:warn-old</b> | Instructs <b>connect</b> to select an old connection if one exists (and warns) or make a new one.                                                               |
| <b>:old</b>      | Instructs <b>connect</b> to select an old connection if one exists or make a new one.                                                                           |

See also      **connect**

## **connected-databases** *Function*

Summary      Returns a list of connected databases.

Package      **sql**

Signature      **connected-databases => database-list**

Arguments      None.

Values      **database-list**      A list of connected databases.

Description      The function **connected-databases** returns a list of the databases LispWorks is connected to.

See also      **connect**  
**disconnect**  
**status**  
**find-database**  
**database-name**

## **create-index** *Function*

Summary      Creates an index for a table.

Package      **sql**

Signature      **create-index name &key on unique attributes database =>**

Arguments      **name**      The name of the index.

**on**      The name of a table.

**unique**      A boolean.

*This chapter applies to the Enterprise Edition only*

|             |                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <i>attributes</i> | A list of attributes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|             | <i>database</i>   | A database.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Values      |                   | None.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Description |                   | The function <code>create-index</code> creates an index called <i>name</i> on the table specified by <i>on</i> . The attributes of the table to index are given by <i>attributes</i> . Setting <i>unique</i> to <code>t</code> includes <code>UNIQUE</code> in the SQL index command, specifying that the columns indexed must contain unique values.<br><br>The default value of <i>unique</i> is <code>nil</code> . The default value of <i>database</i> is <code>*default-database*</code> . |
| Example     |                   | <pre>(create-index [manager]   :on [emp] :unique t :attributes '([ename] [sal]))</pre>                                                                                                                                                                                                                                                                                                                                                                                                          |
| See also    |                   | <code>*default-database*</code><br><code>drop-index</code><br><code>create-table</code>                                                                                                                                                                                                                                                                                                                                                                                                         |

|           |                      | <i>Function</i>                                                                       |
|-----------|----------------------|---------------------------------------------------------------------------------------|
|           | <b>create-table</b>  |                                                                                       |
| Summary   |                      | Creates a table.                                                                      |
| Package   |                      | <code>sql</code>                                                                      |
| Signature |                      | <code>create-table name description &amp;key database type extra-options</code>       |
| Arguments | <i>name</i>          | The name of the table.                                                                |
|           | <i>description</i>   | The table properties.                                                                 |
|           | <i>database</i>      | A database.                                                                           |
|           | <i>type</i>          | A string or the keyword<br><code>:support-transactions</code> , or <code>nil</code> . |
|           | <i>extra-options</i> | A string or <code>nil</code> .                                                        |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Values      | None.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Description | <p>The function <code>create-table</code> creates a table called <i>name</i> and defines its columns and other properties with <i>description</i>. The argument <i>description</i> is a list containing lists of attribute-name and type information pairs.</p> <p>The default value of <i>database</i> is <code>*default-database*</code>.</p> <p><i>type</i> and <i>extra-options</i> are treated in a <i>database-type</i> specific way. Currently only <i>database-type</i> <code>:mysql</code> uses these options, as follows.</p> <p>If <i>type</i> is not supplied, it defaults to the value (if any) of <i>default-table-type</i> that was supplied to <code>connect</code>. If <i>extra-options</i> is not supplied, it defaults to the value (if any) of <i>default-table-extra-options</i> that was supplied to <code>connect</code>.</p> <p><i>type</i>, if non-nil, is used as argument to TYPE in the SQL statement:</p> <pre>create table MyTable (<i>column-specs</i>) TYPE = <i>type</i></pre> <p>except that if <i>type</i> is <code>:support-transactions</code> then <code>create-table</code> will attempt to make tables that support transactions, by using the type <code>innodb</code>.</p> <p><i>extra-options</i> (if non-nil) is appended in the end of this SQL statement.</p> <p>When <i>database-type</i> is not <code>:mysql</code>, <i>type</i> and <i>extra-options</i> are ignored.</p> |
| Example     | <p>The following code:</p> <pre>(create-table [manager]   '(([id] (char 10) not-null)     ([salary] (number 8 2))))</pre> <p>is equivalent to the following SQL:</p> <pre>CREATE TABLE MANAGER   (ID CHAR(10) NOT NULL, SALARY NUMBER(8,2))</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

*This chapter applies to the Enterprise Edition only*

See also

`connect`  
`*default-database*`  
`drop-table`

## **create-view**

*Function*

Summary      Creates a view using a specified query.

Package      `sql`

Signature      `create-view name &key as column-list with-check-option database =>`

Arguments      `name`      The view to be created.

`as`      A SQL query statement.

`column-list`      A list.

`with-check-option`

                A boolean.

`database`      A database.

Values      None.

Description      The function `create-view` creates a view called `name` using the `as` query and the optional `column-list` and `with-check-option`. The `column-list` argument is a list of columns to add to the view. The `with-check-option` adds `WITH CHECK OPTION` to the resulting SQL.

The default value of `with-check-option` is `nil`. The default value of `database` is `*default-database*`.

Example      This example creates the view `manager` with the records in the employee table whose department is 50.

```
(create-view [manager] :as [select [*]
                           :from [emp]
                           :where [= [dept] 50]])
```

See also

**create-index**  
**create-table**  
**\*default-database\***  
**drop-view**

## create-view-from-class *Function*

Summary      Creates a view in a database based on a class that defines the view.

Package      **sql**

Signature     **create-view-from-class** *class* &**key** *database* =>

Arguments     *class*                A class.  
                 *database*            A database.

Values        None.

Description    The function **create-view-from-class** creates a view in *database* based on *class* which defines the view. The argument *database* has a default value of **\*default-database\***.

See also     **\*default-database\***  
              **drop-view-from-class**  
              **create-view**

## database-name *Function*

Summary       Returns the name of a database.

*This chapter applies to the Enterprise Edition only*

|             |                                                                                                                                          |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>sql</code>                                                                                                                         |
| Signature   | <code>database-name database =&gt; connection</code>                                                                                     |
| Arguments   | <code>database</code> A database.                                                                                                        |
| Values      | <code>connection</code> A string.                                                                                                        |
| Description | The function <code>database-name</code> returns the name of the database specified by <code>database</code> .                            |
| See also    | <code>connect</code><br><code>disconnect</code><br><code>connected-databases</code><br><code>find-database</code><br><code>status</code> |

## decode-to-db-standard-date

## decode-to-db-standard-timestamp

## *Functions*

|           |                                                                                                                                                                                                    |                                                          |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|
| Summary   | Convert Lisp universal time to standard SQL DATE and TIMESTAMP.                                                                                                                                    |                                                          |
| Package   | <code>sql</code>                                                                                                                                                                                   |                                                          |
| Signature | <code>decode-to-db-standard-date universal-time &amp;key stream quoted =&gt; date</code><br><br><code>decode-to-db-standard-timestamp universal-time &amp;key stream quoted =&gt; timestamp</code> |                                                          |
| Arguments | <code>universal-time</code>                                                                                                                                                                        | A universal time.                                        |
|           | <code>stream</code>                                                                                                                                                                                | <code>nil</code> , <code>t</code> , or an output stream. |
|           | <code>quoted</code>                                                                                                                                                                                | A boolean.                                               |
| Values    | <code>date</code>                                                                                                                                                                                  | A string or <code>nil</code> .                           |

|             |                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                             |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <b>timestamp</b>                                                                                                                                                                    | A string or <code>nil</code> .                                                                                                                                                                                                                                                                                              |
| Description | The functions <code>decode-db-standard-date</code> and <code>decode-db-standard-timestamp</code> take a Lisp universal time and convert it to a SQL DATE or TIMESTAMP respectively. |                                                                                                                                                                                                                                                                                                                             |
|             |                                                                                                                                                                                     | The format of the date is YYYY-MM-DD.                                                                                                                                                                                                                                                                                       |
|             |                                                                                                                                                                                     | The format of the timestamp is YYYY-MM-DD HH:MM:SS.                                                                                                                                                                                                                                                                         |
|             |                                                                                                                                                                                     | <code>stream</code> is interpreted as in <code>cl:format</code> . If <code>stream</code> is <code>nil</code> then the string representing the DATE or TIMESTAMP is returned, otherwise the string is written to the stream and <code>nil</code> is returned. The default value of <code>stream</code> is <code>nil</code> . |
|             |                                                                                                                                                                                     | When <code>quoted</code> is true, the date or timestamp is quoted (by single quote). This is useful when these functions are used while building a SQL command string, and the result should be interpreted as a string. The default value of <code>quoted</code> is <code>nil</code> .                                     |
| See also    | <code>encode-db-standard-date</code><br><code>encode-db-standard-timestamp</code><br><code>connect</code><br>“Working with date fields” on page 370                                 |                                                                                                                                                                                                                                                                                                                             |

**encode-db-standard-date****encode-db-standard-timestamp***Functions*

|           |                                                                                                                                          |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------|
| Summary   | Convert standard SQL DATE and TIMESTAMP to Lisp universal time.                                                                          |
| Package   | <code>sql</code>                                                                                                                         |
| Signature | <code>encode-db-standard-date date-string =&gt; result</code><br><code>encode-db-standard-timestamp timestamp-string =&gt; result</code> |
| Arguments | <code>date-string</code> A string.                                                                                                       |

*This chapter applies to the Enterprise Edition only*

*timestamp-string* A string.

|             |               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Values      | <i>result</i> | A Lisp universal time or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Description |               | The functions <code>encode-db-standard-date</code> and <code>encode-db-standard-timestamp</code> interpret their argument as a DATE or TIMESTAMP and return the corresponding universal time.<br><br><i>date-string</i> must be a string of length at least 10, where the first 10 characters specify a DATE, that is have the format YYYY-MM-DD.<br><br><i>timestamp-string</i> must be a string of length at least 19, where the first 19 characters specify a TIMESTAMP, that is have the format YYYY-MM-DD HH:MM:SS.<br><br><code>encode-db-standard-date</code> and <code>encode-db-standard-timestamp</code> do not actually check the separators between the numeric values, so the hyphens, space and colons can each be replaced by any character. Both functions return <code>nil</code> if the argument is not correct. |
| See also    |               | <code>decode-to-db-standard-date</code><br><code>decode-to-db-standard-timestamp</code><br><code>connect</code><br>“Working with date fields” on page 370                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

## \*default-database\*

*Variable*

|               |                                                                                                                                                    |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary       | The default database in database operations.                                                                                                       |
| Package       | <code>sql</code>                                                                                                                                   |
| Initial value | <code>nil</code>                                                                                                                                   |
| Description   | The variable <code>*default-database*</code> is set by <code>connect</code> and specifies the default database to be used for database operations. |

See also      **connect**

**\*default-database-type\***                          *Variable*

Summary      Specifies the default type of database.

Package      **sql**

Initial value      **nil**

Description      The variable **\*default-database-type\*** specifies the default type of database. You can set this or it is initialized by the **initialize-database-type** function.

LispWorks supports the values shown in “Supported databases” on page 333.

See also      **initialize-database-type**

**\*default-update-objects-max-len\***                          *Variable*

Summary      The default maximum number of objects supplying data for a query when updating remote joins.

Package      **sql**

Initial value      **nil**

Description      The variable **\*default-update-objects-max-len\*** provides the default value of the *max-len* argument in the function **update-objects-joins**.

See also      **update-objects-joins**

| Macro                      | def-view-class                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                    |                                                                                                                                                                                                                                   |                           |                                                                                                                                                                                                                                                                          |                    |                                        |                            |                                     |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|----------------------------------------|----------------------------|-------------------------------------|
| Summary                    | Extends the syntax of <code>defclass</code> to allow specified slots to be mapped onto the attributes of database views.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                    |                                                                                                                                                                                                                                   |                           |                                                                                                                                                                                                                                                                          |                    |                                        |                            |                                     |
| Package                    | <code>sql</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                    |                                                                                                                                                                                                                                   |                           |                                                                                                                                                                                                                                                                          |                    |                                        |                            |                                     |
| Signature                  | <code>def-view-class name superclasses slots &amp;rest class-options =&gt; class</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                    |                                                                                                                                                                                                                                   |                           |                                                                                                                                                                                                                                                                          |                    |                                        |                            |                                     |
| Arguments                  | <table><tr><td><code>name</code></td><td>A class name.</td></tr><tr><td><code>superclasses</code></td><td>The superclasses of the class to be created.</td></tr><tr><td><code>slots</code></td><td>The slot definitions of the new class.</td></tr><tr><td><code>class-options</code></td><td>The class options of the new class.</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <code>name</code>  | A class name.                                                                                                                                                                                                                     | <code>superclasses</code> | The superclasses of the class to be created.                                                                                                                                                                                                                             | <code>slots</code> | The slot definitions of the new class. | <code>class-options</code> | The class options of the new class. |
| <code>name</code>          | A class name.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                    |                                                                                                                                                                                                                                   |                           |                                                                                                                                                                                                                                                                          |                    |                                        |                            |                                     |
| <code>superclasses</code>  | The superclasses of the class to be created.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                    |                                                                                                                                                                                                                                   |                           |                                                                                                                                                                                                                                                                          |                    |                                        |                            |                                     |
| <code>slots</code>         | The slot definitions of the new class.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                    |                                                                                                                                                                                                                                   |                           |                                                                                                                                                                                                                                                                          |                    |                                        |                            |                                     |
| <code>class-options</code> | The class options of the new class.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                    |                                                                                                                                                                                                                                   |                           |                                                                                                                                                                                                                                                                          |                    |                                        |                            |                                     |
| Values                     | <table><tr><td><code>class</code></td><td>The defined class.</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <code>class</code> | The defined class.                                                                                                                                                                                                                |                           |                                                                                                                                                                                                                                                                          |                    |                                        |                            |                                     |
| <code>class</code>         | The defined class.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                    |                                                                                                                                                                                                                                   |                           |                                                                                                                                                                                                                                                                          |                    |                                        |                            |                                     |
| Slot Options               | <p>The slot options for <code>def-view-class</code> are <code>:db-kind</code> and <code>:db-info</code>. In addition the slot option <code>:type</code> is treated specially for View Classes.</p> <p><code>:db-kind</code> may be one of <code>:base</code>, <code>:key</code>, <code>:join</code>, or <code>:virtual</code>. The default is <code>:base</code>. Each value is described below:</p> <table><tr><td><code>:base</code></td><td>This indicates that this slot corresponds to an ordinary attribute of the database view. You can name the database attribute by using the keyword <code>:column</code>. By default, the database attribute is named by the slot.</td></tr><tr><td><code>:key</code></td><td>This indicates that this slot corresponds to part of the unique key for this view. A <code>:key</code> slot is also a <code>:base</code> slot. All View Classes must have <code>:key</code> fields that uniquely distinguish the instances, to maintain object identity.</td></tr></table> | <code>:base</code> | This indicates that this slot corresponds to an ordinary attribute of the database view. You can name the database attribute by using the keyword <code>:column</code> . By default, the database attribute is named by the slot. | <code>:key</code>         | This indicates that this slot corresponds to part of the unique key for this view. A <code>:key</code> slot is also a <code>:base</code> slot. All View Classes must have <code>:key</code> fields that uniquely distinguish the instances, to maintain object identity. |                    |                                        |                            |                                     |
| <code>:base</code>         | This indicates that this slot corresponds to an ordinary attribute of the database view. You can name the database attribute by using the keyword <code>:column</code> . By default, the database attribute is named by the slot.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                    |                                                                                                                                                                                                                                   |                           |                                                                                                                                                                                                                                                                          |                    |                                        |                            |                                     |
| <code>:key</code>          | This indicates that this slot corresponds to part of the unique key for this view. A <code>:key</code> slot is also a <code>:base</code> slot. All View Classes must have <code>:key</code> fields that uniquely distinguish the instances, to maintain object identity.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                    |                                                                                                                                                                                                                                   |                           |                                                                                                                                                                                                                                                                          |                    |                                        |                            |                                     |

To specify a key which spans multiple slots, each of the slots should have `:db-kind :key`. The underlying requirement is that tuples of the form (key1 ... keyN) are unique. The `:db-kind :key` slots do not need to be keys in the table.

**`:join`** This indicates that this slot corresponds to a join. A slot of this type will contain View Class objects.

**`:virtual`** This indicates that this slot is an ordinary CLOS slot not associated with a database column.

A join is defined by the slot option `:db-info`, which takes a list. Items in the list may be:

**`:join-class class-name`**

This is the class to join on.

**`:home-key slot-name`**

This is the slot of the defining class to be a subject for the join. The argument *slot-name* may be an element or a list of elements, where elements can be symbols, `nil`, strings, integers or floats.

**`:foreign-key slot-name`**

This is the name of the slot of the `:join-class` to be a subject for the join. The *slot-name* may be an element or a list of elements, where elements can be symbols, `nil`, strings, integers or floats.

*This chapter applies to the Enterprise Edition only*

**:target-slot** *target-slot*

This is the name of a **:join** slot in **:join-class**. This is optional and is only specified if you want the defining slot to contain instances of this target slot as opposed to those of **:join-class**. The actual behavior depends on the value of *set*. An example of its usage is when the **:join-class** is an intermediate class and you are really only interested in it as a route to the **:target-slot**.

**:retrieval** *retrieval-time*

*retrieval-time* can be **:deferred**, which defers filling this slot from the database until the slot itself is accessed. This is the default value.

*retrieval-time* can alternatively be **:immediate** which generates the join SQL for this slot whenever a query is generated on the class. In other words, this is an intermediate class only, which is present for the purpose of joining two entities of other classes together. When *retrieval-time* is **:immediate**, then *set* is **nil**.

**:set** *set*

When *set* is **t** and *target-slot* is defined, the slot will contain a list of pairs (*target-value join-instance*) where *target-value* is the value of the target slot and *join-instance* is the corresponding instance of the join class.

When *set* is **t** and *target-slot* is undefined, the slot will contain a list of instances of the join class.

When *set* is `nil` the slot will contain a single instance.

The default value of *set* is `t`.

The syntax for `:home-key` and `:foreign-key` means that an object from a join class will only be included in the join slot if the values from *home-key* are `equal` to the values in *foreign-key*, in order. These values are calculated as follows: if the element in the list is a symbol it is taken to be a slot name and the value of the slot is used, otherwise the element is taken to be the value. See the second example below.

The `:type` slot option is treated specially for View Classes. There is a need for stringent type-checking in View Classes because of the translation into database data, and therefore `:type` is mandatory for slots with `:db-kind :base` or `:key`. Some methods are provided for type checking and type conversion. For example, a `:type` specifier of `(string 10)` in SQL terms means allow a character type value with length of less than or equal to 10. The following Lisp types are accepted for *type*, and correspond to the SQL type shown:

|                                 |            |
|---------------------------------|------------|
| <code>(string n)</code>         | CHAR(n)    |
| <code>integer</code>            | INTEGER    |
| <code>(integer n)</code>        | INTEGER(n) |
| <code>float</code>              | FLOAT      |
| <code>(float n)</code>          | FLOAT(n)   |
| <code>sql:universal-time</code> | TIMESTAMP  |

Class Options    `def-view-class` recognizes the following class options in addition to the standard class options defined for `defclass`:

- `(:base-table table-name)`

The slots of the class *name* will be read from the table *table-name*. If you do not specify the `:base-table` option, then *table-name* defaults to the name of the class.

**Description** The macro `def-view-class` creates a class called *name* which maps onto a database view. Such a class is called a View Class.

The macro `def-view-class` extends the syntax of `defclass` to allow special *base slots* to be mapped onto the attributes of database views (presently single tables). When a `select` query that names a View Class is submitted, then the corresponding database view is queried, and the slots in the resulting View Class instances are filled with attribute values from the database.

If *superclasses* is `nil` then `standard-db-object` automatically becomes the superclass of the newly-defined View Class. If *superclasses* is `nil`, it must include `standard-db-object`.

**Examples** The following example shows a class corresponding to the traditional *employees* table, with the employee's department given by a join with the *departments* table.

```
(def-view-class employee (standard-db-object)
  ((employee-number :db-kind :key
                    :column empno
                    :type integer)
   (employee-name :db-kind :base
                  :column ename
                  :type (string 20)
                  :accessor employee-name)
   (employee-department :db-kind :base
                         :column deptno
                         :type integer
                         :accessor employee-department)
   (employee-job :db-kind :base
                 :column job
                 :type (string 9))
   (employee-manager :db-kind :base
                      :column mgr
                      :type integer)
   (employee-location :db-kind :join
                       :db-info (:join-class department
   :retrieval :deferred
   :set nil
   :home-key
   employee-department
   :foreign-key
   department-number
   :target-slot
   department-loc)
                       :accessor employee-location)
   (:base-table emp))
```

The following example illustrates how elements or lists of elements can follow `:home-key` and `:foreign-key` in the `:db-info` slot option.

```
(def-view-class flex-schema ()
  ((name       :type (string 8) :db-kind :key)
   (description :type (string 256)))
  (classes :db-kind :join
            :db-info (:home-key name
                                :foreign-key schema-name
                                :join-class flex-class
                                :retrieval :deferred)))
  (:base-table flex_schema))
```

*This chapter applies to the Enterprise Edition only*

```
(def-view-class flex-class ()
  ((schema-name :type (string 8) :db-kind :key
     :column schema_name)
   (name       :type (string 32) :db-kind :key)
   (base-name  :type (string 64) :column base_name)
   (super-classes :db-kind :join
     :db-info (:home-key
               (schema-name name)
               :foreign-key
               (schema-name class-name)
               :join-class
               flex-superclass
               :retrieval :deferred))
   (schema :db-kind :join
     :db-info (:home-key schema-name
                           :foreign-key name
                           :join-class flex-schema
                           :set nil))
   (properties :db-kind :join
     :db-info (:home-key (schema-name name ""))
               :foreign-key
               (schema-name class-name slot-name)
               :join-class flex-property
               :retrieval :deferred)))
  (:base-table flex_class))

(def-view-class flex-slot ()
  ((schema-name :type (string 8) :db-kind :key
     :column schema_name)
   (class-name :type (string 32) :db-kind :key
     :column class_name)
   (name       :type (string 32) :db-kind :key)
   (class :db-kind :join
     :db-info (:home-key (schema-name class-name)
                           :foreign-key (schema-name name)
                           :join-class flex-class
                           :set nil))
   (properties :db-kind :join
     :db-info (:home-key
               (schema-name class-name name)
               :foreign-key
               (schema-name class-name slot-name)
               :join-class flex-property
               :retrieval :deferred)))
  (:base-table flex_slot))
```

```
(def-view-class flex-property ()
  ((schema-name :type (string 8) :db-kind :key
   :column schema_name)
   (class-name :type (string 32) :db-kind :key
   :column class_name)
   (slot-name :type (string 32) :db-kind :key
   :column slot_name)
   (property :type (string 32) :db-kind :key)
   (values :db-kind :join
   :db-info (:home-key
   (schema-name class-name
   slot-name property)
   :foreign-key
   (schema-name class-name
   slot-name property)
   :join-class flex-property-value
   :retrieval :deferred)))
  (:base-table flex_property))

(def-view-class flex-property-value ()
  ((schema-name :type (string 8) :db-kind :key
   :column schema_name)
   (class-name :type (string 32) :db-kind :key
   :column class_name)
   (slot-name :type (string 32) :column slot_name)
   (property :type (string 32) :db-kind :key)
   (order :type integer)
   (value :type (string 128)))
  (:base-table flex_property_value))
```

**See also**

[create-view-from-class](#)  
[delete-instance-records](#)  
[drop-view-from-class](#)  
[standard-db-object](#)  
[update-record-from-slot](#)  
[update-records-from-instance](#)

**delete-instance-records****Generic Function**

**Summary** Deletes records corresponding to View Class instances.

**Package** `sql`

*This chapter applies to the Enterprise Edition only*

|             |                                                                                                                                                                                                                                                  |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signature   | <code>delete-instance-records <i>instance</i> =&gt;</code>                                                                                                                                                                                       |
| Arguments   | <code><i>instance</i></code> An instance of a View Class.                                                                                                                                                                                        |
| Values      | None.                                                                                                                                                                                                                                            |
| Description | The function <code>delete-instance-records</code> deletes the records represented by <i>instance</i> from the database associated with it. If <i>instance</i> has no associated database, <code>delete-instance-records</code> signals an error. |
| See also    | <code>update-records</code><br><code>update-records-from-instance</code>                                                                                                                                                                         |

## **delete-records** *Function*

|             |                                                                                                                                                                                                                                                                                         |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Deletes rows from a database table.                                                                                                                                                                                                                                                     |
| Package     | <code>sql</code>                                                                                                                                                                                                                                                                        |
| Signature   | <code>delete-records &amp;key <i>from where database</i> =&gt;</code>                                                                                                                                                                                                                   |
| Arguments   | <code><i>from</i></code> A database table.<br><code><i>where</i></code> A SQL conditional statement.<br><code><i>database</i></code> A database.                                                                                                                                        |
| Values      | None.                                                                                                                                                                                                                                                                                   |
| Description | The function <code>delete-records</code> deletes rows from a table specified by <i>from</i> in which the <i>where</i> condition is true. The argument <i>database</i> specifies a database from which the records are to be removed, and defaults to <code>*default-data-base*</code> . |

See also      **\*default-database\***  
                  **insert-records**  
                  **update-records**

## delete-sql-stream *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                              |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| Summary     | Deletes a stream from the broadcast list for SQL commands or results traffic.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                              |
| Package     | <b>sql</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                              |
| Signature   | <b>delete-sql-stream</b> <i>stream</i> & <b>key</b> <i>type database</i> => <b>deleted-stream</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                              |
| Arguments   | <b>stream</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | A stream or <i>t</i> .       |
|             | <b>type</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | A keyword.                   |
|             | <b>database</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | A database.                  |
| Values      | <b>deleted-stream</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | The argument <i>stream</i> . |
| Description | <p>The function <b>delete-sql-stream</b> deletes the stream <i>stream</i> from the list of streams which receive SQL commands or results traffic.</p> <p>To remove <b>*standard-output*</b> from the list, pass <i>stream t</i>.</p> <p>The keyword <i>type</i> is <b>:commands</b>, <b>:results</b> or <b>:both</b>. It determines whether a stream for SQL commands traffic, results traffic, or both is deleted.</p> <p>The default value of <i>type</i> is <b>:commands</b>. The default value for <i>database</i> is the value of <b>*default-database*</b>.</p> |                              |

See also      **add-sql-stream**  
                  **\*default-database\***  
                  **list-sql-streams**  
                  **sql-recording-p**  
                  **sql-stream**

*This chapter applies to the Enterprise Edition only*

```
start-sql-recording  
stop-sql-recording
```

## destroy-prepared-statement *Function*

Summary      Destroys a **prepared-statement** and frees its resources.

Package      **sql**

Signature      **destroy-prepared-statement** *prepared-statement* => **nil**

Arguments      *prepared-statement*

                  A **prepared-statement**.

Description      The function **destroy-prepared-statement** destroys the **prepared-statement** *prepared-statement* and frees its resources. It should be called before closing the database associated with *prepared-statement*. A destroyed **prepared-statement** can be reused by calling **set-prepared-statement-variables** with a new database.

**destroy-prepared-statement** always returns **nil**.

See also      **prepare-statement**  
                  **set-prepared-statement-variables**

## disable-sql-reader-syntax *Function*

Summary      Turns off square bracket syntax.

Package      **sql**

Signature      **disable-sql-reader-syntax** =>

Arguments      None.

|             |                                                                                                                                                                                                                      |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Values      | None.                                                                                                                                                                                                                |
| Description | The function <code>disable-sql-reader-syntax</code> turns off square bracket syntax and sets state so that <code>restore-sql-reader-syntax-state</code> will make the syntax disabled if it is consequently enabled. |
| See also    | <code>enable-sql-reader-syntax</code><br><code>locally-disable-sql-reader-syntax</code><br><code>locally-enable-sql-reader-syntax</code><br><code>restore-sql-reader-syntax-state</code>                             |

## disconnect *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| Summary     | Closes a connection to a database.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |
| Package     | <code>sql</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |
| Signature   | <code>disconnect &amp;key database error =&gt; success</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |
| Arguments   | <code>database</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | A database. |
|             | <code>error</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | A boolean.  |
| Values      | <code>success</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | A boolean.  |
| Description | <p>The function <code>disconnect</code> closes a connection to a database specified by <code>database</code>. If successful, <code>success</code> is <code>t</code> and if only one other connection exists, <code>*default-database*</code> is reset.</p> <p>The default value for <code>database</code> is <code>*default-database*</code>. If <code>database</code> is a database object, then it is used directly. Otherwise, the list of connected databases is searched to find one with <code>database</code> as its connection specifications (see <code>connect</code>). If no such database is found, then if <code>error</code> and <code>database</code> are both non-nil an error is signaled, otherwise <code>disconnect</code> returns <code>nil</code>.</p> |             |

*This chapter applies to the Enterprise Edition only*

Example      `(disconnect :database "test")`

See also     `connect`  
`connected-databases`  
`database-name`  
`*default-database*`  
`find-database`  
`reconnect`  
`status`

| do-query    |                                                                                                                                                                                                                                                                                                                       | Macro |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Summary     | Repeatedly binds a set of variables to the results of a query, and executes a body of code using the bound variables.                                                                                                                                                                                                 |       |
| Package     | sql                                                                                                                                                                                                                                                                                                                   |       |
| Signature   | <pre>do-query ((&amp;rest args) query &amp;key database not-inside-transaction get-all) &amp;body body =&gt;</pre>                                                                                                                                                                                                    |       |
| Arguments   | <p><i>args</i> A set of variables.</p> <p><i>query</i> A database query or a <code>prepared-statement</code> containing a query.</p> <p><i>database</i> A database.</p> <p><i>not-inside-transaction</i> A generalized boolean.</p> <p><i>get-all</i> A generalized boolean.</p> <p><i>body</i> A Lisp code body.</p> |       |
| Values      | None.                                                                                                                                                                                                                                                                                                                 |       |
| Description | The macro <code>do-query</code> repeatedly executes <i>body</i> within a binding of <i>args</i> on the attributes of each record resulting from <i>query</i> . <code>do-query</code> returns no values.                                                                                                               |       |

The default value of *database* is **\*default-database\***.

*not-inside-transaction* and *get-all* may be useful when fetching many records through a connection with *database-type* **:mysql**. Both of these arguments have default value **nil**. See the section “Special considerations for iteration functions and macros” on page 375 for details.

|         |                                                                                                                                                                                                                                               |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Example | The following code repeatedly binds the result of selecting an entry in <code>ename</code> from the table <code>emp</code> to the variable <code>name</code> , and then prints <code>name</code> using the Lisp function <code>print</code> . |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

```
(do-query ((name) [select [ename] :from [emp]])
          (print name))
```

|          |                                                                                                                                                            |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| See also | <code>loop</code><br><code>map-query</code><br><code>prepare-statement</code><br><code>query</code><br><code>select</code><br><code>simple-do-query</code> |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------|

## drop-index *Function*

|         |                                   |
|---------|-----------------------------------|
| Summary | Deletes an index from a database. |
|---------|-----------------------------------|

|         |                  |
|---------|------------------|
| Package | <code>sql</code> |
|---------|------------------|

|           |                                                       |
|-----------|-------------------------------------------------------|
| Signature | <code>drop-index index &amp;key database =&gt;</code> |
|-----------|-------------------------------------------------------|

|           |                                                                   |
|-----------|-------------------------------------------------------------------|
| Arguments | <i>index</i> The name of an index.<br><i>database</i> A database. |
|-----------|-------------------------------------------------------------------|

|        |       |
|--------|-------|
| Values | None. |
|--------|-------|

|             |                                                                                                                                                         |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | The function <code>drop-index</code> deletes <i>index</i> from <i>database</i> .<br>The default value of <i>database</i> is <b>*default-database*</b> . |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|

*This chapter applies to the Enterprise Edition only*

See also [create-index](#)  
[drop-table](#)

| drop-table  |                                                                                                                                                                 | Function             |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| Summary     | Deletes a table from a database.                                                                                                                                |                      |
| Package     | sql                                                                                                                                                             |                      |
| Signature   | <code>drop-table table &amp;key database =&gt;</code>                                                                                                           |                      |
| Arguments   | <code>table</code>                                                                                                                                              | The name of a table. |
|             | <code>database</code>                                                                                                                                           | A database.          |
| Values      | None.                                                                                                                                                           |                      |
| Description | The function <code>drop-table</code> deletes <i>table</i> from a <i>database</i> .<br>The default value of <i>database</i> is <code>*default-database*</code> . |                      |
| See also    | <code>create-table</code><br><code>*default-database*</code>                                                                                                    |                      |

|                       | <i>Function</i>                                                                                                               |                   |         |                       |             |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------|-------------------|---------|-----------------------|-------------|
| <b>drop-view</b>      |                                                                                                                               |                   |         |                       |             |
| Summary               | Deletes a view from a database.                                                                                               |                   |         |                       |             |
| Package               | <code>sql</code>                                                                                                              |                   |         |                       |             |
| Signature             | <code>drop-view view &amp;key database =&gt;</code>                                                                           |                   |         |                       |             |
| Arguments             | <table><tr><td><code>view</code></td><td>A view.</td></tr><tr><td><code>database</code></td><td>A database.</td></tr></table> | <code>view</code> | A view. | <code>database</code> | A database. |
| <code>view</code>     | A view.                                                                                                                       |                   |         |                       |             |
| <code>database</code> | A database.                                                                                                                   |                   |         |                       |             |
| Values                | None                                                                                                                          |                   |         |                       |             |

|             |                                                                                                                                                              |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | The function <code>drop-view</code> deletes <i>view</i> from <i>database</i> .<br>The default value of <i>database</i> is <code>*default-database*</code> .  |
| Notes       | <code>DROP VIEW</code> is not implemented in MS Access SQL, so <code>drop-view</code> does not work with that database. Use <code>drop-table</code> instead. |
| See also    | <code>create-view</code><br><code>*default-database*</code><br><code>drop-index</code><br><code>drop-table</code>                                            |

|                       | <b>Function</b>                                                                                                                                                                                                                       |                    |          |                       |             |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|----------|-----------------------|-------------|
| Summary               | Deletes a view from a database based on a class defining the view.                                                                                                                                                                    |                    |          |                       |             |
| Package               | <code>sql</code>                                                                                                                                                                                                                      |                    |          |                       |             |
| Signature             | <code>drop-view-from-class class &amp;key database =&gt;</code>                                                                                                                                                                       |                    |          |                       |             |
| Arguments             | <table> <tr> <td><code>class</code></td> <td>A class.</td> </tr> <tr> <td><code>database</code></td> <td>A database.</td> </tr> </table>                                                                                              | <code>class</code> | A class. | <code>database</code> | A database. |
| <code>class</code>    | A class.                                                                                                                                                                                                                              |                    |          |                       |             |
| <code>database</code> | A database.                                                                                                                                                                                                                           |                    |          |                       |             |
| Values                | None.                                                                                                                                                                                                                                 |                    |          |                       |             |
| Description           | The function <code>drop-view-from-class</code> deletes a view or base table from <i>database</i> based on <i>class</i> which defines that view. The argument <i>database</i> has a default value of <code>*default-database*</code> . |                    |          |                       |             |
| See also              | <code>create-view-from-class</code><br><code>*default-database*</code><br><code>drop-view</code>                                                                                                                                      |                    |          |                       |             |

*This chapter applies to the Enterprise Edition only*

| <b>enable-sql-reader-syntax</b> |                                                                                                                                                                                                                        | <i>Function</i> |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Summary                         | Turns on square bracket SQL syntax.                                                                                                                                                                                    |                 |
| Package                         | <code>sql</code>                                                                                                                                                                                                       |                 |
| Signature                       | <code>enable-sql-reader-syntax =&gt;</code>                                                                                                                                                                            |                 |
| Arguments                       | None.                                                                                                                                                                                                                  |                 |
| Values                          | None.                                                                                                                                                                                                                  |                 |
| Description                     | The function <code>enable-sql-reader-syntax</code> turns on square bracket syntax and sets the state so that <code>restore-sql-reader-syntax-state</code> will make the syntax enabled if it is subsequently disabled. |                 |
| See also                        | <code>disable-sql-reader-syntax</code><br><code>locally-disable-sql-reader-syntax</code><br><code>locally-enable-sql-reader-syntax</code><br><code>restore-sql-reader-syntax-state</code>                              |                 |

| <b>execute-command</b> |                                                              | <i>Function</i>                       |
|------------------------|--------------------------------------------------------------|---------------------------------------|
| Summary                | Executes a SQL expression.                                   |                                       |
| Package                | <code>sql</code>                                             |                                       |
| Signature              | <code>execute-command sql-exp &amp;key database =&gt;</code> |                                       |
| Arguments              | <code>sql-exp</code>                                         | Any SQL statement other than a query. |
|                        | <code>database</code>                                        | A database.                           |
| Values                 | None.                                                        |                                       |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | The function <code>execute-command</code> executes the SQL command specified by <code>sql-exp</code> for the database specified by <code>database</code> , which has a default value of <code>*default-database*</code> . The argument <code>sql-exp</code> may be any SQL statement other than a query.<br><br>To run a stored procedure, pass an appropriate string. The call to the procedure needs to be wrapped in a PL/SQL <code>BEGIN END</code> pair, for example: |
| See also    | <code>*default-database*</code><br><code>query</code>                                                                                                                                                                                                                                                                                                                                                                                                                      |

## find-database *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                     |                                            |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|
| Summary     | Returns a database, given a database or database name.                                                                                                                                                                                                                                                                                                                                                              |                                            |
| Package     | <code>sql</code>                                                                                                                                                                                                                                                                                                                                                                                                    |                                            |
| Signature   | <code>find-database database &amp;optional errorp =&gt; database, count</code>                                                                                                                                                                                                                                                                                                                                      |                                            |
| Arguments   | <code>database</code>                                                                                                                                                                                                                                                                                                                                                                                               | A string or a database.                    |
|             | <code>errorp</code>                                                                                                                                                                                                                                                                                                                                                                                                 | A boolean. Default value: <code>t</code> . |
| Values      | <code>database</code>                                                                                                                                                                                                                                                                                                                                                                                               | A database.                                |
|             | <code>count</code>                                                                                                                                                                                                                                                                                                                                                                                                  | An integer.                                |
| Description | <p>The function <code>find-database</code>, given a string <code>database</code>, searches amongst the connected databases for one matching the name <code>database</code>.</p> <p>If there is exactly one such database, it is returned and the second return value <code>count</code> is 1. If more than one databases match and <code>errorp</code> is <code>nil</code>, then the most recently connected of</p> |                                            |

the matching databases is returned and *count* is the number of matches. If no matching database is found and *errorp* is *nil*, then *nil* is returned. If none, or more than one, matching databases are found and *errorp* is true, then an error is signaled.

If the argument *database* is a database, it is simply returned.

See also

`connect`  
`connected-databases`  
`database-name`  
`disconnect`  
`status`

## **initialize-database-type** *Function*

Summary      Initializes a database type.

Package      `sql`

Signature      `initialize-database-type &key database-type => type`

Arguments      *database-type*      A database type.

Values      *type*      A database type.

Description      The function `initialize-database-type` initializes a database type by loading code and appropriate database libraries according to the value of *database-type*. If `*default-database-type*` is not initialized, this function initializes it. It adds *database-type* to the list of initialized types. The initialized database type is returned.

Example      The following example shows how to use `initialize-database-type` to initialize the `:odbc` database type.

```
(require "odbc")
(in-package sql)
(setf *default-database-type* :odbc)
(initialize-database-type)
(print *initialized-database-types*)
```

The ODBC database type is now initialized, and connections can be made to ODBC databases.

See also

`database-name`  
`*initialized-database-types*`  
`*default-database-type*`

## \*initialized-database-types\*

*Variable*

Summary A list of initialized database types.

Package `sql`

Initial value `nil`

Description The variable `*initialized-database-types*` contains a list of database types that have been initialized by calls to `initialize-database-type`.

See also `initialize-database-type`

## insert-records

*Function*

Summary Inserts a set of values into a table.

Package `sql`

Signature `insert-records &key into attributes values av-pairs query database`

Arguments `into` A database table.

*This chapter applies to the Enterprise Edition only*

|             |                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <i>values</i>     | A list of values, or <code>nil</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|             | <i>attributes</i> | A list of attributes, or <code>nil</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|             | <i>av-pairs</i>   | A list of two-element lists, or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|             | <i>query</i>      | A query expression, or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|             | <i>database</i>   | A database.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Values      |                   | None.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Description |                   | <p>The function <code>insert-records</code> inserts records into the table <i>into</i>.</p> <p>The records created contain <i>values</i> for <i>attributes</i> (or <i>av-pairs</i>). The argument <i>values</i> is a list of values. If <i>attributes</i> is supplied then <i>values</i> must be a corresponding list of values for each of the listed attribute names.</p> <p>If <i>av-pairs</i> is non-nil, then both <i>attributes</i> and <i>values</i> must be <code>nil</code>.</p> <p>If <i>query</i> is non-nil, then neither <i>values</i> nor <i>av-pairs</i> should be. <i>query</i> should be a query expression, and the attribute names in it must also exist in the table <i>into</i>.</p> <p>The default value of <i>database</i> is <code>*default-database*</code>.</p> |
| Example     |                   | <p>In the first example, the Lisp expression</p> <pre>(insert-records :into [person]   :values '("abc" "Joe" "Bloggs" 10000 3000 nil             "plumber"))</pre> <p>is equivalent to the following SQL:</p> <pre>INSERT INTO PERSON   VALUES ('abc','Joe',          'Bloggs',10000,3000,NULL,'plumber')</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

In the second example, the LispWorks expression

```
(insert-records :into [person]
  :attributes '(person_id income surname occupation)
  :values '("aaa" 10 "jim" "plumb"))
```

is equivalent to the following SQL:

```
INSERT INTO PERSON
  (PERSON_ID, INCOME, SURNAME, OCCUPATION)
  VALUES ('aaa', 10, 'jim', 'plumb')
```

The following example demonstrates how to use `:av-pairs`.

```
(insert-records :into [person] :av-pairs
  '((person_id "bbb") (surname "Jones")))
```

See also

- `*default-database*`
- `delete-records`
- `update-records`

## instance-refreshed

## Generic Function

|             |                                                                                                                                                                                                                                                                                                                                                                           |                              |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| Summary     | Provides a hook for user code on View Class instance updates.                                                                                                                                                                                                                                                                                                             |                              |
| Package     | <code>sql</code>                                                                                                                                                                                                                                                                                                                                                          |                              |
| Signature   | <code>instance-refreshed instance</code>                                                                                                                                                                                                                                                                                                                                  |                              |
| Arguments   | <code>instance</code>                                                                                                                                                                                                                                                                                                                                                     | An instance of a View Class. |
| Values      | None.                                                                                                                                                                                                                                                                                                                                                                     |                              |
| Description | <p>The function <code>instance-refreshed</code> is called inside <code>select</code> when its <code>refresh</code> argument is true and the instance <code>instance</code> has just been updated.</p> <p>The supplied method on <code>standard-db-object</code> does nothing. If your application needs to take action when a View Class instance has been updated by</p> |                              |

```
(select ... :refresh t)
```

then add an `instance-refresh` method specializing on your subclass of `standard-db-object`.

See also      **def-view-class**  
                 **select**

|             |                 | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     |                 | Returns type information for a table's attributes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Package     |                 | <code>sql</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Signature   |                 | <code>list-attribute-types <i>table</i> &amp;key <i>database owner</i> =&gt; <i>result</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Arguments   | <i>table</i>    | A table.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|             | <i>database</i> | A database.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|             | <i>owner</i>    | <code>nil</code> , <code>:all</code> or a string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Values      | <i>result</i>   | A list.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Description |                 | <p>The function <code>list-attribute-types</code> returns type information for the attributes in the table given by <i>table</i>. <i>database</i> has a default value of <code>*default-database*</code>.</p> <p>If <i>owner</i> is <code>nil</code>, only user-owned attributes are considered. This is the default.</p> <p>If <i>owner</i> is <code>:all</code>, all attributes are considered.</p> <p>If <i>owner</i> is a string, this denotes a username and only attributes owned by <i>owner</i> are considered.</p> <p><i>result</i> is a list in which each element is a list (<i>attribute datatype precision scale nullable</i>). <i>attribute</i> is a string denoting the attribute name. <i>datatype</i> is the vendor-specific type as described in <code>attribute-type</code>. <i>nullable</i> is 1 if the attribute accepts the value NULL, and 0 otherwise.</p> |
| Notes       |                 | When using ODBC to connect to Access database, the <i>nullable</i> value is not reliable, at least on version 7.1. There seems to be                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

a bug in the driver. Using ODBC with other DBMS works as documented.

**Example** To print the type of every attribute in the database, do

```
(loop for tab in
      (sql:list-tables)
      do
        (loop for type-info in
              (sql:list-attribute-types tab)
              do
                (format t "~&Table ~S Attribute ~S Type ~S"
                        tab
                        (first type-info)
                        (second type-info))))
```

**See also** **attribute-type**  
**list-attributes**

## list-attributes *Function*

**Summary** Returns a list of attributes from a table in a database.

**Package** **sql**

**Signature** **list-attributes** *table* &**key** *database owner* => *result*

**Arguments** *table* A table in the database.

*database* A database.

*owner* *nil*, **:all** or a string.

**Values** *result* A list of attributes.

**Description** The function **list-attributes** returns a list of attributes from *table* in *database*, which has a default value of **\*default-database\***.

*This chapter applies to the Enterprise Edition only*

If *owner* is `nil`, only user-owned attributes are considered.  
This is the default.

If *owner* is `:all`, all attributes are considered.

If *owner* is a string, this denotes a username and only  
attributes owned by *owner* are considered.

See also      **attribute-type**  
                 **list-attribute-types**  
                 **list-tables**

## **list-classes** *Function*

Summary      Returns a list of View Classes connected to a given database.

Package      `sql`

Signature      `list-classes &key database root-class test => result-list`

Arguments      `database`      A database.

`root-class`      A class.

`test`      A test function.

Values      `result-list`      A list of class objects.

Description      The function `list-classes` collects all the classes below  
`root-class` (which defaults to `standard-db-object`) that are  
connected to the given database specified by `database`, and  
which satisfy the `test` function. The default for the `test` argu-  
ment is `c1:identity`.

By default, `list-classes` returns a list of all the classes con-  
nected to the default database, `*default-database*`.

|                         |                                            | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------------------|--------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>list-sql-streams</b> |                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Summary                 |                                            | Returns the broadcast list of streams recording SQL commands or results traffic.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Package                 | <code>sql</code>                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Signature               |                                            | <code>list-sql-streams &amp;key type database =&gt; streams</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Arguments               | <code>type</code><br><code>database</code> | A keyword.<br>A database.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Values                  | <code>streams</code>                       | A list.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Description             |                                            | <p>The function <code>list-sql-streams</code> returns the broadcast list of streams recording SQL commands or results traffic.</p> <p>Each element of <code>streams</code> is a stream or the symbol <code>t</code>, denoting <code>*standard-output*</code>.</p> <p>The keyword <code>type</code> is one of <code>:commands</code> or <code>:results</code>, and determines whether to return a list of streams for SQL commands or results traffic.</p> <p>The default value of <code>type</code> is <code>:commands</code>. The default value for <code>database</code> is the value of <code>*default-database*</code>.</p> |
| See also                |                                            | <code>add-sql-stream</code><br><code>delete-sql-stream</code><br><code>sql-recording-p</code><br><code>sql-stream</code><br><code>start-sql-recording</code><br><code>stop-sql-recording</code>                                                                                                                                                                                                                                                                                                                                                                                                                                 |

|                    |  | <i>Function</i>                                  |
|--------------------|--|--------------------------------------------------|
| <b>list-tables</b> |  |                                                  |
| Summary            |  | Returns a list of the table names in a database. |

*This chapter applies to the Enterprise Edition only*

|             |                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------|-------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>sql</code>                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Signature   | <code>list-tables &amp;key database owner -&gt; table-list</code> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Arguments   | <code>database</code>                                             | A database.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|             | <code>owner</code>                                                | <code>nil</code> , <code>:all</code> or a string.                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Values      | <code>table-list</code>                                           | A list of table names.                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Description |                                                                   | The function <code>list-tables</code> returns the list of table names in <code>database</code> , which has a default value of <code>*default-database*</code> .<br><br>If <code>owner</code> is <code>nil</code> , only user-owned tables are considered. This is the default.<br><br>If <code>owner</code> is <code>:all</code> , all tables are considered.<br><br>If <code>owner</code> is a string, this denotes a username and only tables owned by <code>owner</code> are considered. |
| See also    |                                                                   | <code>create-table</code><br><code>drop-table</code><br><code>list-attributes</code><br><code>table-exists-p</code>                                                                                                                                                                                                                                                                                                                                                                         |

## lob-stream *Class*

|              |                                                                                                                                                                                                  |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary      | The LOB stream class.                                                                                                                                                                            |
| Superclasses | <code>buffered-stream</code>                                                                                                                                                                     |
| Initargs     | <code>:lob-locator</code><br>A LOB locator.<br><code>:direction</code> One of <code>:input</code> or <code>:output</code> .<br><code>:free-lob-locator-on-close</code><br>A generalized boolean. |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Accessors   | <code>lob-stream-lob-locator</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Description | <p>The class <code>lob-stream</code> implements LOB streams in the Oracle LOB interface.</p> <p>A <code>lob-stream</code> for input can be returned from <code>select</code> or <code>query</code> by specifying <code>:input-stream</code> as the type to return for the LOB column.</p> <p>A <code>lob-stream</code> for output can be returned from <code>select</code> or <code>query</code> by specifying <code>:output-stream</code> as the type to return for the LOB column.</p> <p>A <code>lob-stream</code> can be attached to an existing LOB locator by creating the stream explicitly.</p> <p><i>direction</i> specifies whether the stream is for input or output. The default value of <i>direction</i> is <code>:input</code>.</p> <p>By default, if the stream is closed the LOB locator is freed, unless <code>free-lab-locator-on-close</code> is passed as <code>nil</code>. The default value of <code>free-lab-locator-on-close</code> is <code>t</code>.</p> |
| Example     | <p>This creates an input stream connected to the LOB locator <i>lob-locator</i>:</p> <pre>(make-instance 'lob-stream :lob-locator <i>lob-locator</i>)</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| See also    | <p><code>query</code><br/> <code>select</code></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

|                                          | <b>Function</b>                                                   |
|------------------------------------------|-------------------------------------------------------------------|
| <b>locally-disable-sql-reader-syntax</b> |                                                                   |
| Summary                                  | Turns off square bracket syntax and does not change syntax state. |
| Package                                  | <code>sql</code>                                                  |
| Signature                                | <code>locally-disable-sql-reader-syntax =&gt;</code>              |

*This chapter applies to the Enterprise Edition only*

|             |                                                                                                                                                                                                                                         |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arguments   | None.                                                                                                                                                                                                                                   |
| Values      | None.                                                                                                                                                                                                                                   |
| Description | The function <code>locally-disable-sql-reader-syntax</code> turns off square bracket syntax and does not change syntax state. This ensures that <code>restore-sql-reader-syntax-state</code> restores the current enable/disable state. |
| Example     | The intended use of <code>locally-disable-sql-reader-syntax</code> is in a file:                                                                                                                                                        |
|             | <pre>#.(locally-disable-sql-reader-syntax) &lt;Lisp code not using [...] syntax&gt; #.(restore-sql-reader-syntax-state)</pre>                                                                                                           |
| See also    | <code>disable-sql-reader-syntax</code><br><code>enable-sql-reader-syntax</code><br><code>locally-enable-sql-reader-syntax</code><br><code>restore-sql-reader-syntax-state</code>                                                        |

## **locally-enable-sql-reader-syntax** *Function*

|             |                                                                                                                          |
|-------------|--------------------------------------------------------------------------------------------------------------------------|
| Summary     | Turns on square bracket syntax and does not change syntax state.                                                         |
| Package     | <code>sql</code>                                                                                                         |
| Signature   | <code>locally-enable-sql-reader-syntax</code>                                                                            |
| Arguments   | None.                                                                                                                    |
| Values      | None.                                                                                                                    |
| Description | The function <code>locally-enable-sql-reader-syntax</code> turns on square bracket syntax and does not change the syntax |

state. This ensures that `restore-sql-reader-syntax-state` restores the current enable/disable state.

**Example** The intended use of `locally-enable-sql-reader-syntax` is in a file:

```
#.(locally-enable-sql-reader-syntax)
<code using [...] syntax>
#. (restore-sql-reader-syntax-state)
```

**See also** `disable-sql-reader-syntax`  
`enable-sql-reader-syntax`  
`locally-disable-sql-reader-syntax`  
`restore-sql-reader-syntax-state`

## loop Macro

**Summary** Extends `loop` to provide a clause for iterating over query results.

**Package** `common-lisp`

**Signature** `loop {for|as} var [type-spec] being {the|each}
{records|record} {in|of} query-expression [not-inside-
transaction not-inside-transaction] [get-all get-all] => result`

**Arguments** `var` A variable.

`query-expression` A SQL query statement or a `prepared-
statement` containing a query.

`not-inside-transaction`

A generalized boolean.

`get-all` A generalized boolean.

**Values** `result` A `loop` return value.

**Description** The Common Lisp `loop` macro has been extended with a clause for iterating over query results. This extension is available only when Common SQL has been loaded. For a full description of the rest of the Common Lisp `loop` facility, including the possible return values, see the ANSI Common Lisp specification.

Each iteration of the loop assigns the next record of the table to the variable `var`. The record is represented in Lisp as a list. Destructuring can be used in `var` to bind variables to specific attributes of the records resulting from *query-expression*. In conjunction with the panoply of existing clauses available from the `loop` macro, the new iteration clause provides an integrated report generation facility.

The additional loop keywords `not-inside-transaction` and `get-all` may be useful when fetching many records through a connection with `database-type :mysql`. See the section “Special considerations for iteration functions and macros” on page 375 for details.

**Example** This extended `loop` example performs the following on each record returned as a result of a query: bind `name` to the query result, find the salary (if any) from an associated hash-table, increment a count for salaries greater than 20000, accumulate the salary, and print the details. Finally, it prints the average salary.

```
(loop
  for (name) being each record in
  [select [ename] :from [emp]]
  as salary = (gethash name *salary-table*)
  initially (format t "~&~20A~10D" 'name 'salary)
  when (and salary (> salary 20000))
  count salary into salaries
  and sum salary into total
  and do (format t "~&~20A~10D" name salary)
  else
  do (format t "~&~20A~10A" name "N/A")
  finally
  (format t "~2&Av Salary: ~10D" (/ total salaries)))
```

## See also

`do-query`  
`map-query`  
`prepare-statement`  
`query`  
`select`  
`simple-do-query`

|                  | <i>Function</i>                                                                                                                                                                                                                                                                                                                           |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>map-query</b> |                                                                                                                                                                                                                                                                                                                                           |
| Summary          | Returns the results of mapping a function across a SQL query statement.                                                                                                                                                                                                                                                                   |
| Package          | <code>sql</code>                                                                                                                                                                                                                                                                                                                          |
| Signature        | <code>map-query output-type-spec function query-exp &amp;key database not-inside-transaction get-all =&gt; result</code>                                                                                                                                                                                                                  |
| Arguments        | <p><i>output-type-spec</i> The output type specification.</p> <p><i>function</i> A function.</p> <p><i>query-exp</i> A SQL query or a <code>prepared-statement</code> containing a query.</p> <p><i>database</i> A database.</p> <p><i>not-inside-transaction</i> A generalized boolean.</p> <p><i>get-all</i> A generalized boolean.</p> |
| Values           | <i>result</i> A sequence of type <i>output-type-spec</i> containing the results of the map function.                                                                                                                                                                                                                                      |
| Description      | The function <code>map-query</code> returns the result of mapping <i>function</i> across the results of <i>query-exp</i> . The <i>output-type-spec</i> argument specifies the type of the result sequence as per the Common Lisp <code>map</code> function.                                                                               |

The default value of *database* is **\*default-database\***.

*not-inside-transaction* and *get-all* may be useful when fetching many records through a connection with *database-type* **:mysql**. Both of these arguments have default value **nil**. See the section “Special considerations for iteration functions and macros” on page 375 for details.

**Example** This example binds `name` to each name in the employee table and prints it.

```
(map-query
  nil
  #'(lambda (name) (print name))
  [select [ename] :from [emp] :flatp t])
```

**See also** `do-query`  
`loop`  
`prepare-statement`  
`print-query`  
`query`  
`select`  
`simple-do-query`

## **\*mysql-library-directories\*** *Variable*

**Package** `sql`

**Initial value** `nil`

**Description** The variable **\*mysql-library-directories\*** helps Lisp-Works for Windows to locate the MySQL library for use with *database-type* **:mysql**. It specifies a directory or a list of directories in which to search for the MySQL library. If the value is a directory pathname designator then it is passed to `directory`. If the value is a list of directory pathname designators then each item is

passed to `directory`. The collected results are the list of directories to search in.

|                     |                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes               | The default value <code>nil</code> causes the system to use <code>*mysql-library-sub-directories*</code> to construct the search path. With the default installation of MySQL this copes better with 64-bit/32-bit mixing on the same machine. When <code>*mysql-library-directories*</code> is non- <code>nil</code> , it overrides <code>*mysql-library-sub-directories*</code> . |
| Compatibility notes | In LispWorks 6.0 <code>*mysql-library-directories*</code> has initial value <code>"C:\\Program Files\\MySQL\\MySQL*\\bin"</code> .<br>In LispWorks 6.1 and later, <code>*mysql-library-directories*</code> has initial value <code>nil</code> so the search path is constructed using <code>*mysql-library-sub-directories*</code> .                                                |
| See also            | <code>*mysql-library-path*</code><br><code>*mysql-library-sub-directories*</code>                                                                                                                                                                                                                                                                                                   |

## **\*mysql-library-path\*** Variable

|               |                                                                                                                                                                                                                           |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package       | <code>sql</code>                                                                                                                                                                                                          |
| Initial value | On Microsoft Windows:<br><br><code>"libmysql.dll"</code><br><br>On other platforms with pthreads:<br><br><code>"-lmysqlclient_r"</code><br><br>On other platforms without pthreads:<br><br><code>"-lmysqlclient"</code>   |
| Description   | The variable <code>*mysql-library-path*</code> helps the system to locate the MySQL library for use with <i>database-type</i> <code>:mysql</code> . It specifies the library name, and can also be set to a full path. If |

it is not a name, the system searches the standard library locations.

You can override the value of **\*mysql-library-path\*** by setting the environment variable `LW_MYSQL_LIBRARY`.

See also      **\*mysql-library-directories\***

**\*mysql-library-sub-directories\***                          *Variable*

Package      `sql`

Initial value      `"MySQL\\MySQL*\\bin"`

Description      The variable **\*mysql-library-sub-directories\*** helps LispWorks for Windows to locate the MySQL library for use with *database-type :mysql*.

It specifies a directory in which to search for the MySQL library, as a sub-directory of the appropriate Program Files directory. On a 32-bit machine that normally means `C:\\Program Files\\`, while on a 64-bit machine it normally means `C:\\Program Files\\` for 64-bit programs and `C:\\Program Files (x86)\\` for 32-bit programs.

The value must be a pathname designator. It is merged with the Program Files directory yielding a path (for example `"C:\\Program Files\\MySQL\\MySQL*\\bin"`) which is then passed to `directory`. The result is a list of directories that are used to search for the MySQL library.

The default value matches the default MySQL installation.

If **\*mysql-library-directories\*** is non-nil, it overrides **\*mysql-library-sub-directories\***.

Note that this default will match any MySQL release, so if you need to be sure to match a specific MySQL release, you

need to change the value of `*mysql-library-sub-directories*` such that it matches only that particular release.

See also      **\*mysql-library-directories\***

|                               | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                              |                |                               |                |                     |                        |
|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|----------------|-------------------------------|----------------|---------------------|------------------------|
| <b>ora-lob-append</b>         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                              |                |                               |                |                     |                        |
| Summary                       | Appends two internal LOBs together.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                              |                |                               |                |                     |                        |
| Package                       | <code>sql</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                              |                |                               |                |                     |                        |
| Signature                     | <code>ora-lob-append src-lob-locator dest-lob-locator &amp;key errorp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                              |                |                               |                |                     |                        |
| Arguments                     | <table border="0"> <tr> <td><code>src-lob-locator</code></td><td>A LOB locator.</td></tr> <tr> <td><code>dest-lob-locator</code></td><td>A LOB locator.</td></tr> <tr> <td><code>errorp</code></td><td>A generalized boolean.</td></tr> </table>                                                                                                                                                                                                                                                                                                                                                                                            | <code>src-lob-locator</code> | A LOB locator. | <code>dest-lob-locator</code> | A LOB locator. | <code>errorp</code> | A generalized boolean. |
| <code>src-lob-locator</code>  | A LOB locator.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                              |                |                               |                |                     |                        |
| <code>dest-lob-locator</code> | A LOB locator.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                              |                |                               |                |                     |                        |
| <code>errorp</code>           | A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                              |                |                               |                |                     |                        |
| Description                   | <p>The function <code>ora-lob-append</code> appends the contents of the LOB pointed to by <code>src-lob-locator</code> to the end of LOB pointed by <code>dest-lob-locator</code>. The source and destination LOBs must be of the same internal LOB type, that is, either both BLOB or both CLOB/NCLOB.</p> <p>If an error occurs and <code>errorp</code> is true, an error is signaled. If <code>errorp</code> is false, the function returns an object of type <code>sql-database-error</code>. The default value of <code>errorp</code> is <code>nil</code>.</p> <p><code>ora-lob-append</code> is applicable to internal LOBs only.</p> |                              |                |                               |                |                     |                        |
| Notes                         | <ol style="list-style-type: none"> <li>1. <code>ora-lob-append</code> is a direct call OCILobAppend.</li> <li>2. <code>ora-lob-append</code> is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.</li> </ol>                                                                                                                                                                                                                                                                                                                                                      |                              |                |                               |                |                     |                        |

*This chapter applies to the Enterprise Edition only*

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <i>Function</i> |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>ora-lob-assign</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                 |
| Summary               | Assigns a LOB to another LOB locator.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                 |
| Package               | <code>sql</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                 |
| Signature             | <code>ora-lob-assign src-lob-locator &amp;key dest-lob-locator errorp =&gt; lob-locator</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                 |
| Arguments             | <code>src-lob-locator</code> A LOB locator.<br><code>dest-lob-locator</code> A LOB locator.<br><code>errorp</code> A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |
| Values                | <code>lob-locator</code> A LOB locator.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |
| Description           | The function <code>ora-lob-assign</code> assigns the underlying LOB for <code>src-lob-locator</code> to another LOB locator.<br><br>If <code>dest-lob-locator</code> is <code>nil</code> then a new LOB locator is created and returned. Otherwise <code>dest-lob-locator</code> should be an existing LOB locator which is modified and returned. The default value of <code>dest-lob-locator</code> is <code>nil</code> .<br><br>If an error occurs and <code>errorp</code> is true, an error is signaled. If <code>errorp</code> is false, the function returns an object of type <code>sql-database-error</code> . The default value of <code>errorp</code> is <code>nil</code> . |                 |
| Notes                 | <ol style="list-style-type: none"><li>1. <code>ora-lob-assign</code> is a direct call to <code>OCILobAssign</code>.</li><li>2. <code>ora-lob-assign</code> is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.</li></ol>                                                                                                                                                                                                                                                                                                                                                                                   |                 |

|                              |                                          | <i>Function</i> |
|------------------------------|------------------------------------------|-----------------|
| <b>ora-lob-char-set-form</b> |                                          |                 |
| Summary                      | Returns the character set form of a LOB. |                 |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                         |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| Package     | <code>sql</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                         |
| Signature   | <code>ora-lob-char-set-form lob-locator &amp;key errorp =&gt; charset</code>                                                                                                                                                                                                                                                                                                                                                                                                                                          |                         |
| Arguments   | <i>lob-locator</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | A LOB locator.          |
|             | <i>errorp</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | A generalized boolean.  |
| Values      | <i>charset</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | A non-negative integer. |
| Description | <p>The function <code>ora-lob-char-set-form</code> returns the char set form of the LOB underlying <i>lob-locator</i>.</p> <p><i>charset</i> is 0 for a binary LOB (BLOB or BFILE), SQLCS_IMPLICIT (1) for a character LOB (CFILE or CLOB) and SQLCS_NCHAR (2) for a NCLOB.</p> <p>If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <code>sql-database-error</code>. The default value of <i>errorp</i> is <code>nil</code>.</p> |                         |
| Notes       | <ol style="list-style-type: none"> <li>1. This is a direct call to OCILobCharSetForm.</li> <li>2. <code>ora-lob-char-set-form</code> is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.</li> </ol>                                                                                                                                                                                                                                        |                         |

|           |                                                                                  | <i>Function</i>        |
|-----------|----------------------------------------------------------------------------------|------------------------|
| Summary   | Returns the database character set identifier of a LOB.                          |                        |
| Package   | <code>sql</code>                                                                 |                        |
| Signature | <code>ora-lob-char-set-id lob-locator &amp;key errorp =&gt; db-charset-id</code> |                        |
| Arguments | <i>lob-locator</i>                                                               | A LOB locator.         |
|           | <i>errorp</i>                                                                    | A generalized boolean. |

*This chapter applies to the Enterprise Edition only*

|                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                      |                        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Values                                                                                                                                                                                                                           | <i>db-charset-id</i>                                                                                                                                                                                                                                                                 | A non-negative number. |
| Description                                                                                                                                                                                                                      | The function <code>ora-lob-char-set-id</code> returns the database character set identifier of the LOB underlying <i>lob-locator</i> .<br><i>db-charset-id</i> is 0 for a binary LOB.                                                                                                |                        |
| If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <code>sql-database-error</code> . The default value of <i>errorp</i> is <code>nil</code> . |                                                                                                                                                                                                                                                                                      |                        |
| <b>Notes</b>                                                                                                                                                                                                                     | <ol style="list-style-type: none"><li>1. This is a direct call to <code>OCILobCharSetID</code>.</li><li>2. <code>ora-lob-char-set-id</code> is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.</li></ol> |                        |

|                      |                                                                                                                                                                                                                                                                                                                                                                                                       | <i>Function</i>        |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| <b>ora-lob-close</b> |                                                                                                                                                                                                                                                                                                                                                                                                       |                        |
| Summary              | Closes an opened LOB.                                                                                                                                                                                                                                                                                                                                                                                 |                        |
| Package              | <code>sql</code>                                                                                                                                                                                                                                                                                                                                                                                      |                        |
| Signature            | <code>ora-lob-close lob-locator &amp;key errorp</code>                                                                                                                                                                                                                                                                                                                                                |                        |
| Arguments            | <i>lob-locator</i>                                                                                                                                                                                                                                                                                                                                                                                    | A LOB locator.         |
|                      | <i>errorp</i>                                                                                                                                                                                                                                                                                                                                                                                         | A generalized boolean. |
| Description          | The function <code>ora-lob-close</code> closes a LOB which has been opened by <code>ora-lob-open</code> .<br>For more information see <code>ora-lob-open</code> .<br>If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <code>sql-database-error</code> . The default value of <i>errorp</i> is <code>nil</code> . |                        |
| Notes                | <ol style="list-style-type: none"><li>1. This is a direct call to <code>OCILobClose</code>.</li></ol>                                                                                                                                                                                                                                                                                                 |                        |

2. **ora-lob-close** is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.

See also      **ora-lob-open**

| <b>ora-lob-copy</b> | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary             | Copies part of an internal LOB.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Package             | <b>sql</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Signature           | <b>ora-lob-copy dest-lob-locator src-lob-locator amount &amp;key dest-offset src-offset errorp</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Arguments           | <p><i>dest-lob-locator</i>    A LOB locator.</p> <p><i>src-lob-locator</i>    A LOB locator.</p> <p><i>amount</i>            A non-negative integer.</p> <p><i>dest-offset</i>       A non-negative integer.</p> <p><i>src-offset</i>        A non-negative integer.</p> <p><i>errorp</i>           A generalized boolean.</p>                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Description         | <p>The function <b>ora-lob-copy</b> copies part of the LOB pointed to by <i>src-lob-locator</i> into the LOB pointed to by <i>dest-lob-locator</i>. The details of the operation are determined by <i>amount</i>, <i>src-offset</i> and <i>dest-offset</i>. These numbers are in characters for CLOB/NCLOB and bytes for BLOB, and the offsets start from 1. The part of the source LOB from offset <i>src-offset</i> of length <i>amount</i> is copied into the destination LOB at offset <i>dest-offset</i>. The default value of <i>dest-offset</i> is 1 and the default value of <i>src-offset</i> is 1.</p> <p>The destination LOB is extended if needed. If the <i>dest-offset</i> is beyond the end of the destination LOB, the gap between the</p> |

*This chapter applies to the Enterprise Edition only*

end and *dest-offset* is erased, that is, filled with 0 for BLOBs or spaces for CLOBs.

Both LOBs must be internal LOBs, and they must be of the same type, that is, either both BLOB or both CLOB/NCLOB.

**ora-lob-append** is applicable to internal LOBs only.

If an error occurs and *errorp* is true, an error is signaled. If *errorp* is false, the function returns an object of type **sql-database-error**. The default value of *errorp* is **nil**.

Notes

1. This is a direct call OCILobCopy.
2. This function is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.

See also

**ora-lob-load-from-file**

## ora-lob-create-empty

## *Function*

Summary      Creates an empty LOB.

Package      **sql**

Signature      **ora-lob-create-empty &key db type => lob-locator**

Arguments      **db**      A database.

**type**      A Lisp object.

Values      **lob-locator**      A LOB locator.

Description      The function **ora-lob-create-empty** creates an empty LOB object and returns a LOB locator for it.

If *type* is `:lob` then `ora-lob-create-empty` creates a LOB of type BLOB/CLOB. If *type* is any other value, it creates a file LOB. The default value of *type* is `:lob`.

Empty LOBs can be put in the database by passing them to `insert-records` or `update-records`. However, the preferred approach is to use the Oracle SQL function `EMPTY_BLOB` as described in the section “Inserting empty LOBs” on page 380.

The default value of *db* is the value of `*default-database*`.

|       |                                                                                                                                                                  |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes | <code>ora-lob-create-empty</code> is available only when the “oracle” module is loaded. See the section “Oracle LOB interface” on page 380 for more information. |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|           |                                | <i>Function</i>                                                                                                         |
|-----------|--------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| Summary   | Creates a temporary LOB.       |                                                                                                                         |
| Package   | <code>sql</code>               |                                                                                                                         |
| Signature |                                | <code>ora-lob-create-temporary db-or-lob-locator &amp;key errorp cache session-duration clob-p =&gt; lob-locator</code> |
| Arguments | <code>db-or-lob-locator</code> | A database or a LOB locator.                                                                                            |
|           | <code>errorp</code>            | A generalized boolean.                                                                                                  |
|           | <code>cache</code>             | A generalized boolean.                                                                                                  |
|           | <code>session-duration</code>  | A generalized boolean.                                                                                                  |
|           | <code>clob-p</code>            | A generalized boolean.                                                                                                  |
| Values    | <code>lob-locator</code>       | A LOB locator.                                                                                                          |

*This chapter applies to the Enterprise Edition only*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | The function <b>ora-lob-create-temporary</b> creates a temporary LOB.<br><br><i>db-or-lob-locator</i> specifies the database to associate the new LOB with. If it is a LOB locator the database from which the LOB locator came is used.<br><br>If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <b>sql-database-error</b> . The default value of <i>errorp</i> is <b>nil</b> .<br><br><i>cache</i> specifies whether to use a cache or not. The default value of <i>cache</i> is <b>nil</b> .<br><br><i>session-duration</i> specifies the lifetime: if it is true then it uses OCI_DURATION_SESSION, otherwise it uses OCI_DURATION_CALL. The default value of <i>session-duration</i> is <b>t</b> .<br><br>If <i>clob-p</i> is true then the new LOB is a CLOB, otherwise it is a BLOB. The default value of <i>clob-p</i> is <b>nil</b> .<br><br>The new temporary LOB locator is returned. |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|       |                                                                                                                                                                                                                                                                              |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes | <ol style="list-style-type: none"><li>1. This is a direct call to OCILobCreateTemporary.</li><li>2. <b>ora-lob-create-temporary</b> is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.</li></ol> |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|          |                                                              |
|----------|--------------------------------------------------------------|
| See also | <b>ora-lob-free-temporary</b><br><b>ora-lob-is-temporary</b> |
|----------|--------------------------------------------------------------|

|                                  | <i>Function</i>                                              |
|----------------------------------|--------------------------------------------------------------|
| <b>ora-lob-disable-buffering</b> |                                                              |
| Summary                          | Disables the buffering of the Oracle client.                 |
| Package                          | <b>sql</b>                                                   |
| Signature                        | <b>ora-lob-disable-buffering lob-locator &amp;key errorp</b> |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                        |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Arguments   | <i>lob-locator</i>                                                                                                                                                                                                                                                                                                                                                                                                                                | A LOB locator.         |
|             | <i>errorp</i>                                                                                                                                                                                                                                                                                                                                                                                                                                     | A generalized boolean. |
| Description | <p>The function <code>ora-lob-disable-buffering</code> disables the buffering of the Oracle client. This function does not flush the buffers.</p> <p>This function is applicable to internal LOBs only.</p> <p>If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <code>sql-database-error</code>. The default value of <i>errorp</i> is <code>nil</code>.</p> |                        |
| Notes       | <ol style="list-style-type: none"> <li>1. This is a direct call to <code>OCILobDisableBuffering</code>.</li> <li>2. <code>ora-lob-disable-buffering</code> is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.</li> </ol>                                                                                                                                              |                        |
| See also    | <code>ora-lob-enable-buffering</code><br><code>ora-lob-flush-buffer</code>                                                                                                                                                                                                                                                                                                                                                                        |                        |

| <b>ora-lob-element-type</b> |                                                                       | <i>Function</i>         |
|-----------------------------|-----------------------------------------------------------------------|-------------------------|
| Summary                     | Returns the Lisp element type corresponding to that of a LOB locator. |                         |
| Package                     | <code>sql</code>                                                      |                         |
| Signature                   | <code>ora-lob-element-type lob-locator =&gt; type</code>              |                         |
| Arguments                   | <i>lob-locator</i>                                                    | A LOB locator.          |
| Values                      | <i>type</i>                                                           | A Lisp type descriptor. |

*This chapter applies to the Enterprise Edition only*

|             |                                                                                                                                                                                                                                                                                                                                                       |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | The function <code>ora-lob-element-type</code> returns the Lisp element type that best corresponds to the charset of the LOB locator <i>lob-locator</i> .<br><br>For BLOB and BFILE type is ( <code>unsigned-byte 8</code> ). For CLOB, NCLOB and CFILE type is either <code>base-char</code> or <code>simple-char</code> , depending on the charset. |
| Notes       | <code>ora-lob-element-type</code> is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.                                                                                                                                                                                      |

## **ora-lob-enable-buffering** *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                            |                        |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Summary     | Enables the buffering of the Oracle client.                                                                                                                                                                                                                                                                                                                                                                                                |                        |
| Package     | <code>sql</code>                                                                                                                                                                                                                                                                                                                                                                                                                           |                        |
| Signature   | <code>ora-lob-enable-buffering lob-locator &amp;key errorp</code>                                                                                                                                                                                                                                                                                                                                                                          |                        |
| Arguments   | <i>lob-locator</i>                                                                                                                                                                                                                                                                                                                                                                                                                         | A LOB locator.         |
|             | <i>errorp</i>                                                                                                                                                                                                                                                                                                                                                                                                                              | A generalized boolean. |
| Description | The function <code>ora-lob-enable-buffering</code> enables the buffering of the Oracle client. This function does not flush the buffers.<br><br>This function is applicable to internal LOBs only.<br><br>If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <code>sql-database-error</code> . The default value of <i>errorp</i> is <code>nil</code> . |                        |
| Notes       | <ol style="list-style-type: none"><li>1. This is a direct call to <code>OCILobEnableBuffering</code>.</li><li>2. <code>ora-lob-enable-buffering</code> is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.</li></ol>                                                                                                                                            |                        |

See also      **ora-lob-disable-buffering**  
**ora-lob-flush-buffer**

## ora-lob-env-handle Function

|             |                                                                                                                                                          |                                              |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| Summary     | Returns a foreign pointer to the environment handle of a LOB.                                                                                            |                                              |
| Package     | <b>sql</b>                                                                                                                                               |                                              |
| Signature   | <b>ora-lob-env-handle lob-locator =&gt; pointer</b>                                                                                                      |                                              |
| Arguments   | <i>lob-locator</i>                                                                                                                                       | A LOB locator.                               |
| Values      | <i>pointer</i>                                                                                                                                           | A foreign pointer of type <b>p-oci-env</b> . |
| Description | The function <b>ora-lob-env-handle</b> returns a foreign pointer to the environment handle of the LOB underlying <i>lob-locator</i> .                    |                                              |
| Notes       | <b>ora-lob-env-handle</b> is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information. |                                              |

## ora-lob-erase Function

|           |                                                                             |                         |
|-----------|-----------------------------------------------------------------------------|-------------------------|
| Summary   | Erases part of an internal LOB.                                             |                         |
| Package   | <b>sql</b>                                                                  |                         |
| Signature | <b>ora-lob-erase lob-locator offset amount &amp;key errorp =&gt; erased</b> |                         |
| Arguments | <i>lob-locator</i>                                                          | A LOB locator.          |
|           | <i>offset</i>                                                               | A non-negative integer. |
|           | <i>amount</i>                                                               | A non-negative integer. |

*This chapter applies to the Enterprise Edition only*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                         |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <i>errorp</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | A generalized boolean.                                                                                                                                                                                                                                  |
| Values      | <i>erased</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | A non-negative integer.                                                                                                                                                                                                                                 |
| Description | The function <b>ora-lob-erase</b> erases part of the LOB pointed to by <i>lob-locator</i> . That is, it fills part of the LOB with 0 for BLOBs or spaces for CLOBs.<br><br>The operation starts from offset <i>offset</i> into the LOB and erases <i>amount</i> of data in the LOB, or to the end of the LOB. Note that the offset starts from 1, and that <i>offset</i> and <i>amount</i> are in characters for CLOBs and bytes for BLOB.<br><br>Erasing does not extend beyond the end of the LOB. The return value <i>erased</i> is the number of characters or bytes erased. <i>erased</i> will be smaller than <i>amount</i> if the sum of <i>offset</i> and <i>amount</i> is greater than the length of the LOB.<br><br><b>ora-lob-erase</b> is applicable to internal LOBs only.<br><br>If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <b>sql-database-error</b> . The default value of <i>errorp</i> is <b>nil</b> . |                                                                                                                                                                                                                                                         |
| Notes       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <ol style="list-style-type: none"><li>1. This is a direct call to OCILobErase.</li><li>2. <b>ora-lob-erase</b> is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.</li></ol> |

|           |                                                                              | <i>Function</i>     |
|-----------|------------------------------------------------------------------------------|---------------------|
| Summary   | Closes a file LOB.                                                           |                     |
| Package   | <b>sql</b>                                                                   |                     |
| Signature | <b>ora-lob-file-close</b> <i>file-lob-locator</i> & <i>key</i> <i>errorp</i> |                     |
| Arguments | <i>file-lob-locator</i>                                                      | A file LOB locator. |

|             |                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                  |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <i>errorp</i>                                                                                                                                                                                                                                                                          | A generalized boolean.                                                                                                                                                                                                           |
| Description | The function <code>ora-lob-file-close</code> closes the file that <i>file-locator</i> is associated with.                                                                                                                                                                              | If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <code>sql-database-error</code> . The default value of <i>errorp</i> is <code>nil</code> . |
| Notes       | <ol style="list-style-type: none"> <li>1. This is a direct call to <code>OCILobFileClose</code>.</li> <li>2. <code>ora-lob-file-close</code> is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.</li> </ol> |                                                                                                                                                                                                                                  |
| See also    | <code>ora-lob-file-open</code>                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                  |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <i>Function</i>        |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
|             | <b><code>ora-lob-file-close-all</code></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                        |
| Summary     | Closes all the file LOBs.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                        |
| Package     | <code>sql</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                        |
| Signature   | <code>ora-lob-file-close-all &amp;key db errorp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                        |
| Arguments   | <i>db</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | A database.            |
|             | <i>errorp</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | A generalized boolean. |
| Description | <p>The function <code>ora-lob-file-close-all</code> closes the files that are associated with all the file LOB locators that are opened through the database connection specified by <i>database</i>.</p> <p>The default value of <i>db</i> is the value of <code>*default-database*</code>.</p> <p>If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <code>sql-database-error</code>. The default value of <i>errorp</i> is <code>nil</code>.</p> |                        |

*This chapter applies to the Enterprise Edition only*

- Notes
1. This is a direct call to OCILobFileCloseAll.
  2. `ora-lob-file-close-all` is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.

See also      `ora-lob-file-close`

## **ora-lob-file-exists**                                          *Function*

Summary      The predicate for whether a LOB file exists.

Package      `sql`

Signature      `ora-lob-file-exists lob-locator &key errorp => result`

Arguments      *lob-locator*      A LOB locator.

*errorp*      A generalized boolean.

Values      *result*      A boolean.

Description      The function `ora-lob-file-exists` returns `t` if the file associated with the LOB exists. This function is applicable only to file LOBs (CFILE or BFILE).

If an error occurs and *errorp* is true, an error is signaled. If *errorp* is false, the function returns an object of type `sql-database-error`. The default value of *errorp* is `nil`.

- Notes
1. This is a direct call to OCILobFileExists.
  2. `ora-lob-file-exists` is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <i>Function</i> |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Summary     | Returns the directory and name for the file associated with a file LOB.                                                                                                                                                                                                                                                                                                                                                                                                                                       |                 |
| Package     | <code>sql</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                 |
| Signature   | <code>ora-lob-file-get-name lob-locator &amp;key errorp =&gt; dir, filename</code>                                                                                                                                                                                                                                                                                                                                                                                                                            |                 |
| Arguments   | <p><i>lob-locator</i>      A LOB locator.</p> <p><i>errorp</i>          A generalized boolean.</p>                                                                                                                                                                                                                                                                                                                                                                                                            |                 |
| Values      | <p><i>dir</i>            A string of length no greater than 30.</p> <p><i>filename</i>       A string of length no greater than 255.</p>                                                                                                                                                                                                                                                                                                                                                                      |                 |
| Description | <p>The function <code>ora-lob-file-get-name</code> returns as multiple values the directory alias <i>dir</i> and the filename <i>filename</i> associated with the LOB denoted by <i>lob-locator</i>. The function is applicable only to file LOBs (CFILE or BFILE).</p> <p>If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <code>sql-database-error</code>. The default value of <i>errorp</i> is <code>nil</code>.</p> |                 |
| Notes       | <ol style="list-style-type: none"> <li>1. This is a direct call to <code>OCILobFileGetName</code>.</li> <li>2. <code>ora-lob-file-get-name</code> is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.</li> </ol>                                                                                                                                                                                                                   |                 |

|         |                                               | <i>Function</i> |
|---------|-----------------------------------------------|-----------------|
| Summary | The predicate for whether a LOB file is open. |                 |
| Package | <code>sql</code>                              |                 |

*This chapter applies to the Enterprise Edition only*

|             |                                                                                                                                                                                                                                                                                                                                                                                                         |                        |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Signature   | <b>ora-lob-file-is-open</b> <i>lob-locator</i> & <b>key</b> <i>errorp</i> => <i>result</i>                                                                                                                                                                                                                                                                                                              |                        |
| Arguments   | <i>lob-locator</i>                                                                                                                                                                                                                                                                                                                                                                                      | A LOB locator.         |
|             | <i>errorp</i>                                                                                                                                                                                                                                                                                                                                                                                           | A generalized boolean. |
| Values      | <i>result</i>                                                                                                                                                                                                                                                                                                                                                                                           | A boolean.             |
| Description | <p>The function <b>ora-lob-file-is-open</b> returns <b>t</b> if the file associated with the LOB is open. This function is applicable only to file LOBs (CFILE or BFILE).</p> <p>If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <b>sql-database-error</b>. The default value of <i>errorp</i> is <b>nil</b>.</p> |                        |
| Notes       | <ol style="list-style-type: none"><li>1. This is a direct call to OCILobFileIsOpen.</li><li>2. <b>ora-lob-file-is-open</b> is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.</li></ol>                                                                                                                                     |                        |

|             | <i>Function</i>                                                                                       |
|-------------|-------------------------------------------------------------------------------------------------------|
| Summary     | Opens a file LOB.                                                                                     |
| Package     | <b>sql</b>                                                                                            |
| Signature   | <b>ora-lob-file-open</b> <i>file-lob-locator</i> & <b>key</b> <i>errorp</i>                           |
| Arguments   | <i>file-lob-locator</i> A file LOB locator.<br><i>errorp</i> A generalized boolean.                   |
| Description | The function <b>ora-lob-file-open</b> opens the file that <i>file-lob-locator</i> is associated with. |

If an error occurs and *errorp* is true, an error is signaled. If *errorp* is false, the function returns an object of type **sql-database-error**. The default value of *errorp* is **nil**.

- Notes
1. This is a direct call to OCILobFileOpen.
  2. **ora-lob-file-open** is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.
- See also      **ora-lob-file-close**

## **ora-lob-file-set-name** *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Sets the name of a file LOB.                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Package     | <b>sql</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Signature   | <b>ora-lob-file-set-name</b> <i>file-lob-locator</i> <i>dir-alias</i> <i>name</i> & <i>key</i><br><i>errorp</i>                                                                                                                                                                                                                                                                                                                                              |
| Arguments   | <i>file-lob-locator</i> A file LOB locator.<br><i>dir-alias</i> A string or <b>nil</b> .<br><i>name</i> A string or <b>nil</b> .<br><i>errorp</i> A generalized boolean.                                                                                                                                                                                                                                                                                     |
| Description | <p>The function <b>ora-lob-file-set-name</b> sets the directory alias and the name of the file LOB pointed to by <i>file-lob-locator</i>.</p> <p>If <i>dir-alias</i> is a string it should be of length no greater than 30. If it is <b>nil</b> then the directory alias of the file LOB is not changed.</p> <p>If <i>name</i> is a string it should be of length no greater than 255. If it is <b>nil</b> then the name of the file LOB is not changed.</p> |

If an error occurs and *errorp* is true, an error is signaled. If *errorp* is false, the function returns an object of type **sql-database-error**. The default value of *errorp* is **nil**.

- Notes
1. This is a direct call to OCILobFileSetAlias.
  2. **ora-lob-file-set-name** is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.

|                             | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                        |                    |                |                    |                        |               |                        |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|----------------|--------------------|------------------------|---------------|------------------------|
| <b>ora-lob-flush-buffer</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                    |                |                    |                        |               |                        |
| Summary                     | Flushes the buffer of the Oracle client.                                                                                                                                                                                                                                                                                                                                                                                                               |                    |                |                    |                        |               |                        |
| Package                     | <b>sql</b>                                                                                                                                                                                                                                                                                                                                                                                                                                             |                    |                |                    |                        |               |                        |
| Signature                   | <b>ora-lob-flush-buffer lob-locator &amp;key free-buffer errorp</b>                                                                                                                                                                                                                                                                                                                                                                                    |                    |                |                    |                        |               |                        |
| Arguments                   | <table><tr><td><i>lob-locator</i></td><td>A LOB locator.</td></tr><tr><td><i>free-buffer</i></td><td>A generalized boolean.</td></tr><tr><td><i>errorp</i></td><td>A generalized boolean.</td></tr></table>                                                                                                                                                                                                                                            | <i>lob-locator</i> | A LOB locator. | <i>free-buffer</i> | A generalized boolean. | <i>errorp</i> | A generalized boolean. |
| <i>lob-locator</i>          | A LOB locator.                                                                                                                                                                                                                                                                                                                                                                                                                                         |                    |                |                    |                        |               |                        |
| <i>free-buffer</i>          | A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                 |                    |                |                    |                        |               |                        |
| <i>errorp</i>               | A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                 |                    |                |                    |                        |               |                        |
| Description                 | <p>The function <b>ora-lob-flush-buffer</b> flushes the buffer that is used by the Oracle client.</p> <p>If <i>free-buffer</i> is true, it also frees the buffer. The default value of <i>free-buffer</i> is <b>nil</b>.</p> <p>If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <b>sql-database-error</b>. The default value of <i>errorp</i> is <b>nil</b>.</p> |                    |                |                    |                        |               |                        |
| Notes                       | <ol style="list-style-type: none"><li>1. This is a direct call to OCILobFlushBuffer.</li><li>2. <b>ora-lob-flush-buffer</b> is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.</li></ol>                                                                                                                                                                                   |                    |                |                    |                        |               |                        |

See also      **ora-lob-enable-buffering**

| <b>ora-lob-free</b> | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary             | Frees a LOB locator.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Package             | <b>sql</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Signature           | <b>ora-lob-free lob-locator</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Arguments           | <b>lob-locator</b> A LOB locator.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Description         | <p>The function <b>ora-lob-free</b> frees the LOB locator <i>lob-locator</i>. If <i>lob-locator</i> was retrieved inside an iteration macro or function (that is, one of <b>map-query</b>, <b>do-query</b>, <b>simple-do-query</b> and <b>loop</b>), it is freed before the next record is fetched, or when terminating the iteration for the last record.</p> <p>LOB locators which were retrieved by <b>select</b> or <b>query</b>, or were created by the user by <b>ora-lob-assign</b> or <b>ora-lob-create-empty</b> are freed automatically when the database connection is closed by a call to <b>disconnect</b>.</p> <p>If you create many LOB locators without closing the connection, it is useful to free them by calling <b>ora-lob-free</b>, to free the resources that are associated with them.</p> <p>Freeing a LOB locator does not affect the underlying LOB. In particular, after modifications to the LOB there is no <b>roll-back</b> even if there was not yet a <b>commit</b>.</p> |
| Notes               | <b>ora-lob-free</b> is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

*This chapter applies to the Enterprise Edition only*

| <b>ora-lob-free-temporary</b> | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary                       | Frees a temporary LOB locator.                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Package                       | <code>sql</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Signature                     | <code>ora-lob-free-temporary temp-lob-locator &amp;key errorp</code>                                                                                                                                                                                                                                                                                                                                                                                                   |
| Arguments                     | <code>temp-lob-locator</code> A temporary LOB locator.<br><code>errorp</code> A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                   |
| Description                   | The function <code>ora-lob-free-temporary</code> frees a temporary LOB locator.<br><br><code>temp-lob-locator</code> should be a temporary LOB locator as created by <code>ora-lob-create-temporary</code> .<br><br>If an error occurs and <code>errorp</code> is true, an error is signaled. If <code>errorp</code> is false, the function returns an object of type <code>sql-database-error</code> . The default value of <code>errorp</code> is <code>nil</code> . |
| Notes                         | <ol style="list-style-type: none"><li>1. Temporary LOB locators are freed automatically when the database connection is closed by <code>disconnect</code>.</li><li>2. This is a direct call to <code>OCILobFreeTemporary</code>.</li><li>3. <code>ora-lob-free-temporary</code> is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.</li></ol>                                               |
| See also                      | <code>ora-lob-create-temporary</code><br><code>ora-lob-is-temporary</code>                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>ora-lob-get-buffer</b>     | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Summary                       | Gets a buffer for efficient I/O with foreign functions.                                                                                                                                                                                                                                                                                                                                                                                                                |
| Package                       | <code>sql</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                              |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| Signature   | <code>ora-lab-get-buffer lob-locator &amp;key for-writing offset =&gt; amount/size, foreign-buffer, eof-or-error-p</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                              |
| Arguments   | <i>lob-locator</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | A LOB locator.                               |
|             | <i>for-writing</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | A generalized boolean.                       |
|             | <i>offset</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | A non-negative integer or <code>nil</code> . |
| Values      | <i>amount/size</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | A non-negative integer.                      |
|             | <i>foreign-buffer</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | A FLI pointer.                               |
|             | <i>eof-or-error-p</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | A boolean or an error object.                |
| Description | <p>The function <code>ora-lab-get-buffer</code> gets a buffer for efficient I/O with foreign functions.</p> <p>If <i>for-writing</i> is <code>nil</code>, then <code>ora-lab-get-buffer</code> fills an internal buffer and returns three values: <i>amount/size</i> is how much it filled, <i>foreign-buffer</i> points to the actual buffer, and <i>eof-or-error-p</i> is the return value from the call to <code>ora-lab-read-foreign-buffer</code>. The offset <i>offset</i> is passed directly <code>ora-lab-read-foreign-buffer</code>.</p> <p>If <i>for-writing</i> is true, then <code>ora-lab-get-buffer</code> returns two values: <i>amount/size</i> is the size of the foreign buffer and <i>foreign-buffer</i> points to the actual buffer, which then can be passed to <code>ora-lab-write-foreign-buffer</code>.</p> <p>The default value of <i>for-writing</i> is <code>nil</code>.</p> <p>The buffer that is used by <code>ora-lab-get-buffer</code> is always the same for the LOB locator, it is used by <code>ora-lab-read-buffer</code> and <code>ora-lab-write-buffer</code>, and is freed automatically when the LOB locator is freed. Thus until you finish with the buffer, you cannot use <code>ora-lab-read-buffer</code> or <code>ora-lab-write-buffer</code> or call <code>ora-lab-get-buffer</code> again or free the LOB locator.</p> |                                              |

Notes      **ora-lob-get-buffer** is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.

Example    This first example illustrates reading using the buffer obtained by **ora-lob-get-buffer**. You have a foreign function:

```
my_chunk_processor(char *data, int size)
```

with this FLI definition:

```
(fli:define-foreign-function my_chunk_processor
  ((data :pointer)
   (size :int)))
```

You can pass all the data from the LOB locator to this function. Assuming no other function reads from it, it will start from the beginning.

```
(loop
  (multiple-value-bind (amount buffer eof-or-error-p)
    (ora-lob-get-buffer lob)
    (when (zerop amount) (return))
    (my_chunk_processor buffer amount)))
```

This second example illustrates writing with the buffer obtained by **ora-lob-get-buffer**. You have a foreign function that fills a buffer with data, and you want to write it to a LOB. First you should lock the record, and if required trim the LOB locator.

```
(multiple-value-bind (size buffer)
  (ora-lob-get-buffer lob-locator
    :for-writing t
    ;; start at the beginning
    :offset 1)
  (loop (let ((amount (my-fill-buffer buffer size)))
    (when (zerop amount) (return))
    (ora-lob-write-foreign-buffer
     lob-locator nil
     amount buffer size))))
```

See also      **ora-lob-read-buffer**  
**ora-lob-read-foreign-buffer**  
**ora-lob-write-buffer**  
**ora-lob-write-foreign-buffer**

## ora-lob-get-chunk-size *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                             |                         |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| Summary     | Returns the chunk size of a LOB.                                                                                                                                                                                                                                                                                                                                                            |                         |
| Package     | <b>sql</b>                                                                                                                                                                                                                                                                                                                                                                                  |                         |
| Signature   | <b>ora-lob-get-chunk-size lob-locator &amp;key errorp =&gt; size</b>                                                                                                                                                                                                                                                                                                                        |                         |
| Arguments   | <i>lob-locator</i>                                                                                                                                                                                                                                                                                                                                                                          | A LOB locator.          |
|             | <i>errorp</i>                                                                                                                                                                                                                                                                                                                                                                               | A generalized boolean.  |
| Values      | <i>size</i>                                                                                                                                                                                                                                                                                                                                                                                 | A non-negative integer. |
| Description | <p>The function <b>ora-lob-get-chunk-size</b> returns the chunk size of the LOB locator <i>lob-locator</i>, which is the best value for the size of a buffer.</p> <p>If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <b>sql-database-error</b>. The default value of <i>errorp</i> is <b>nil</b>.</p> |                         |
| Notes       | <ol style="list-style-type: none"> <li>1. This is a direct call to OCILobGetChunkSize.</li> <li>2. <b>ora-lob-get-chunk-size</b> is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.</li> </ol>                                                                                                                  |                         |

## ora-lob-get-length *Function*

|         |                              |
|---------|------------------------------|
| Summary | Returns the length of a LOB. |
|---------|------------------------------|

*This chapter applies to the Enterprise Edition only*

|                    |                                                                                                                                                                                                                                                                                                                                                                |                    |                         |               |                        |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-------------------------|---------------|------------------------|
| Package            | <code>sql</code>                                                                                                                                                                                                                                                                                                                                               |                    |                         |               |                        |
| Signature          | <code>ora-lob-get-length lob-locator &amp;key errorp =&gt; length</code>                                                                                                                                                                                                                                                                                       |                    |                         |               |                        |
| Arguments          | <table><tr><td><i>lob-locator</i></td><td>A LOB locator.</td></tr><tr><td><i>errorp</i></td><td>A generalized boolean.</td></tr></table>                                                                                                                                                                                                                       | <i>lob-locator</i> | A LOB locator.          | <i>errorp</i> | A generalized boolean. |
| <i>lob-locator</i> | A LOB locator.                                                                                                                                                                                                                                                                                                                                                 |                    |                         |               |                        |
| <i>errorp</i>      | A generalized boolean.                                                                                                                                                                                                                                                                                                                                         |                    |                         |               |                        |
| Values             | <table><tr><td><i>length</i></td><td>A non-negative integer.</td></tr></table>                                                                                                                                                                                                                                                                                 | <i>length</i>      | A non-negative integer. |               |                        |
| <i>length</i>      | A non-negative integer.                                                                                                                                                                                                                                                                                                                                        |                    |                         |               |                        |
| Description        | <p>The function <code>ora-lob-get-length</code> returns the current length of the LOB underlying <i>lob-locator</i>.</p> <p>If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <code>sql-database-error</code>. The default value of <i>errorp</i> is <code>nil</code>.</p> |                    |                         |               |                        |
| Notes              | <ol style="list-style-type: none"><li>1. This is a direct call to <code>OCILobGetLength</code>.</li><li>2. <code>ora-lob-get-length</code> is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.</li></ol>                                                                            |                    |                         |               |                        |

## **ora-lob-internal-lob-p**

## *Function*

|                    |                                                                                                                                                                           |                    |                |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|----------------|
| Summary            | The predicate for internal LOBs.                                                                                                                                          |                    |                |
| Package            | <code>sql</code>                                                                                                                                                          |                    |                |
| Signature          | <code>ora-lob-internal-lob-p lob-locator =&gt; result</code>                                                                                                              |                    |                |
| Arguments          | <table><tr><td><i>lob-locator</i></td><td>A LOB locator.</td></tr></table>                                                                                                | <i>lob-locator</i> | A LOB locator. |
| <i>lob-locator</i> | A LOB locator.                                                                                                                                                            |                    |                |
| Values             | <table><tr><td><i>result</i></td><td>A boolean.</td></tr></table>                                                                                                         | <i>result</i>      | A boolean.     |
| <i>result</i>      | A boolean.                                                                                                                                                                |                    |                |
| Description        | The function <code>ora-lob-internal-lob-p</code> returns <code>t</code> if <i>lob-locator</i> is internal (BLOB, CLOB, or NCLOB). Otherwise it returns <code>nil</code> . |                    |                |

**Notes** **ora-lob-internal-lob-p** is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.

## ora-lob-is-equal *Function*

**Summary** The comparison function for LOB locators.

**Package** **sql**

**Signature** **ora-lob-is-equal lob-locator1 lob-locator2 => result**

**Arguments** *lob-locator1* A LOB locator.  
*lob-locator2* A LOB locator.

**Values** *result* A boolean.

**Description** The function **ora-lob-is-equal** returns **t** if *lob-locator1* and *lob-locator2* point to the same LOB object.

**Notes**

1. This is a direct call to OCILobIsEqual.
2. **ora-lob-is-equal** is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.

## ora-lob-is-open *Function*

**Summary** The predicate for whether a LOB locator is opened.

**Package** **sql**

**Signature** **ora-lob-is-open lob-locator &key errorp => result**

**Arguments** *lob-locator* A LOB locator.

*This chapter applies to the Enterprise Edition only*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                      |                        |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
|             | <i>errorp</i>                                                                                                                                                                                                                                                                                                                                                                                                                        | A generalized boolean. |
| Values      | <i>result</i>                                                                                                                                                                                                                                                                                                                                                                                                                        | A boolean.             |
| Description | The function <b>ora-lab-is-open</b> returns <b>t</b> if the LOB pointed to by <i>lob-locator</i> is opened (by <b>ora-lab-open</b> ).<br><br><b>ora-lab-is-open</b> is applicable to internal LOBs only.<br><br>If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <b>sql-database-error</b> . The default value of <i>errorp</i> is <b>nil</b> . |                        |
| Notes       | 1. This is a direct call to OCILobIsOpen.<br><br>2. <b>ora-lab-is-open</b> is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.                                                                                                                                                                                                                            |                        |
| See also    | <b>ora-lab-open</b>                                                                                                                                                                                                                                                                                                                                                                                                                  |                        |

|             |                                                                                                                                                                               | <i>Function</i>        |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
|             | <b>ora-lab-is-temporary</b>                                                                                                                                                   |                        |
| Summary     | The predicate for whether a LOB is temporary.                                                                                                                                 |                        |
| Package     | <b>sql</b>                                                                                                                                                                    |                        |
| Signature   | <b>ora-lab-is-temporary lob-locator &amp;key errorp =&gt; result</b>                                                                                                          |                        |
| Arguments   | <i>lob-locator</i>                                                                                                                                                            | A LOB locator.         |
|             | <i>errorp</i>                                                                                                                                                                 | A generalized boolean. |
| Values      | <i>result</i>                                                                                                                                                                 | A boolean.             |
| Description | The function <b>ora-lab-is-temporary</b> returns <b>t</b> if the LOB underlying <i>lob-locator</i> is temporary, that is, it was created by <b>ora-lab-create-temporary</b> . |                        |

If an error occurs and *errorp* is true, an error is signaled. If *errorp* is false, the function returns an object of type **sql-database-error**. The default value of *errorp* is **nil**.

- Notes
1. This is a direct call to OCILobIsTemporary.
  2. **ora-lob-is-temporary** is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.
- See also      **[ora-lob-create-temporary](#)**

## **ora-lob-load-from-file** *Function*

|             |                                                                                                                                                                                                                                                  |                          |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| Summary     | Loads data from a file LOB into a LOB.                                                                                                                                                                                                           |                          |
| Package     | <b>sql</b>                                                                                                                                                                                                                                       |                          |
| Signature   | <b>ora-lob-load-from-file dest-lob-locator src-lob-file amount &amp;key src-offset dest-offset errorp</b>                                                                                                                                        |                          |
| Arguments   | <i>dest-lob-locator</i>                                                                                                                                                                                                                          | An internal LOB locator. |
|             | <i>src-lob-file</i>                                                                                                                                                                                                                              | A file LOB locator.      |
|             | <i>amount</i>                                                                                                                                                                                                                                    | A non-negative integer.  |
|             | <i>src-offset</i>                                                                                                                                                                                                                                | A non-negative integer.  |
|             | <i>dest-offset</i>                                                                                                                                                                                                                               | A non-negative integer.  |
|             | <i>errorp</i>                                                                                                                                                                                                                                    | A generalized boolean.   |
| Description | <p>The function <b>ora-lob-load-from-file</b> loads the data from the <i>src-lob-file</i> into the destination LOB pointed to by <i>dest-lob-locator</i>.</p> <p>The source LOB must be a BFILE and the destination must be an internal LOB.</p> |                          |

*This chapter applies to the Enterprise Edition only*

The details of the operation are determined by *amount*, *src-offset* and *dest-offset*. *amount* and *dest-offset* are in characters for CLOB/NCLOB and are in bytes for BLOB. *src-offset* is in bytes. The offsets start from 1. The default value of *dest-offset* is 1 and the default value of *src-offset* is 1.

No conversion is performed by `ora-lob-load-from-file`, so if the destination is a CLOB/NCLOB, the source must already be in the right format.

If an error occurs and *errorp* is true, an error is signaled. If *errorp* is false, the function returns an object of type `sql-database-error`. The default value of *errorp* is `nil`.

- Notes
1. This is a direct call to OCILobLoadFromFile. The Oracle documentation is ambiguous on whether it is mandatory to open the source LOB before calling this function.
  2. `ora-lob-load-from-file` is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.

See also      `ora-lob-copy`

|             |                    | <i>Function</i>                                                                                                                |
|-------------|--------------------|--------------------------------------------------------------------------------------------------------------------------------|
| Summary     |                    | Returns a foreign pointer to the underlying LOB locator.                                                                       |
| Package     |                    | <code>sql</code>                                                                                                               |
| Signature   |                    | <code>ora-lob-lob-locator lob-locator =&gt; pointer</code>                                                                     |
| Arguments   | <i>lob-locator</i> | A LOB locator.                                                                                                                 |
| Values      | <i>pointer</i>     | A foreign pointer.                                                                                                             |
| Description |                    | The function <code>ora-lob-lob-locator</code> returns a foreign pointer to the OCI LOB locator underlying <i>lob-locator</i> . |

*pointer* is of type **p-oci-lob-locator** or **p-oci-file**.

|       |                                                                                                                                                           |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes | <b>ora-lob-lob-locator</b> is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information. |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|

## ora-lob-locator-is-init *Function*

|             |                                                                                                                                                                                                                                                                                                                                                     |                        |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Summary     | The predicate for whether a LOB is initialized.                                                                                                                                                                                                                                                                                                     |                        |
| Package     | <b>sql</b>                                                                                                                                                                                                                                                                                                                                          |                        |
| Signature   | <b>ora-lob-locator-is-init lob-locator &amp;key errorp =&gt; result</b>                                                                                                                                                                                                                                                                             |                        |
| Arguments   | <i>lob-locator</i>                                                                                                                                                                                                                                                                                                                                  | A LOB locator.         |
|             | <i>errorp</i>                                                                                                                                                                                                                                                                                                                                       | A generalized boolean. |
| Values      | <i>result</i>                                                                                                                                                                                                                                                                                                                                       | A boolean.             |
| Description | <p>The function <b>ora-lob-locator-is-init</b> returns <b>t</b> if the LOB locator <i>lob-locator</i> is initialized.</p> <p>If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <b>sql-database-error</b>. The default value of <i>errorp</i> is <b>nil</b>.</p> |                        |
| Notes       | <ol style="list-style-type: none"> <li>1. This is a direct call to <b>OCILobIsInit</b>.</li> <li>2. <b>ora-lob-locator-is-init</b> is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.</li> </ol>                                                                        |                        |

## ora-lob-open *Function*

|         |              |
|---------|--------------|
| Summary | Opens a LOB. |
|---------|--------------|

*This chapter applies to the Enterprise Edition only*

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                          |                |                     |                        |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|----------------|---------------------|------------------------|
| Package                  | <code>sql</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                          |                |                     |                        |
| Signature                | <code>ora-lob-open lob-locator &amp;key errorp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                          |                |                     |                        |
| Arguments                | <table><tr><td><code>lob-locator</code></td><td>A LOB locator.</td></tr><tr><td><code>errorp</code></td><td>A generalized boolean.</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <code>lob-locator</code> | A LOB locator. | <code>errorp</code> | A generalized boolean. |
| <code>lob-locator</code> | A LOB locator.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                          |                |                     |                        |
| <code>errorp</code>      | A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                          |                |                     |                        |
| Description              | <p>The function <code>ora-lob-open</code> opens the LOB pointed to by <code>lob-locator</code>, which can be an internal LOB or a file LOB.</p> <p>Opening the LOB creates a transaction, so any updates associated with modifying the LOB are delayed until the <code>ora-lob-close</code> call. This saves round-trips and avoids extra work on the server side. However it is not mandatory to use <code>ora-lob-open</code>.</p> <p>Calls to <code>ora-lob-open</code> must be strictly paired to calls to <code>ora-lob-close</code>, and the latter must be called before a call to <code>commit</code>. It is also an error to call <code>ora-lob-open</code> on a server LOB object that is already open, even if it has been opened via a different LOB locator.</p> <p>If an error occurs and <code>errorp</code> is true, an error is signaled. If <code>errorp</code> is false, the function returns an object of type <code>sql-database-error</code>. The default value of <code>errorp</code> is <code>nil</code>.</p> |                          |                |                     |                        |
| Notes                    | <ol style="list-style-type: none"><li>1. This is a direct call to <code>OCILobOpen</code>.</li><li>2. <code>ora-lob-open</code> is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.</li></ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                          |                |                     |                        |
| See also                 | <code>ora-lob-close</code><br><code>ora-lob-is-open</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                          |                |                     |                        |

## **ora-lob-read-buffer**

## *Function*

|         |                                 |
|---------|---------------------------------|
| Summary | Reads from a LOB into a buffer. |
|---------|---------------------------------|

|             |                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>sql</code>      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Signature   |                       | <code>ora-lob-read-buffer lob-locator offset amount buffer &amp;key<br/>buffer-offset csid =&gt; amount-read, eof-or-error-p</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Arguments   | <i>lob-locator</i>    | A LOB locator.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|             | <i>offset</i>         | A non-negative integer or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|             | <i>amount</i>         | A non-negative integer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|             | <i>buffer</i>         | A string, or a vector of element type<br><code>(unsigned-byte 8)</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|             | <i>buffer-offset</i>  | A non-negative integer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|             | <i>csid</i>           | A Character Set ID                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Values      | <i>amount-read</i>    | A non-negative integer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|             | <i>eof-or-error-p</i> | A boolean or an error object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Description |                       | <p>The function <code>ora-lob-read-buffer</code> reads into <i>buffer</i> from the LOB pointed to by <i>lob-locator</i>.</p> <p><i>offset</i> specifies the offset to start reading from. It starts with 1, and specifies characters for CLOB/NCLOB/CFILE and bytes for BLOB/BFILE. If <i>offset</i> is <code>nil</code> then the offset after the end of the previous read operation is used (write operations are ignored). This is especially useful for reading linearly from the LOB.</p> <p><i>amount</i> is the amount to read, in characters for CLOB/NCLOB/CFILE and bytes for BLOB/BFILE.</p> <p>The element type of <i>buffer</i> should match the element type of the LOB locator (see <code>ora-lob-element-type</code>). For this comparison <code>(unsigned-byte 8)</code> and <code>base-char</code> are considered as the same.</p> <p>If the buffer <i>buffer</i> is not static, there is some additional overhead. For small amounts of data, this is probably insignificant.</p> |

*buffer-offset* specifies where to put the data. It is an offset in bytes from the beginning of the buffer. The default value of *buffer-offset* is 0.

*csid* specifies what Character Set ID the data in the target buffer should be. It defaults to the CSID of the LOB pointed to by *lob-locator*.

The return value *amount-read* is the number of elements (characters or bytes) that were read.

If the return value *eof-or-error-p* is *nil* then there is still more to read. If *eof-or-error-p* is *t* then it read to the end of the LOB. If an error occurred then *eof-or-error-p* is an error object.

- Notes
1. This is a direct call to OCILobRead, without callback.
  2. *ora-lob-read-buffer* is available only when the "oracle" module is loaded. See the section “Oracle LOB interface” on page 380 for more information.

- Example
- This example sequentially reads the LOB data into a string, starting from offset 10000. It calls a processing function on each chunk of data and then reads in the next chunk starting from where the previous read ended.

```
(let ((my-buffer (make-string 1000
                               :element-type 'base-char))
      (offset 10000))
  (loop
    (let ((nread
           (ora-lob-read-buffer lob-locator
                                 offset
                                 1000
                                 my-buffer)))
      (when (zerop nread) ; end of the LOB
        (return))
      (my-processing-function my-buffer nread)
      (setq offset nil))) ; so next time it continues
                           ; from where it finished
```

- See also
- ora-lob-element-type*  
*ora-lob-read-foreign-buffer*

|                    | Function                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                    |                |                  |                        |               |                                               |                    |                                               |                  |                                 |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|----------------|------------------|------------------------|---------------|-----------------------------------------------|--------------------|-----------------------------------------------|------------------|---------------------------------|
| Summary            | Writes the contents of a LOB into a file.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                    |                |                  |                        |               |                                               |                    |                                               |                  |                                 |
| Package            | <code>sql</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                    |                |                  |                        |               |                                               |                    |                                               |                  |                                 |
| Signature          | <code>ora-lob-read-into-plain-file lob-locator file-name &amp;key offset file-offset if-exists</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                    |                |                  |                        |               |                                               |                    |                                               |                  |                                 |
| Arguments          | <table> <tr> <td><i>lob-locator</i></td><td>A LOB locator.</td></tr> <tr> <td><i>file-name</i></td><td>A pathname designator.</td></tr> <tr> <td><i>offset</i></td><td>A non-negative integer, or <code>nil</code>.</td></tr> <tr> <td><i>file-offset</i></td><td>A non-negative integer, or <code>nil</code>.</td></tr> <tr> <td><i>if-exists</i></td><td>A keyword or <code>nil</code>.</td></tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <i>lob-locator</i> | A LOB locator. | <i>file-name</i> | A pathname designator. | <i>offset</i> | A non-negative integer, or <code>nil</code> . | <i>file-offset</i> | A non-negative integer, or <code>nil</code> . | <i>if-exists</i> | A keyword or <code>nil</code> . |
| <i>lob-locator</i> | A LOB locator.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                    |                |                  |                        |               |                                               |                    |                                               |                  |                                 |
| <i>file-name</i>   | A pathname designator.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                    |                |                  |                        |               |                                               |                    |                                               |                  |                                 |
| <i>offset</i>      | A non-negative integer, or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                    |                |                  |                        |               |                                               |                    |                                               |                  |                                 |
| <i>file-offset</i> | A non-negative integer, or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                    |                |                  |                        |               |                                               |                    |                                               |                  |                                 |
| <i>if-exists</i>   | A keyword or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                    |                |                  |                        |               |                                               |                    |                                               |                  |                                 |
| Description        | <p>The function <code>ora-lob-read-into-plain-file</code> writes the contents of a LOB into a file.</p> <p><i>file-name</i> specifies the file to write, which should be a standard file. The file is always opened in a binary mode, so if the LOB is a CLOB, the file will be generated in the right format when reading it from the LOB.</p> <p><i>offset</i> is the offset into the LOB from where to start reading. It starts from 1, counts characters in a CLOB, and if it is <code>nil</code> then the operation starts from the end of the previous read operation. The default value of <i>offset</i> is <code>nil</code>.</p> <p><i>file-offset</i> specifies the offset into the file to start the operation from. If <i>file-offset</i> is <code>nil</code> then it starts writing at the start of the file. The default value of <i>file-offset</i> is <code>nil</code>.</p> <p><i>if-exists</i> is passed to <code>open</code> when opening the file, with the standard Common Lisp meaning. The default value of <i>if-exists</i> is <code>:error</code>.</p> |                    |                |                  |                        |               |                                               |                    |                                               |                  |                                 |

*This chapter applies to the Enterprise Edition only*

|          |                                                                                                                                                                          |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | <code>ora-lob-read-into-plain-file</code> is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information. |
| See also | <code>ora-lob-write-from-plain-file</code>                                                                                                                               |

## **ora-lob-read-foreign-buffer** *Function*

|             |                                                                                                                                                                                                                                                                                         |                                              |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| Summary     | Reads from a LOB into a foreign buffer.                                                                                                                                                                                                                                                 |                                              |
| Package     | <code>sql</code>                                                                                                                                                                                                                                                                        |                                              |
| Signature   | <code>ora-lob-read-foreign-buffer lob-locator offset amount foreign-buffer buffer-length &amp;key buffer-offset csid =&gt; amount-read, eof-or-error-p</code>                                                                                                                           |                                              |
| Arguments   | <i>lob-locator</i>                                                                                                                                                                                                                                                                      | A LOB locator.                               |
|             | <i>offset</i>                                                                                                                                                                                                                                                                           | A non-negative integer or <code>nil</code> . |
|             | <i>amount</i>                                                                                                                                                                                                                                                                           | A non-negative integer.                      |
|             | <i>foreign-buffer</i>                                                                                                                                                                                                                                                                   | A FLI pointer.                               |
|             | <i>buffer-length</i>                                                                                                                                                                                                                                                                    | A non-negative integer.                      |
|             | <i>buffer-offset</i>                                                                                                                                                                                                                                                                    | A non-negative integer.                      |
|             | <i>csid</i>                                                                                                                                                                                                                                                                             | A Character Set ID                           |
| Values      | <i>amount-read</i>                                                                                                                                                                                                                                                                      | A non-negative integer.                      |
|             | <i>eof-or-error-p</i>                                                                                                                                                                                                                                                                   | A boolean or an error object.                |
| Description | <p>The function <code>ora-lob-read-foreign-buffer</code> reads from the LOB pointed to by <i>lob-locator</i> into the foreign buffer <i>foreign-buffer</i>.<br/>This is just like <code>ora-lob-read-buffer</code> except that it reads from the LOB locator into a foreign buffer.</p> |                                              |

*foreign-buffer* is a FLI pointer to a buffer, which must be of size at least *buffer-length*.

|          |                                                                                                                                                                                                                                                                                           |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | <ol style="list-style-type: none"> <li>1. This is a direct call to OCILobRead, without callback.</li> <li>2. <b>ora-lob-read-foreign-buffer</b> is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.</li> </ol> |
| See also | <b>ora-lob-get-buffer</b><br><b>ora-lob-read-buffer</b>                                                                                                                                                                                                                                   |

## ora-lob-svc-ctx-handle *Function*

|             |                                                                                                                                                              |                                                  |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|
| Summary     | Returns a foreign pointer to the context handle of a LOB.                                                                                                    |                                                  |
| Package     | <b>sql</b>                                                                                                                                                   |                                                  |
| Signature   | <b>ora-lob-svc-ctx-handle lob-locator =&gt; pointer</b>                                                                                                      |                                                  |
| Arguments   | <i>lob-locator</i>                                                                                                                                           | A LOB locator.                                   |
| Values      | <i>pointer</i>                                                                                                                                               | A foreign pointer of type <b>p-oci-svc-ctx</b> . |
| Description | The function <b>ora-lob-svc-ctx-handle</b> returns a foreign pointer to the context handle of the LOB underlying <i>lob-locator</i> .                        |                                                  |
| Notes       | <b>ora-lob-svc-ctx-handle</b> is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information. |                                                  |

## ora-lob-trim *Function*

|         |                        |
|---------|------------------------|
| Summary | Trims an internal LOB. |
|---------|------------------------|

*This chapter applies to the Enterprise Edition only*

|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                    |                |                 |                         |               |                        |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|----------------|-----------------|-------------------------|---------------|------------------------|
| Package            | <code>sql</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                    |                |                 |                         |               |                        |
| Signature          | <code>ora-lob-trim lob-locator new-size &amp;key errorp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                    |                |                 |                         |               |                        |
| Arguments          | <table><tr><td><i>lob-locator</i></td><td>A LOB locator.</td></tr><tr><td><i>new-size</i></td><td>A non-negative integer.</td></tr><tr><td><i>errorp</i></td><td>A generalized boolean.</td></tr></table>                                                                                                                                                                                                                                                                                                                                                             | <i>lob-locator</i> | A LOB locator. | <i>new-size</i> | A non-negative integer. | <i>errorp</i> | A generalized boolean. |
| <i>lob-locator</i> | A LOB locator.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                    |                |                 |                         |               |                        |
| <i>new-size</i>    | A non-negative integer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                    |                |                 |                         |               |                        |
| <i>errorp</i>      | A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                    |                |                 |                         |               |                        |
| Description        | <p>The function <code>ora-lob-trim</code> trims the LOB pointed to by <i>lob-locator</i> to a new size <i>new-size</i>, which must be smaller than its current size.</p> <p>Note that <i>new-size</i> is in characters for CLOBs and bytes for BLOBs.</p> <p><code>ora-lob-trim</code> is applicable to internal LOBs only.</p> <p>If an error occurs and <i>errorp</i> is true, an error is signaled. If <i>errorp</i> is false, the function returns an object of type <code>sql-database-error</code>. The default value of <i>errorp</i> is <code>nil</code>.</p> |                    |                |                 |                         |               |                        |
| Notes              | <ol style="list-style-type: none"><li>1. This is a direct call to <code>OCILobTrim</code>.</li><li>2. <code>ora-lob-trim</code> is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.</li></ol>                                                                                                                                                                                                                                                                                              |                    |                |                 |                         |               |                        |

|                    | <i>Function</i>                                                                                                                     |                    |                |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------|--------------------|----------------|
| Summary            | Writes a buffer to a LOB.                                                                                                           |                    |                |
| Package            | <code>sql</code>                                                                                                                    |                    |                |
| Signature          | <code>ora-lob-write-buffer lob-locator offset amount buffer &amp;key buffer-offset csid -&gt; amount-written, eof-or-error-p</code> |                    |                |
| Arguments          | <table><tr><td><i>lob-locator</i></td><td>A LOB locator.</td></tr></table>                                                          | <i>lob-locator</i> | A LOB locator. |
| <i>lob-locator</i> | A LOB locator.                                                                                                                      |                    |                |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                           |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|
|             | <i>offset</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | A non-negative integer or <code>nil</code> .                              |
|             | <i>amount</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | A non-negative integer.                                                   |
|             | <i>buffer</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | A string, or a vector of element type<br><code>(unsigned-byte 8)</code> . |
|             | <i>buffer-offset</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | A non-negative integer.                                                   |
|             | <i>csid</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | A Character Set ID                                                        |
| Values      | <i>amount-written</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | A non-negative integer.                                                   |
|             | <i>eof-or-error-p</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | A boolean or an error object.                                             |
| Description | The function <code>ora-lob-write-buffer</code> writes to the LOB pointed to by <i>lob-locator</i> from <i>buffer</i> .<br><br><i>offset</i> specifies the offset to start writing to. It starts with 1, and specifies characters for CLOB/NCLOB/CFILE and bytes for BLOB/BFILE. If <i>offset</i> is <code>nil</code> then the offset after the end of the previous write operation is used (read operations are ignored). This is especially useful for writing linearly to the LOB.<br><br><i>amount</i> is the amount to write, in characters for CLOB/NCLOB/CFILE and bytes for BLOB/BFILE.<br><br>The element type of <i>buffer</i> should match the element type of the LOB locator (see <code>ora-lob-element-type</code> ). For this comparison <code>(unsigned-byte 8)</code> and <code>base-char</code> are considered as the same.<br><br>If the buffer <i>buffer</i> is not static, there is some additional overhead. For small amounts of data, this is probably insignificant.<br><br><i>buffer-offset</i> specifies where in the buffer to start writing data from. It is an offset in bytes from the beginning of the buffer. The default value of <i>buffer-offset</i> is 0. |                                                                           |

*This chapter applies to the Enterprise Edition only*

*csid* specifies what Character Set ID the data in the source buffer should be. It defaults to the CSID of the LOB pointed to by *lob-locator*.

The return value *amount-written* is the number of elements (characters or bytes) that were written

The LOB is extended as required.

If the return value *eof-or-error-p* is `nil` then there is still more to write. If *eof-or-error-p* is `t` then it wrote to the end of the LOB. If an error occurred then *eof-or-error-p* is an error object.

- Notes
1. The record from which the LOB came must be locked. See the section “Locking” on page 382.
  2. `ora-lob-write-buffer` is a direct call to `OCILobWrite`, without callback.
  3. `ora-lob-write-buffer` is available only when the “oracle” module is loaded. See the section “Oracle LOB interface” on page 380 for more information.

- See also
- `ora-lob-element-type`  
`ora-lob-write-foreign-buffer`

## **ora-lob-write-from-plain-file** *Function*

- Summary      Writes the contents of a file into a LOB.

- Package      `sql`

- Signature      `ora-lob-write-from-plain-file lob-locator file-name &key offset file-offset if-does-not-exist`

- Arguments      *lob-locator*      A LOB locator.

- file-name*      A pathname designator.

- offset*      A non-negative integer, or `nil`.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                               |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|
|             | <i>file-offset</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | A non-negative integer, or <code>nil</code> . |
|             | <i>if-does-not-exist</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | A keyword or <code>nil</code> .               |
| Description | <p>The function <code>ora-lob-write-from-plain-file</code> writes the contents of a file into a LOB.</p> <p><i>file-name</i> specifies the file to read, which should be a standard file. The file is always opened in a binary mode, so if the LOB is a CLOB, the file must be in the right format when writing it into the LOB.</p> <p><i>offset</i> is the offset into the LOB from where to start writing. It starts from 1, counts characters in a CLOB, and if it is <code>nil</code> then the operation starts from the end of the previous write operation. The default value of <i>offset</i> is <code>nil</code>.</p> <p><i>file-offset</i> specifies the offset into the file to start the operation from. If <i>file-offset</i> is <code>nil</code> then it starts reading at the start of the file. The default value of <i>file-offset</i> is <code>nil</code>.</p> <p><i>if-does-not-exist</i> is passed to <code>open</code> when opening the file, with the standard Common Lisp meaning. The default value of <i>if-does-not-exist</i> is <code>:error</code>.</p> |                                               |
| Notes       | <p><code>ora-lob-write-from-plain-file</code> is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                               |
| See also    | <code>ora-lob-read-into-plain-file</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                               |

| <b>ora-lob-write-foreign-buffer</b> |                                   | <i>Function</i> |
|-------------------------------------|-----------------------------------|-----------------|
| Summary                             | Writes a foreign buffer to a LOB. |                 |
| Package                             | <code>sql</code>                  |                 |

*This chapter applies to the Enterprise Edition only*

|                  |                                                                                                                                                                                                                                                                                                                                                                         |                                              |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| Signature        | <code>ora-lob-write-foreign-buffer lob-locator offset amount<br/>foreign-buffer buffer-length &amp;key buffer-offset csid =&gt; amount-written, eof-or-error-p</code>                                                                                                                                                                                                   |                                              |
| Arguments        | <i>lob-locator</i>                                                                                                                                                                                                                                                                                                                                                      | A LOB locator.                               |
|                  | <i>offset</i>                                                                                                                                                                                                                                                                                                                                                           | A non-negative integer or <code>nil</code> . |
|                  | <i>amount</i>                                                                                                                                                                                                                                                                                                                                                           | A non-negative integer.                      |
|                  | <i>foreign-buffer</i>                                                                                                                                                                                                                                                                                                                                                   | A FLI pointer.                               |
|                  | <i>buffer-length</i>                                                                                                                                                                                                                                                                                                                                                    | A non-negative integer.                      |
|                  | <i>buffer-offset</i>                                                                                                                                                                                                                                                                                                                                                    | A non-negative integer.                      |
|                  | <i>csid</i>                                                                                                                                                                                                                                                                                                                                                             | A Character Set ID                           |
| Values           | <i>amount-written</i>                                                                                                                                                                                                                                                                                                                                                   | A non-negative integer.                      |
|                  | <i>eof-or-error-p</i>                                                                                                                                                                                                                                                                                                                                                   | A boolean or an error object.                |
| Description      | The function <code>ora-lob-write-foreign-buffer</code> writes to the LOB pointed to by <i>lob-locator</i> from <i>buffer</i> .<br><br>This is just like <code>ora-lob-write-buffer</code> except that it writes the LOB locator from a foreign buffer.<br><br><i>foreign-buffer</i> is a FLI pointer to a buffer, which must be of size at least <i>buffer-length</i> . |                                              |
| Notes            | <code>ora-lob-write-foreign-buffer</code> is available only when the "oracle" module is loaded. See the section "Oracle LOB interface" on page 380 for more information.                                                                                                                                                                                                |                                              |
| See also         | <code>ora-lob-get-buffer</code><br><code>ora-lob-write-buffer</code>                                                                                                                                                                                                                                                                                                    |                                              |
| <b>p-oci-env</b> | <i>FLI type descriptor</i>                                                                                                                                                                                                                                                                                                                                              |                                              |
| Summary          | A foreign type representing objects in the Oracle interface.                                                                                                                                                                                                                                                                                                            |                                              |

|                          |                                                                |                            |
|--------------------------|----------------------------------------------------------------|----------------------------|
| Package                  | <code>sql</code>                                               |                            |
| Description              | See “Interactions with foreign calls” on page 384 for details. |                            |
| <b>p-oci-file</b>        |                                                                | <i>FLI type descriptor</i> |
| Summary                  | A foreign type representing objects in the Oracle interface.   |                            |
| Package                  | <code>sql</code>                                               |                            |
| Description              | See “Interactions with foreign calls” on page 384 for details. |                            |
| <b>p-oci-lob-locator</b> |                                                                | <i>FLI type descriptor</i> |
| Summary                  | A foreign type representing objects in the Oracle interface.   |                            |
| Package                  | <code>sql</code>                                               |                            |
| Description              | See “Interactions with foreign calls” on page 384 for details. |                            |
| <b>p-oci-lob-or-file</b> |                                                                | <i>FLI type descriptor</i> |
| Summary                  | A foreign type representing objects in the Oracle interface.   |                            |
| Package                  | <code>sql</code>                                               |                            |
| Description              | See “Interactions with foreign calls” on page 384 for details. |                            |
| <b>p-oci-svc-ctx</b>     |                                                                | <i>FLI type descriptor</i> |
| Summary                  | A foreign type representing objects in the Oracle interface.   |                            |

*This chapter applies to the Enterprise Edition only*

|             |                                                                |
|-------------|----------------------------------------------------------------|
| Package     | <code>sql</code>                                               |
| Description | See “Interactions with foreign calls” on page 384 for details. |

## **prepare-statement** *Function*

|                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                      |                   |                       |             |                             |         |                    |                                              |                    |            |                           |                    |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-------------------|-----------------------|-------------|-----------------------------|---------|--------------------|----------------------------------------------|--------------------|------------|---------------------------|--------------------|
| Summary                     | Returns a <code>prepared-statement</code> object for a <code>sql-exp</code> in a database.                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                      |                   |                       |             |                             |         |                    |                                              |                    |            |                           |                    |
| Package                     | <code>sql</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                      |                   |                       |             |                             |         |                    |                                              |                    |            |                           |                    |
| Signature                   | <code>prepare-statement sql-exp &amp;key database variable-types count flatp result-types -&gt; prepared-statement</code>                                                                                                                                                                                                                                                                                                                                                                                                                               |                      |                   |                       |             |                             |         |                    |                                              |                    |            |                           |                    |
| Arguments                   | <table><tr><td><code>sql-exp</code></td><td>A SQL expression.</td></tr><tr><td><code>database</code></td><td>A database.</td></tr><tr><td><code>variable-types</code></td><td>A list.</td></tr><tr><td><code>count</code></td><td>A non-negative integer or <code>nil</code>.</td></tr><tr><td><code>flatp</code></td><td>A boolean.</td></tr><tr><td><code>result-types</code></td><td>A list of symbols.</td></tr></table>                                                                                                                            | <code>sql-exp</code> | A SQL expression. | <code>database</code> | A database. | <code>variable-types</code> | A list. | <code>count</code> | A non-negative integer or <code>nil</code> . | <code>flatp</code> | A boolean. | <code>result-types</code> | A list of symbols. |
| <code>sql-exp</code>        | A SQL expression.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                      |                   |                       |             |                             |         |                    |                                              |                    |            |                           |                    |
| <code>database</code>       | A database.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                      |                   |                       |             |                             |         |                    |                                              |                    |            |                           |                    |
| <code>variable-types</code> | A list.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                      |                   |                       |             |                             |         |                    |                                              |                    |            |                           |                    |
| <code>count</code>          | A non-negative integer or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                      |                   |                       |             |                             |         |                    |                                              |                    |            |                           |                    |
| <code>flatp</code>          | A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                      |                   |                       |             |                             |         |                    |                                              |                    |            |                           |                    |
| <code>result-types</code>   | A list of symbols.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                      |                   |                       |             |                             |         |                    |                                              |                    |            |                           |                    |
| Values                      | <code>prepared-statement</code><br>A <code>prepared-statement</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                      |                   |                       |             |                             |         |                    |                                              |                    |            |                           |                    |
| Description                 | The function <code>prepare-statement</code> returns a <code>prepared-statement</code> object for the SQL statement <code>sql-exp</code> in the database <code>database</code> . <code>sql-exp</code> can contain bind-variables in the form <code>:n</code> where <code>n</code> is a positive integer.<br><br>If <code>database</code> is supplied, then the <code>prepared-statement</code> is associated with the database. Otherwise <code>set-prepared-statement-variables</code> will do the association even if it is called without a database. |                      |                   |                       |             |                             |         |                    |                                              |                    |            |                           |                    |

If *variable-types* is supplied, then it should be a list containing a keyword element for each bind-variable in *sql-exp*. It has an effect in two cases:

- **:string** forces the variable to be passed to the database as a string. That may be useful if you have numeric values in Lisp which are stored as strings in the database.
- **:date** cause an integer to be interpreted as a universal-time and be converted properly to an Oracle date. This is not supported on SQLite databases, which do not support date fields.

If *variable-types* is not supplied, then the types will be chosen dynamically from the values passed to **set-prepared-statement-variables**.

If *count* is supplied, then it should equal the maximum number of bind-variables in the *sql-exp*. If *count* is not supplied, then it is calculated from *sql-exp*.

*flatp* and *result-types* are interpreted the same as in **select**.

The result of **prepare-statement** is a **prepared-statement**. This can be used by calling **set-prepared-statement-variables** to actually bind the variables, and then use one of the querying or executing interfaces that take a SQL expression argument: **execute-command**, **query**, **do-query**, **simple-do-query**, **map-query** and the **loop for...being each record** construct.

A **prepared-statement** that is associated with a database should be destroyed (by **destroy-prepared-statement**) before the database is closed, otherwise it may leak memory.

Notes      *sql-exp* can be any valid SQL expression, not only a query.

Examples    Create a **prepared-statement** for a SQL expression:

```
(setq ps
      (sql:prepare-statement
        "insert into TABLETWO values(:1, :2)"))
```

*This chapter applies to the Enterprise Edition only*

Then insert records into TABLETWO (which has two columns) by repeatedly doing:

```
(sql:set-prepared-statement-variables  
  ps  
  (list value1 value2))  
  
(sql:execute-command ps))
```

See also

[query](#)  
[do-query](#)  
[simple-do-query](#)  
[map-query](#)  
[select](#)  
[set-prepared-statement-variables](#)  
[destroy-prepared-statement](#)

## **prepared-statement**

*System Class*

Summary      A class of objects prepared SQL statements.

Package      `sql`

Signature      `prepared-statement`

Description      Each instance of the system class `prepared-statement` represents a SQL statement prepared by `prepare-statement`.

See also      `prepare-statement`

## **print-query**

*Function*

Summary      Prints a tabulated version of records resulting from a query.

Package      `sql`

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signature   | <code>print-query query-exp &amp;key titles formats sizes stream database<br/>=&gt;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Arguments   | <p><i>query-exp</i>      A SQL query expression.</p> <p><i>titles</i>            A list of strings.</p> <p><i>formats</i>          A list of strings.</p> <p><i>sizes</i>            A list.</p> <p><i>stream</i>           An output stream.</p> <p><i>database</i>        A database.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Values      | None.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Description | <p>The function <code>print-query</code> takes a symbolic SQL query expression and formatting information and prints onto <i>stream</i> a table containing the results of the query.</p> <p>A list of strings to use as column headings is given by <i>titles</i>, which has a default value of <code>nil</code>.</p> <p>The <i>formats</i> argument is a list of format strings used to print each attribute, and has a default value of <code>t</code>, which means that <code>-A</code> or <code>-VA</code> are used if sizes are provided or computed.</p> <p>The field sizes are given by <i>sizes</i>. It has a default value of <code>t</code>, which specifies that minimum sizes are computed.</p> <p>The output stream is given by <i>stream</i>, which has a default value of <code>t</code>. This specifies that <code>*standard-output*</code> is used.</p> |
| Examples    | The following call prints out two even columns of names and salaries:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|             | <pre>(print-query [select [surname] [income] :from [person]]<br/>           :titles '("NAME" "SALARY"))</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| See also    | <p><code>map-query</code></p> <p><code>print-query</code></p> <p><code>select</code></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

| query       | Function                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Queries a database and returns a list of values.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Package     | <code>sql</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Signature   | <code>query sql-exp &amp;key database result-types flatp =&gt; result-list, field-names</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Arguments   | <p><i>sql-exp</i>      A SQL query statement or a <b>prepared-statement</b> containing a query.</p> <p><i>database</i>      A database.</p> <p><i>result-types</i>      A list of symbols.</p> <p><i>flatp</i>      A boolean.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Values      | <p><i>result-list</i>      A list of values.</p> <p><i>field-names</i>      A list of strings.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Description | <p>The function <b>query</b> is the basic SQL query function. It queries the database specified by <i>database</i> with a SQL query statement given by <i>sql-exp</i>.</p> <p>The argument <i>database</i> defaults to <b>*default-database*</b>.</p> <p><i>result-types</i> is a list of symbols such as <code>:string</code> and <code>:integer</code>, one for each field in the query, which are used to specify the types to return. It is ignored if <i>sql-exp</i> is a <b>prepared-statement</b>.</p> <p><i>flatp</i> is used as in <b>select</b> and is ignored if <i>sql-exp</i> is a <b>prepared-statement</b>.</p> <p><i>result-list</i> is a list of values as per <b>select</b>, and <i>field-names</i> is a list of field names selected in <i>sql-exp</i>.</p> |
| Example     | The following two queries, on a table whose second column contains dates that we want to return as strings, are equivalent:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

```
(sql:query "select * from some_table"
           :result-types '(nil :string))

(sql:query [select [*]
            :from [some_table]
            :result-types '(nil :string)])
```

## See also

[do-query](#)  
[execute-command](#)  
[lob-stream](#)  
[loop](#)  
[map-query](#)  
[prepare-statement](#)  
[select](#)  
[simple-do-query](#)

|                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <i>Function</i> |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>reconnect</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                 |
| Summary          | Reconnects a database to its underlying RDBMS.                                                                                                                                                                                                                                                                                                                                                                                                                                       |                 |
| Package          | <code>sql</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                 |
| Signature        | <code>reconnect &amp;key database error force =&gt; success</code>                                                                                                                                                                                                                                                                                                                                                                                                                   |                 |
| Arguments        | <code>database</code> The database to be reconnected.<br><code>error</code> A boolean.<br><code>force</code> A boolean.                                                                                                                                                                                                                                                                                                                                                              |                 |
| Values           | <code>success</code> A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                 |
| Description      | <p>The function <code>reconnect</code> reconnects <code>database</code> to its underlying RDBMS. If successful, <code>success</code> is <code>t</code> and the variable <code>*default-database*</code> is set to the newly reconnected database.</p> <p>The default value for <code>database</code> is <code>*default-database*</code>. If <code>database</code> is a database object, then it is used directly. Otherwise, the list of connected databases is searched to find</p> |                 |

*This chapter applies to the Enterprise Edition only*

one with database as its connection specifications (see `connect`). If no such database is found, then if `error` and `database` are both non-nil an error is signaled, otherwise `reconnect` returns `nil`.

`force` controls whether an error should be signaled if the existing database connection cannot be closed. When non-nil (this is the default value) the connection is closed without error checking. When `force` is `nil`, an error is signaled if the database connection has been lost.

|          |                                                                                                                                                                                                                |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | <code>force</code> non-nil might result in a memory leak if the database driver fails to release its memory (some drivers do not allow the connection to be closed if the underlying RDBMS is not responding). |
| See also | <code>connect</code><br><code>connected-databases</code><br><code>*default-database*</code>                                                                                                                    |

## **restore-sql-reader-syntax-state** *Function*

|             |                                                                                                                                                                                                                    |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Sets the enable/disable square bracket syntax state to reflect the last call to either <code>disable-sql-reader-syntax</code> or <code>enable-sql-reader-syntax</code> .                                           |
| Package     | <code>sql</code>                                                                                                                                                                                                   |
| Signature   | <code>restore-sql-reader-syntax-state</code>                                                                                                                                                                       |
| Arguments   | None.                                                                                                                                                                                                              |
| Values      | None.                                                                                                                                                                                                              |
| Description | The function <code>restore-sql-reader-syntax-state</code> sets the enable/disable state of the square bracket syntax to reflect the last call to either <code>enable-sql-reader-syntax</code> or <code>dis-</code> |

**able-sql-reader-syntax.** The default state of the square bracket syntax is disabled.

## See also

`disable-sql-reader-syntax`  
`enable-sql-reader-syntax`  
`locally-disable-sql-reader-syntax`  
`locally-enable-sql-reader-syntax`

**rollback** *Function*

Summary Rolls back changes made to a database since the last commit.

Package `sql`

Signature `rollback &key database => nil`

Arguments `database` A database.

Values `nil`

Description The function `rollback` rolls back changes made in `database` since the last commit, that is, changes made since the last commit are not recorded. The argument `database` defaults to **\*default-database\***.

## See also

`commit`  
`with-transaction`

**select** *Function*

Summary Selects data from a database given a number of specified constraints.

Package `sql`

*This chapter applies to the Enterprise Edition only*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                           |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| Signature   | <pre>select &amp;rest <i>selections</i> &amp;key all set-operation distinct from<br/>result-types flatp where group-by having database order-by refresh<br/>for-update =&gt; result-list</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                           |
| Arguments   | <i>selections</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | A set of database identifiers or strings. |
|             | <i>all</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | A boolean.                                |
|             | <i>set-operation</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | A SQL operation.                          |
|             | <i>distinct</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A boolean.                                |
|             | <i>from</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | A SQL table.                              |
|             | <i>result-types</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | A list of symbols.                        |
|             | <i>flatp</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | A boolean.                                |
|             | <i>where</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | A SQL condition.                          |
|             | <i>group-by</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A SQL condition.                          |
|             | <i>having</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | A SQL condition.                          |
|             | <i>database</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A database.                               |
|             | <i>order-by</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A SQL condition.                          |
|             | <i>refresh</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | A boolean.                                |
|             | <i>for-update</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | t, :nowait, a string or a list.           |
| Values      | <i>result-list</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | A list of selections.                     |
| Description | <p>The function <code>select</code> selects data from <i>database</i>, which has a default value of <code>*default-database*</code>, given the constraints specified by the rest of the arguments. It returns a list of objects as specified by <i>selections</i>. By default, the objects will each be represented as lists of attribute values.</p> <p>The argument <i>selections</i> consists either of database identifiers, type-modified database identifiers or literal strings.</p> <p>A type-modified database identifier is an expression such as <code>[foo :string]</code> which means that the values in column <code>foo</code> are returned as Lisp strings. This syntax can be used to force</p> |                                           |

values in time/date fields to be returned as strings (see below for an example). It can also be used to affect the value returned from MySQL, using the keywords mentioned in the section “Using MySQL” on page 373. It can also be used to return `lob-stream` objects for queries on Oracle LOB columns, using an expression like `[foo :input-stream]` or `[foo :output-stream]`

*result-types* is used when *selections* is `*` or `[*]`. It should be a list of symbols such as `:string` and `:integer`, one for each field in the table being selected in order to specify the types to return. Note that, for specific selections, the result type can be specified by using a type-modified identifier as described above. However, you cannot use *result-types* to modify the type returned from a time/date field.

*flatp*, which has a default value of `nil`, specifies if full bracketed results should be returned for each matched entry. If *flatp* is `nil`, the results are returned as a list of lists. If *flatp* is `t`, the results are returned as elements of a list, only if there is only one result per row. See the examples section for an example of the use of *flatp*.

The arguments *all*, *set-operation*, *distinct*, *from*, *where*, *group-by*, *having* and *order-by* have the same function as the equivalent SQL expression.

*for-update* is used to specify the FOR UPDATE clause in a select statement which is used by Oracle to lock the selected records. If *for-update* is `t` then a plain "FOR UPDATE" clause is generated. This locks all retrieved records, waiting for the locks to become available. If *for-update* is `:nowait` then a "FOR UPDATE NOWAIT" clause is generated. This locks all the retrieved records, or otherwise returns with error ora-00054 which causes Lisp to signal a `sql-temporary-error`. If *for-update* is a string then it should specify a column to be locked and a clause "FOR UPDATE OF *for-update*" is generated. If *for-update* is a list then the elements of the list should be strings each specifying a column to be locked,

except that the last element of the list may be `:nowait`. A clause locking multiple columns is generated, waiting for the locks according to whether `:nowait` was supplied. For an example see the section “Locking” on page 382.

The function `select` is common across both the functional and object-oriented SQL interfaces. If `selections` refers to View Classes then the `select` operation becomes object-oriented. This means that `select` returns a list of View Class instances, and `slot-value` becomes a valid SQL operator for use within the `where` clause.

In the View Class case, a second equivalent `select` call will return the same View Class instance objects. If `refresh` is true, then existing instances are updated if necessary, and in this case you might need to extend the hook `instance-refreshed`. Any join slots defined using `retrieval :deferred` will be recomputed the next time they are accessed. The default value of `refresh` is `nil`.

SQL expressions used in the `select` function are specified using the square bracket syntax, once this syntax has been enabled using `enable-sql-reader-syntax`.

SQL expressions used in the `select` function are commonly specified using the “Symbolic SQL syntax” on page 358. Note that you need to enable it by using `enable-sql-reader-syntax` or `locally-enable-sql-reader-syntax` so they can be read correctly. An expression can also be made dynamically by using `sql-expression`.

## Examples

The following is a potential query and result:

```
(select [person_id] [surname] :from [person])  
=> ((111 "Brown") (112 "Jones") (113 "Smith"))
```

In the next example, the `flatp` argument is set to `t`, and the result is a simple list of surname values:

```
(select [surname] :from [person] :flatp t)
```

```
=> ("Brown" "Jones" "Smith")
```

In this example data in the attribute `largenum`, which is of a vendor-specific large numeric type, is returned to Lisp as strings:

```
(sql:select [largenum :string] :from [my-table])
```

In this example the second column of `some_table` is a date that we want to return as a string:

```
(sql:select [*]
            :from [some_table]
            :result-types '(nil :string))
```

In this example we see that a time/date field value is returned as an integer. We then use Common Lisp to decode that universal time, and finally query the database again, forcing the return value to be a string formatted by the database:

```
CL-USER 219 > (sql:select [MyDate]
                           :from [MyTable]
                           :flatp t)
(3313785600)
("MYDATE")

CL-USER 220 > (decode-universal-time (car *))
0
0
0
0
4
1
2005
1
NIL
0

CL-USER 221 > (sql:select [MyDate :string]
                           :from [MyTable]
                           :flatp t)
("2005-01-04 00:00:00")
("MYDATE")
```

*This chapter applies to the Enterprise Edition only*

Finally this code gets the first 1 KB of data from the first LOB returned by a query on an Oracle table containing a column of type LOB:

```
(let* ((array
        (make-array 1024
                   :element-type '(unsigned-byte 8)))
       (lobs (sql:select [my-lob-column :input-stream]
                         :from [mytable] :flatp t)))
      (read-sequence array (car lobs)))
```

See also

`instance-refreshed`  
`lob-stream`  
`prepare-statement`  
`print-query`  
`sql-expression`  
`query`  
“Symbolic SQL syntax” on page 358  
“Querying” on page 346

## set-prepared-statement-variables

## *Function*

|             |                                                                                                                                                                 |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Sets the values of the bind variables in a <code>prepared-statement</code> .                                                                                    |
| Package     | <code>sql</code>                                                                                                                                                |
| Signature   | <code>set-prepared-statement-variables <i>prepared-statement</i> &amp;key <i>database</i> <i>values</i> =&gt; <i>prepared-statement</i></code>                  |
| Arguments   | <code>prepared-statement</code><br>A <code>prepared-statement</code> .<br><code>database</code> A database or <code>nil</code> .<br><code>values</code> A list. |
| Description | The function <code>set-prepared-statement-variables</code> sets the values of the bind variables in the <code>prepared-statement</code> pre-                    |

*pared-statement* to the objects in the list given by *values*. The length of *values* must equal the number of bind-variables in *prepared-statement* (that is, the supplied or computed count in `prepare-statement`). If *database* is supplied, then *prepared-statement* is (re)associated with that database.

If *database* is not supplied and the statement is not associated with a database yet, `set-prepared-statement-variables` associates it with the default database `*default-database*`. If the statement was already associated and *database* is `nil`, the association does not change.

`set-prepared-statement-variables` returns the prepared-statement.

See also      `prepared-statement`

`prepare-statement`

`destroy-prepared-statement`

## simple-do-query *Macro*

Summary      Repeatedly binds a variable to the results of a query, optionally binds another variable to the column names, and executes a body of code within the scope of these bindings.

Package      `sql`

Signature     `simple-do-query (values-list query &key names-list database not-inside-transaction get-all) &body body =>`

Arguments    `values-list`      A variable.

`query`        A database query or a `prepared-statement` containing a query.

`names-list`    A variable, or `nil`.

`database`     A database.

`not-inside-transaction`

|                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                      | A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <code>get-all</code> | A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <code>body</code>    | A Lisp code body.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Values               | None.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Description          | <p>The macro <code>simple-do-query</code> repeatedly executes <code>body</code> within a binding of <code>values-list</code> to the attributes of each record resulting from <code>query</code>.</p> <p>If a variable <code>names-list</code> is supplied, then it is bound to a list of the column names for the query during the execution of <code>body</code>. The default value of <code>names-list</code> is <code>nil</code>.</p> <p><code>simple-do-query</code> returns no values.</p> <p>The default value of <code>database</code> is <code>*default-database*</code>.</p> <p><code>not-inside-transaction</code> and <code>get-all</code> may be useful when fetching many records through a connection with <code>database-type :mysql</code>. Both of these arguments have default value <code>nil</code>. See the section “Special considerations for iteration functions and macros” on page 375 for details.</p> |
| Example              | <pre>(sql:simple-do-query   (person-details [select [Surname] [ID] :from [person]]                   :names-list xx)   (format t "~&amp;~A: ~A, ~A: ~A~%"          (first xx)          (first person-details)          (second xx)          (second person-details))) =&gt; SURNAME: Brown, ID: 2 SURNAME: Jones, ID: 3 SURNAME: Smith, ID: 4</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| See also             | <code>do-query</code><br><code>loop</code><br><code>map-query</code><br><code>prepare-statement</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

```
query
select
```

| <b>sql</b>  | <i>Function</i>                                                                                                                                                                                                                                                                                                                         |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Generates SQL from a set of expressions.                                                                                                                                                                                                                                                                                                |
| Package     | <b>sql</b>                                                                                                                                                                                                                                                                                                                              |
| Signature   | <b>sql &amp;rest args =&gt; sql-expression</b>                                                                                                                                                                                                                                                                                          |
| Arguments   | <b>args</b> A set of expressions.                                                                                                                                                                                                                                                                                                       |
| Values      | <b>sql-expression</b> A SQL expression.                                                                                                                                                                                                                                                                                                 |
| Description | The function <b>sql</b> generates SQL from a set of expressions given by <b>args</b> . Each argument to <b>sql</b> is translated into SQL and then the <b>args</b> are concatenated with a single space between each pair. The rules for translation into SQL, based on the type of each individual argument <b>x</b> , are as follows: |
|             | <pre>string =&gt; (format nil "'~A'" x) nil =&gt; "NULL" symbol =&gt; (symbol-name x) number =&gt; (princ-to-string x) list =&gt; (format nil "~{~A~,~}") (mapcar #'sql x)) vector =&gt; (format nil "~{~A~,~}" (map 'list #'sql x)) sql-expression =&gt; x Any other symbol =&gt; error</pre>                                          |
| See also    | <b>sql-expression</b><br><b>sql-operation</b><br><b>sql-operator</b>                                                                                                                                                                                                                                                                    |

*This chapter applies to the Enterprise Edition only*

| <b>Condition</b>               |                                                                                                                                                                                                                                                                |
|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>sql-connection-error</b>    |                                                                                                                                                                                                                                                                |
| Package                        | <code>sql</code>                                                                                                                                                                                                                                               |
| Superclasses                   | <code>sql-database-error</code>                                                                                                                                                                                                                                |
| Subclasses                     | <code>sql-fatal-error</code><br><code>sql-timeout-error</code>                                                                                                                                                                                                 |
| Description                    | The condition class <code>sql-connection-error</code> is used to signal an error with the connection to the database.                                                                                                                                          |
| <b>sql-database-data-error</b> |                                                                                                                                                                                                                                                                |
| Package                        | <code>sql</code>                                                                                                                                                                                                                                               |
| Superclasses                   | <code>sql-database-error</code>                                                                                                                                                                                                                                |
| Description                    | The condition class <code>sql-database-data-error</code> is used to signal an error with the data given. This means either a syntax error or things like accessing a non-existent table.<br><br>It signifies an error that must be fixed for the code to work. |
| <b>sql-database-error</b>      |                                                                                                                                                                                                                                                                |
| Package                        | <code>sql</code>                                                                                                                                                                                                                                               |
| Superclasses                   | <code>simple-error</code>                                                                                                                                                                                                                                      |
| Subclasses                     | <code>sql-connection-error</code><br><code>sql-database-data-error</code><br><code>sql-temporary-error</code>                                                                                                                                                  |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Accessors   | <code>sql-error-error-id</code><br><code>sql-error-secondary-error-id</code><br><code>sql-error-database-message</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Description | <p>The condition class <code>sql-database-error</code> is used to signal errors in the database interface that Common SQL uses.</p> <p><code>sql-error-error-id</code> returns the primary error identifier. On ODBC the value is a string. On Oracle it is some number, the "v2 return code" in the Cursor Data Area.</p> <p><code>sql-error-secondary-error-id</code> returns the secondary error identifier. On ODBC this is the error code from the underlying database. On Oracle that is the "v4 return code" (also known as "return code") in the Cursor Data Area, which is the useful code.</p> <p><code>sql-error-database-message</code> is a string (maybe <code>nil</code>) that came back from the foreign code.</p> |
| Notes       | ODBC drivers for Oracle return the "v4 return code" as the underlying database code. Therefore in the event of an error on connection to an Oracle database, <code>sql-error-secondary-error-id</code> always returns the "v4 return code" whether the connection is through ODBC.                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| See also    | <code>sql-user-error</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

| <b>*sql-enlarge-static*</b> |                                                                                                                                                                                            | <i>Variable</i> |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Package                     | <code>sql</code>                                                                                                                                                                           |                 |
| Initial value               | <code>100000</code>                                                                                                                                                                        |                 |
| Description                 | The amount to enlarge static memory by before loading database code. This is an optimization of static memory fragmentation, useful for some databases. It is ignored when loading Oracle. |                 |

Notes      **\*sql-enlarge-static\*** is applicable in LispWorks for SPARC Solaris.

|                              | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                     |           |                    |                                                        |                        |                                                        |                    |                                                        |                    |           |                   |            |                          |           |                              |          |
|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-----------|--------------------|--------------------------------------------------------|------------------------|--------------------------------------------------------|--------------------|--------------------------------------------------------|--------------------|-----------|-------------------|------------|--------------------------|-----------|------------------------------|----------|
| Summary                      | Generate a SQL expression from the supplied keywords.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                     |           |                    |                                                        |                        |                                                        |                    |                                                        |                    |           |                   |            |                          |           |                              |          |
| Package                      | <code>sql</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                     |           |                    |                                                        |                        |                                                        |                    |                                                        |                    |           |                   |            |                          |           |                              |          |
| Signature                    | <code>sql-expression &amp;key string table attribute owner alias type n-qualified parameter-index =&gt; sql-expression</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     |           |                    |                                                        |                        |                                                        |                    |                                                        |                    |           |                   |            |                          |           |                              |          |
| Arguments                    | <table><tr><td><code>string</code></td><td>A string.</td></tr><tr><td><code>table</code></td><td>String, symbol or <code>sql-expression-object</code>.</td></tr><tr><td><code>attribute</code></td><td>String, symbol or <code>sql-expression-object</code>.</td></tr><tr><td><code>owner</code></td><td>String, symbol or <code>sql-expression-object</code>.</td></tr><tr><td><code>alias</code></td><td>A string.</td></tr><tr><td><code>type</code></td><td>A keyword.</td></tr><tr><td><code>n-qualified</code></td><td>A string.</td></tr><tr><td><code>parameter-index</code></td><td>Integer.</td></tr></table>                                                                            | <code>string</code> | A string. | <code>table</code> | String, symbol or <code>sql-expression-object</code> . | <code>attribute</code> | String, symbol or <code>sql-expression-object</code> . | <code>owner</code> | String, symbol or <code>sql-expression-object</code> . | <code>alias</code> | A string. | <code>type</code> | A keyword. | <code>n-qualified</code> | A string. | <code>parameter-index</code> | Integer. |
| <code>string</code>          | A string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |           |                    |                                                        |                        |                                                        |                    |                                                        |                    |           |                   |            |                          |           |                              |          |
| <code>table</code>           | String, symbol or <code>sql-expression-object</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     |           |                    |                                                        |                        |                                                        |                    |                                                        |                    |           |                   |            |                          |           |                              |          |
| <code>attribute</code>       | String, symbol or <code>sql-expression-object</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     |           |                    |                                                        |                        |                                                        |                    |                                                        |                    |           |                   |            |                          |           |                              |          |
| <code>owner</code>           | String, symbol or <code>sql-expression-object</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     |           |                    |                                                        |                        |                                                        |                    |                                                        |                    |           |                   |            |                          |           |                              |          |
| <code>alias</code>           | A string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |           |                    |                                                        |                        |                                                        |                    |                                                        |                    |           |                   |            |                          |           |                              |          |
| <code>type</code>            | A keyword.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |           |                    |                                                        |                        |                                                        |                    |                                                        |                    |           |                   |            |                          |           |                              |          |
| <code>n-qualified</code>     | A string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |           |                    |                                                        |                        |                                                        |                    |                                                        |                    |           |                   |            |                          |           |                              |          |
| <code>parameter-index</code> | Integer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     |           |                    |                                                        |                        |                                                        |                    |                                                        |                    |           |                   |            |                          |           |                              |          |
| Values                       | <code>sql-expression</code> A <code>sql-expression-object</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                     |           |                    |                                                        |                        |                                                        |                    |                                                        |                    |           |                   |            |                          |           |                              |          |
| Description                  | <p>The function <code>sql-expression</code> generates a SQL expression from the supplied keywords. The result <code>sql-expression</code> is of type <code>sql-expression-object</code>, which specifies some SQL that can be used inside other calls to <code>sql-expression</code>, a "[...]" syntax expression or as an argument to the Common SQL functions. <code>sql-expression</code> matches what the read-time "[...]" syntax generates for identifiers (see “Enclosing database identifiers” on page 359), but can be used at run time.</p> <p>If <code>string</code> is non-nil, it must be the only keyword and specifies the entire SQL, directly without any further processing.</p> |                     |           |                    |                                                        |                        |                                                        |                    |                                                        |                    |           |                   |            |                          |           |                              |          |

If *attribute* is supplied, it specifies an attribute (column) name, and the resulting SQL is an attribute named by *attribute*. It can optionally be qualified by *table* and *owner* (the schema that owns the table), so the attribute name becomes *table.attribute* if *owner* is `nil` or *owner.table.attribute* if *owner* is non-nil. If *table* is `nil` the attribute name is not qualified.

If *table* is supplied, it specifies a table name. If *attribute* is supplied too, it qualifies the attribute as in the previous paragraph, otherwise the resulting SQL is a table name. It can be optionally qualified by *owner*, which specifies *owner.table* as the table name.

*owner* can be non-nil only when *table* is supplied, and qualifies *table* as described above. It specifies the schema to which the table belongs.

If *alias* is non-nil it specifies an alias, which added to the SQL after the attribute name if *attribute* is supplied or after the table name otherwise.

*type* can be non-nil only if *attribute* is supplied, and specifies the expected type of the attribute. This does not affect the SQL, but tells the querying interface (`select`, `query`) what type the value should be. It is useful when the attribute is used in the selection list of a query (see “Specifying the type of retrieved values.” on page 362).

If *parameter-index* is non-nil, it must be the only keyword, and `sql-expression` generates a bind-variable in the SQL. This can be used in an expression that is passed to `prepare-statement` and then later bound by `set-prepared-statement-variables`.

If *n-qualified* is non-nil, it must be the only keyword, and the value is used as-is as an N syntax string. This is required for passing non-ASCII string to Microsoft SQL Server (via ODBC), but does not work on SQLite or Microsoft Access.

*This chapter applies to the Enterprise Edition only*

```
(sql-expression :n-qualified "aa")
=>
#<SQL: "N'aa'">

(sql-expression :string      "aa")
=>
#<SQL: "aa">
```

See “SQL string literals” on page 366 for discussion of N syntax strings.

**Examples** Define a function that queries for the value of a supplied attribute in a supplied table using a supplied type:

```
(defun query-attribute (table-name attribute-name type)
  (let* ((table-arg
          (sql-expression
            :table table-name))
         (selection-arg
          (sql-expression
            :attribute attribute-name
            :type type)))
    (select selection-arg :from table-arg)))
```

**See also** [sql](#)  
[sql-operation](#)  
[sql-operator](#)  
[sql-expression-object](#)  
“Symbolic SQL syntax” on page 358

## sql-expression-object

## System Class

**Summary** A class of objects representing some SQL.

**Package** [sql](#)

**Superclasses** [t](#)

**Description** Each instance of the system class [sql-expression-object](#) represents a SQL expression. They can be used inside another

instance of `sql-expression-object`, in a "[...]" syntax expression or as arguments to the Common SQL functions. They are created by the "[...]" syntax (see “Enclosing database identifiers” on page 359) or dynamically by `sql-expression` or `string-prefix-with-n-if-needed`.

## See also

`sql-expression`  
“Enclosing database identifiers” on page 359

**sql-fatal-error** *Condition*

Package      `sql`

Superclasses    `sql-connection-error`

Description     The condition class `sql-fatal-error` is used to signal errors that mean the connection can no longer be used.

**sqlite-blob** *System Class*

Summary      A class of objects that provide read/write access to a BLOB or TEXT field in a SQLite database.

Package      `sql`

Superclasses    `t`

Description     An instance of the system class `sqlite-blob` provides direct read/write access to a BLOB or TEXT field in a SQLite database. See `replace-from-sqlite-blob` for details.

## See also

`replace-from-sqlite-blob`  
`sqlite-raw-blob`

| <b>sqlite-last-insert-rowid</b> | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary                         | Return the ROWID of the last inserted row in a SQLite database.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Package                         | <code>sql</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Signature                       | <code>sqlite-last-insert-rowid &amp;key database =&gt; rowid</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Arguments                       | <code>database</code> A SQLite database.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Values                          | <code>rowid</code> An integer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Description                     | The function <code>sqlite-last-insert-rowid</code> returns the ROWID of the last row that was inserted in <code>database</code> , or 0 if none.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Notes                           | <code>sqlite-last-insert-rowid</code> is not thread-safe, and you will need to ensure that no other thread inserts rows into <code>database</code> in parallel to the insertion of the row and calling <code>sqlite-last-insert-rowid</code> .<br><br>The result <code>rowid</code> is useful when you want to later access a BLOB in the row using <code>sqlite-open-blob</code> .<br><br>ROWIDs in SQLite are described in the SQLite documentation: "ROWIDs and the INTEGER PRIMARY KEY" in "CREATE TABLE"<br><a href="https://www.sqlite.org/lang_createtable.html#rowid">https://www.sqlite.org/lang_createtable.html#rowid</a> .<br><br>Because <code>sqlite-last-insert-rowid</code> is called on the database connection, any row insertion into <code>database</code> affects it, even if it is not in the same table or even not the same file (if another file is attached to the connection using the "ATTACH DATABASE" statement). Therefore, there must not be another insertion into <code>database</code> in parallel to the sequence of insertion and calling <code>sqlite-last-insert-rowid</code> .<br><br>These restrictions mirror the underlying limitation of the C function <code>sqlite3_last_insert_rowid</code> . |

See also      [sqlite-open-blob](#)

[sqlite-open-blob](#)  
[sqlite-close-blob](#)  
[sqlite-blob-p](#)  
[sqlite-blob-length](#)  
[replace-from-sqlite-blob](#)  
[replace-into-sqlite-blob](#)  
[sqlite-reopen-blob](#)

*Functions*

Summary      Read/write access to a BLOB or TEXT field in a SQLite database.

Package      `sql`

Signature      `sqlite-open-blob table-name column-name rowid &key database owner read-only => sqlite-blob`

`sqlite-close-blob sqlite-blob => boolean`

`sqlite-blob-p object => boolean`

`sqlite-blob-length sqlite-blob => length`

`replace-from-sqlite-blob binary-array sqlite-blob &key array-start array-end blob-start blob-end => binary-array`

`replace-into-sqlite-blob sqlite-blob binary-array &key blob-start blob-end array-start array-end => sqlite-blob`

`sqlite-reopen-blob sqlite-blob rowid`

Arguments      `table-name, column-name`

                  Strings.

`rowid`        An integer.

`database`     A SQLite database.

`owner`        A string.

*This chapter applies to the Enterprise Edition only*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                 |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
|             | <i>read-only</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A generalized boolean.                                                                          |
|             | <i>sqlite-blob</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | An object of type <b>sqlite-blob</b> .                                                          |
|             | <i>object</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Any object.                                                                                     |
|             | <i>binary-array</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | An array with integer or float element type, or a <b>base-string</b> , or a <b>bmp-string</b> . |
|             | <i>array-start</i> , <i>array-end</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Bounding index designators of <i>binary-array</i> .                                             |
|             | <i>blob-start</i> , <i>blob-end</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Bounding index designators of <i>sqlite-blob</i> .                                              |
| Values      | <i>sqlite-blob</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | An object of type <b>sqlite-blob</b> .                                                          |
|             | <i>boolean</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | A boolean.                                                                                      |
|             | <i>length</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | An integer.                                                                                     |
|             | <i>binary-array</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | An array with integer or float element type, or a <b>base-string</b> , or a <b>bmp-string</b> . |
| Description | Instances of the system class <b>sqlite-blob</b> allow reading and writing from/to BLOB or TEXT fields in a SQLite database. It corresponds to the C structure <b>sqlite3_blob</b> (see "A Handle To An Open BLOB" in the SQLite documentation, <a href="https://www.sqlite.org/c3ref/blob.html">https://www.sqlite.org/c3ref/blob.html</a> ).<br><br>The function <b>sqlite-open-blob</b> creates an object of type <b>sqlite-blob</b> , which can be used to access the data in a specific column and row of a SQLite database table, as specified by <i>database</i> , <i>owner</i> , <i>table-name</i> , <i>column-name</i> and <i>rowid</i> . <i>owner</i> specifies the schema-name (which defaults to " <b>main</b> "), and thus allows access to attached databases. <i>table-name</i> and <i>column-name</i> specify the table and column. <i>rowid</i> specifies the row where the value is. For documentation about <i>rowid</i> , see "ROWIDs and the INTEGER PRIMARY KEY" in "CREATE TABLE" in the SQLite documentation ( <a href="https://www.sqlite.org/lang_createtable.html#rowid">https://www.sqlite.org/lang_createtable.html#rowid</a> ), and |                                                                                                 |

also the notes below. `read-only` (which defaults to `nil`) specifies whether the result `sqlite-blob` is read-only or not.

The function `sqlite-blob-p` returns true if `object` is of type `sqlite-blob` and false otherwise.

The function `sqlite-blob-length` returns the length of `sqlite-blob` in bytes. Note that there is no way to change the length.

The functions `replace-from-sqlite-blob` and `replace-into-sqlite-blob` are used to copy from/to `sqlite-blob`, similar to `replace` or `fli:replace-foreign-array`. `binary-array` must be a binary array, which means an array of element type `base-char`, `bmp-char`, `single-float`, `double-float`, `(unsigned-byte bit-size)` or `(signed-byte bit-size)`, where `bit-size` is one of 8, 16, 32 or (64-bit LispWorks only) 64. Note that `simple-string` is not regarded as a binary array, but `bmp-string` and `base-string` are. The length of `sqlite-blob` in elements is the length in bytes, as returned by the function `sqlite-blob-length`, truncated by the number bytes per element in `binary-array`. The values of `array-start`, `array-end`, `blob-start` and `blob-end` are all in elements (rather than bytes).

The function `replace-from-sqlite-blob` replaces the elements of `binary-array` between `array-start` and `array-end` by the elements of `sqlite-blob` between `blob-start` and `blob-end`. The function `replace-into-sqlite-blob` replaces in the other direction.

`blob-start` and `array-start` default to 0, `array-end` defaults to `nil`, meaning the length of `binary-array`, and `blob-end` defaults to `nil`, meaning the length of `sqlite-blob` in elements. When supplied, `array-start` must be a non-negative integer and not bigger than the length of `binary-array`, `array-end` must be not smaller than `array-start` and not bigger than the length of `binary-array`, `blob-start` must be a non-negative integer and not bigger than the length of `sqlite-blob` in elements, and `blob-end` must be not smaller than `blob-start` and not bigger than the length of `sqlite-blob` in elements. The number of elements cop-

ied is the smaller of the difference between *blob-start* and *blob-end*, and the difference between *array-start* and *array-end*.

`replace-from-sqlite-blob` and `replace-into-sqlite-blob` return their first argument.

The function `sqlite-close-blob` closes *sqlite-blob* and returns `t` if it closed, or `nil` if *sqlite-blob* was already closed.

The function `sqlite-reopen-blob` changes *sqlite-blob* to refer to a field in another row. In effect it closes *sqlite-blob* and reopens it with a different *rowid* but otherwise the same arguments as the `sqlite-open-blob` call that opened it.

#### Notes

You can obtain a ROWID by using `rowid` in the selection list of a query. For example, the following query returns a list of ROWIDs for records that match *somecondition* in the table `SomeTable` (in `*default-database*`):

```
(sql:select [rowid] :from [SomeTable]
            :where somecondition
            :flatp t)
```

The ROWID may be also be the value of a primary key in the table, as described in the SQLite documentation: "ROWIDs and the INTEGER PRIMARY KEY" in "CREATE TABLE"  
[https://www.sqlite.org/lang\\_createtable.html#rowid](https://www.sqlite.org/lang_createtable.html#rowid).

It is also possible to find the ROWID of the last inserted row by `sqlite-last-insert-rowid`.

If the row where the field that *sqlite-blob* is accessing is modified, further access to *sqlite-blob* by `replace-into-sqlite-blob` or `replace-from-sqlite-blob` signals an error (of type `sql-user-error`). That is because SQLite itself does not allow further access. As a result, using `sqlite-blob` is not thread-safe, and you need be sure that no other code is trying to modify the same row while *sqlite-blob* is open.

`sqlite-open-blob` may fail for various reasons. When this happens, LispWorks retrieves the error message using the C function `sqlite3_errmsg`, which is not thread-safe (an

apparent misdesign of SQLite). As a result, you will get a misleading error message in very rare occasions, if another thread executing on the same database got an error in parallel. However, the error number, is always correct and its values are documented in the SQLite documentation "Result Code Meanings" <https://www.sqlite.org/rescode.html#error>.

Leaving a `sqlite-blob` opened is not only a resource leak, but also leaves some locks in the database connection that prevents some operations in the future (dropping the table or disconnecting the database for example). Therefore, you should close a `sqlite-blob` as soon as possible. We recommend using `with-sqlite-blob` to open and close the `sqlite-blob` when possible.

**See also**

`with-sqlite-blob`  
`sqlite-blob`  
“Using SQLite” on page 392

**sqlite-raw-blob****System Class**

**Summary** A class of objects that allow efficient access to a SQLite BLOB.

**Package** `sql`

**Superclasses** `t`

**Description** An instance of the system class `sqlite-raw-blob` allows you to efficiently access SQLite BLOB objects inside the dynamic extent of the Common SQL iterative querying interface.

See `copy-from-sqlite-raw-blob` for details.

**See also** `copy-from-sqlite-raw-blob`  
`sqlite-blob`

*This chapter applies to the Enterprise Edition only*

**sqlite-raw-blob-p**

**sqlite-raw-blob-valid-p**

**sqlite-raw-blob-length**

**sqlite-raw-blob-ref**

**copy-from-sqlite-raw-blob**

**replace-from-sqlite-raw-blob**

*Functions*

Summary      Efficient access to a SQLite BLOB field in a query.

Package      `sql`

Signature      `sqlite-raw-blob-p object => boolean`  
`sqlite-raw-blob-valid-p sqlite-raw-blob => boolean`  
`sqlite-raw-blob-length sqlite-raw-blob => length`  
`sqlite-raw-blob-ref sqlite-raw-blob index &optional foreign-element-type => value`  
`copy-from-sqlite-raw-blob sqlite-raw-blob &key start end element-type => binary-array`  
`replace-from-sqlite-raw-blob binary-array sqlite-raw-blob &key array-start array-end blob-start blob-end => binary-array`

Arguments      *object*      Any Lisp object.

*sqlite-raw-blob*      An object of type `sqlite-raw-blob`.

*index*      An integer.

*foreign-element-type*

                  A foreign element type.

*start, end*      Bounding index designators of *sqlite-raw-blob*.

*element-type*      A Lisp element type for a binary array.

*binary-array*      An array with integer or float element type or a `base-string` or a `bmp-string`.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                              |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
|             | <i>array-start, array-end</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Bounding index designators of <i>binary-array</i> .                                          |
|             | <i>blob-start, blob-end</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Bounding index designators of <i>sqlite-raw-blob</i> .                                       |
| Values      | <i>boolean</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | A boolean.                                                                                   |
|             | <i>length</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | An integer.                                                                                  |
|             | <i>value</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | A Lisp value of type matching <i>foreign-element-type</i> .                                  |
|             | <i>binary-array</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | An array with integer or float element type or a <b>base-string</b> or a <b>bmp-string</b> . |
| Description | <p>The <b>sqlite-raw-blob</b> interface allows a flexible and more efficient way to read from a SQLite BLOB object inside the dynamic extent of a Common SQL the iterative querying interface. The iterative querying interfaces include <b>map-query</b>, <b>do-query</b>, <b>simple-do-query</b>, <b>loop</b> with <b>each record</b>, but does not include <b>select</b> and <b>query</b>.</p> <p>Note that <b>sqlite-raw-blob</b> corresponds to the result of the C function <b>sqlite3_column_blob</b>. You can read data from a BLOB using <b>sqlite-raw-blob</b>, but cannot modify it. For an interface that corresponds to the C structure <b>sqlite3_blob</b>, see <b>sqlite-blob</b>.</p> <p>You receive a <b>sqlite-raw-blob</b> object as the value from the query for fields where you specify the type as <b>:blob</b>. This object is associated with a SQLite BLOB corresponding to the value of this field in the current row. For example, you can print the size (in bytes) of all the fields in the DataPointsColumn in SomeTable using this code:</p> |                                                                                              |

*This chapter applies to the Enterprise Edition only*

```
(do-query
  ((raw-data-points)
   [select [DataPointsColumn :blob]
          :from [Sometable]])
  (print (sqlite-raw-blob-length raw-data-points)))
```

The function `sqlite-raw-blob-p` returns true if *object* is of type `sqlite-raw-blob` and false otherwise.

The function `sqlite-raw-blob-length` returns the length in bytes of the BLOB associated with `sqlite-raw-blob`.

For the functions `sqlite-raw-blob-ref`, `copy-from-sqlite-raw-blob` and `replace-from-sqlite-raw-blob`, `sqlite-raw-blob` can be regarded as a handle to a foreign array of bytes, whose length in bytes as returned by `sqlite-raw-blob-length`. When the element type argument (*foreign-element-type* or *element-type*) requires more than one byte, then the length of `sqlite-raw-blob` in elements is the length in bytes truncated by the number of bytes per element.

The function `sqlite-raw-blob-ref` is analogous to `fli:dereference`. The element type is specified by *foreign-element-type*, which defaults to `(:unsigned :byte)`. *index* must be a non-negative integer and smaller than the length of `sqlite-raw-blob` in elements. `sqlite-raw-blob-ref` returns *value* in the same way that `(fli:dereference pointer-to-the-blob-data :index index :type foreign-element-type)` would return it, if *pointer-to-the-blob-data* pointed to a foreign array with the same contents as `sqlite-raw-blob`.

The function `copy-from-sqlite-raw-blob` returns a Lisp array of element type *element-type* containing the elements of `sqlite-raw-blob` bounded by *start* and *end* (in . *start* and *end* specify the start and the end indices in elements (rather than bytes) into `sqlite-raw-blob`. *start* defaults to 0, and *end* to `nil`, meaning the length of `sqlite-raw-blob` in elements. When supplied, *start* must be a non-negative integer and not bigger than the length of `sqlite-raw-blob` in elements, and *end* must be not smaller than *start* and not bigger than the length of `sqlite-raw-blob` in elements. *element-type* specifies the Lisp type of

*binary-array*. It is upgraded by `upgraded-array-element-type`, and the result must be one of:

- `base-char`
- `bmp-char`
- `single-float`
- `double-float`
- `(unsigned-byte 8)`
- `(unsigned-byte 16)`
- `(unsigned-byte 32)`
- `(unsigned-byte 64)` (64-bit LispWorks only)
- `(signed-byte 8)`
- `(signed-byte 16)`
- `(signed-byte 32)`
- `(signed-byte 64)` (64-bit LispWorks only)

The function `replace-from-sqlite-raw-blob` is analogous to `fli:replace-foreign-array`. It replaces the elements of *binary-array*, bounded by `array-start` and `array-end`, by the elements of *sqlite-raw-blob*, bounded by `blob-start` and `blob-end` (all in `elements`). *binary-array* must be a binary array, which means an array with one of the element types listed in the previous paragraph. `array-start` and `blob-start` default to 0, `array-end` defaults to `nil`, meaning the length of *binary-array*, and `blob-end` defaults to `nil`, meaning the length of *sqlite-raw-blob* in `elements`. When supplied, `array-start` must be a non-negative integer and not bigger than the length of *binary-array*, `array-end` must be not smaller than `array-start` and not bigger than the length of *binary-array*, `blob-start` must be a non-negative integer and not bigger than the length of *sqlite-raw-blob* in `elements`, and `blob-end` must be not smaller than `blob-start` and not bigger than the length of *sqlite-raw-blob* in `elements`. The number of elements copied is the smaller of

the difference between `array-start` and `array-end`, and the difference between `blob-start` and `blob-end`. `replace-from-sqlite-raw-blob` returns *binary-array*.

A `sqlite-raw-blob` object is valid only inside the dynamic extent of the code that receives it from the iterative querying interface function or macro. Note that the `sqlite-raw-blob` is already invalid in the next iteration of the same operation. Trying to read data from an invalid `sqlite-raw-blob` using one of `sqlite-raw-blob-ref`, `copy-from-sqlite-raw-blob` or `replace-from-sqlite-raw-blob` signals an error (of type `sql-user-error`). `sqlite-raw-blob-length` still returns the correct value for an invalid `sqlite-raw-blob`. `sqlite-raw-blob-valid-p` can be used to check if a `sqlite-raw-blob` is valid, but should be rarely useful.

See also

`map-query`  
`do-query`  
`simple-do-query`  
`loop`  
`sqlite-raw-blob`  
`sqlite-blob`  
“Iteration” on page 351

## \*sql-libraries\*

### *Variable*

|               |                                                                                                                                                                                                                                                                                                                                     |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package       | <code>sql</code>                                                                                                                                                                                                                                                                                                                    |
| Initial value | <code>nil</code>                                                                                                                                                                                                                                                                                                                    |
| Description   | Holds a pathname or list of libraries to override default database library loading. The value should be a pathname or a list.<br><br>If its value is a pathname, it is prepended to a list of relative pathnames in the same manner that the supplied environment variable (for example <code>ORACLE_HOME</code> ) would be. If its |

value is a list, then it is assumed to be a complete list of full library names which are loaded verbatim.

Notes      \***sql-libraries\*** is applicable only on Unix/Linux.

### **\*sql-loading-verbose\***                          *Variable*

Package      **sql**

Initial value      **nil**

Description      The variable **\*sql-loading-verbose\*** controls the verbosity of messages while loading the database libraries.

Notes      \***sql-loading-verbose\*** is applicable only on Unix.

### **sql-operation**                          *Function*

Summary      Generates a SQL statement from an operator and arguments.

Package      **sql**

Signature      **sql-operation op &rest args => sql-result**  
**sql-operation sql-function name &rest args => sql-result**  
**sql-operation sql-operator inop1 left &rest rights => sql-result**  
**sql-operation sql-boolean-operator inop2 left &rest rights => sql-result**

Arguments      *op*                          An operator.

*args*                          A set of arguments for *op*.

*name*                          An arbitrary function.

*args*                          A set of arguments for *name*.

*This chapter applies to the Enterprise Edition only*

|             |                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <i>inop1</i>      | An infix operator with non-boolean result.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|             | <i>inop2</i>      | An infix operator that returns a boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|             | <i>left</i>       | Argument to be placed on the left of an infix operator.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|             | <i>rights</i>     | Arguments to be placed on the right of an infix operator.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Values      | <i>sql-result</i> | A SQL expression.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Description |                   | <p>The function <b>sql-operation</b> takes an operator and its arguments, and returns a SQL expression.</p> <p><b>(sql-operation op args)</b></p> <p>is shorthand for</p> <p><b>(apply (sql-operator op) args).</b></p> <p>The pseudo operator <b>sql-function</b> allows an arbitrary function <i>name</i> to be passed. In this case, <i>name</i> is put in the SQL expression using <b>princ</b>, and <i>args</i> are given as arguments.</p> <p>The pseudo operators <b>sql-boolean-operator</b> and <b>sql-operator</b> generate SQL that calls an infix operator with <i>left</i> on the left and <i>rights</i> on the right separated by spaces. Use <b>sql-boolean-operator</b> for SQL infix operators that return a boolean and use <b>sql-operator</b> for any other SQL infix operator.</p> |
| Notes       |                   | The pseudo operator <b>sql-operator</b> should not be confused with the Common SQL function <b>sql-operator</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Example     |                   | The following code, uses <b>sql-operation</b> to produce a SQL expression.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

```
(sql-operation 'select
  (sql-expression :table 'foo :attribute 'bar)
  (sql-expression :attribute 'baz)
  :from (list
    (sql-expression :table 'foo)
    (sql-expression :table 'quux)))
:where
  (sql-operation 'or
    (sql-operation '>
      (sql-expression :attribute 'baz)
      3)
    (sql-operation 'like
      (sql-expression :table 'foo :attribute 'bar)
      "SU%")))
```

The following SQL expression is produced.

```
#<SQL-QUERY: "(SELECT FOO.BAR,BAZ FROM FOO,QUUX
  WHERE ((BAZ > 3) OR (FOO.BAR LIKE 'SU%')))">
```

The following code illustrates use of the pseudo operator `sql-function`:

```
(sql-operation 'sql-function "TO_DATE" "03/06/99"
  "mm/DD/RR")
```

The following SQL expression is produced.

```
#<SQL-VALUE-EXP "TO_DATE('03/06/99','mm/DD/RR')">
```

#### See also

- `sql`
- `sql-expression`
- `sql-operator`

## sql-operator

## Function

|         |                                        |
|---------|----------------------------------------|
| Summary | Returns the symbol for a SQL operator. |
|---------|----------------------------------------|

|         |                  |
|---------|------------------|
| Package | <code>sql</code> |
|---------|------------------|

|           |                                                   |
|-----------|---------------------------------------------------|
| Signature | <code>sql-operator symbol =&gt; sql-symbol</code> |
|-----------|---------------------------------------------------|

|           |                     |                                 |
|-----------|---------------------|---------------------------------|
| Arguments | <code>symbol</code> | A symbol naming a SQL operator. |
|-----------|---------------------|---------------------------------|

*This chapter applies to the Enterprise Edition only*

|             |                                                                                                                 |           |
|-------------|-----------------------------------------------------------------------------------------------------------------|-----------|
| Values      | <i>sql-symbol</i>                                                                                               | A symbol. |
| Description | The function <b>sql-operator</b> takes an operator as an argument and returns the Lisp symbol for the operator. |           |
| See also    | <b>sql</b><br><b>sql-expression</b><br><b>sql-operation</b>                                                     |           |

## **sql-recording-p** *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                        |  |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Summary     | A predicate for determining if SQL commands or results traffic is being recorded.                                                                                                                                                                                                                                                                                      |  |
| Package     | <b>sql</b>                                                                                                                                                                                                                                                                                                                                                             |  |
| Signature   | <b>sql-recording-p &amp;key type database =&gt; recording-p</b>                                                                                                                                                                                                                                                                                                        |  |
| Arguments   | <i>type</i> One of :commands or :results.<br><i>database</i> A database.                                                                                                                                                                                                                                                                                               |  |
| Values      | <i>recording-p</i> A boolean.                                                                                                                                                                                                                                                                                                                                          |  |
| Description | The function <b>sql-recording-p</b> returns <b>t</b> if <i>type</i> is :commands and SQL commands traffic is being recorded, or if <i>type</i> is :results and SQL results traffic is being recorded. Otherwise it returns <b>nil</b> .<br><br>The default value of <i>type</i> is :commands. The default value of <i>database</i> is the value of *default-database*. |  |
| See also    | <b>add-sql-stream</b><br><b>delete-sql-stream</b><br><b>list-sql-streams</b><br><b>sql-stream</b>                                                                                                                                                                                                                                                                      |  |

```
start-sql-recording
stop-sql-recording
```

| <b>sql-stream</b> | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |                                                |                 |             |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|------------------------------------------------|-----------------|-------------|
| Summary           | Returns the broadcast stream used for recording SQL commands or results traffic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |                                                |                 |             |
| Package           | <b>sql</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             |                                                |                 |             |
| Signature         | <b>sql-stream &amp;key type database =&gt; stream</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |                                                |                 |             |
| Arguments         | <table border="0"> <tr> <td><b>type</b></td><td>One of :<b>commands</b> or :<b>results</b>.</td></tr> <tr> <td><b>database</b></td><td>A database.</td></tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                   | <b>type</b> | One of : <b>commands</b> or : <b>results</b> . | <b>database</b> | A database. |
| <b>type</b>       | One of : <b>commands</b> or : <b>results</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |                                                |                 |             |
| <b>database</b>   | A database.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             |                                                |                 |             |
| Values            | <b>stream</b> A broadcast stream.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |                                                |                 |             |
| Description       | <p>The function <b>sql-stream</b> returns the broadcast stream used for recording SQL commands or results traffic.</p> <p><b>type</b> can be either :<b>commands</b> or :<b>results</b>, and specifies whether to return the broadcast stream for commands or results traffic.</p> <p>The default value of <b>type</b> is :<b>commands</b>. The default value of <b>database</b> is the value of *<b>default-database</b>*.</p> <p>Note that SQL traffic can appear on *<b>standard-output</b>* as well as on <b>stream</b>. See <b>add-sql-stream</b> for details.</p> |             |                                                |                 |             |
| See also          | <a href="#"><b>add-sql-stream</b></a><br><a href="#"><b>delete-sql-stream</b></a><br><a href="#"><b>list-sql-streams</b></a><br><a href="#"><b>sql-recording-p</b></a><br><a href="#"><b>start-sql-recording</b></a><br><a href="#"><b>stop-sql-recording</b></a>                                                                                                                                                                                                                                                                                                       |             |                                                |                 |             |

*This chapter applies to the Enterprise Edition only*

|                            |                                                                                                                                                                                                             | <i>Condition</i>                                                                         |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| <b>sql-temporary-error</b> |                                                                                                                                                                                                             |                                                                                          |
| Package                    | <code>sql</code>                                                                                                                                                                                            |                                                                                          |
| Superclasses               | <code>sql-database-error</code>                                                                                                                                                                             |                                                                                          |
| Description                | The condition class <code>sql-temporary-error</code> is used to signal an error that results from other users using the same database. This can be a table lock, but also running out of various resources. |                                                                                          |
|                            |                                                                                                                                                                                                             | It means the code can work without change, once the other users stop using the database. |
| <b>sql-timeout-error</b>   |                                                                                                                                                                                                             |                                                                                          |
| Package                    | <code>sql</code>                                                                                                                                                                                            |                                                                                          |
| Superclasses               | <code>sql-connection-error</code>                                                                                                                                                                           |                                                                                          |
| Description                | The condition class <code>sql-timeout-error</code> is used to signal an error due to the time out of some operation.                                                                                        |                                                                                          |
| <b>sql-user-error</b>      |                                                                                                                                                                                                             |                                                                                          |
| Package                    | <code>sql</code>                                                                                                                                                                                            |                                                                                          |
| Superclasses               | <code>simple-error</code>                                                                                                                                                                                   |                                                                                          |
| Description                | The condition class <code>sql-user-error</code> is used to signal errors in Lisp code.                                                                                                                      |                                                                                          |
| See also                   | <code>sql-database-error</code>                                                                                                                                                                             |                                                                                          |

|                           |              |
|---------------------------|--------------|
| <b>standard-db-object</b> | <i>Class</i> |
|---------------------------|--------------|

Package      **sql**

Superclasses    **standard-object**

Description     The class **standard-db-object** implements View Classes.

See also      **def-view-class**

|                            |                 |
|----------------------------|-----------------|
| <b>start-sql-recording</b> | <i>Function</i> |
|----------------------------|-----------------|

Summary       Starts recording SQL commands or results traffic.

Package      **sql**

Signature     **start-sql-recording &key type database =>**

Arguments    **type**                  A keyword.

**database**              A database.

Values        None.

Description     The function **start-sql-recording** starts recording SQL traffic, potentially to multiple streams. The traffic recorded can be the commands, the results, or both commands and results.

By default the output appears only **\*standard-output\***. You can modify the broadcast list of recording streams using **add-sql-stream** and **delete-sql-stream**.

**type** is one of **:commands**, **:results** or **:both**. It determines whether SQL commands traffic, results traffic or both is recorded.

*This chapter applies to the Enterprise Edition only*

The default value of *type* is `:commands`. The default value for *database* is the value of `*default-database*`.

See also

`add-sql-stream`  
`delete-sql-stream`  
`list-sql-streams`  
`sql-stream`  
`sql-recording-p`  
`stop-sql-recording`

|               | <i>Function</i>                                                                                                                                                                                                                                                                                     |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>status</b> |                                                                                                                                                                                                                                                                                                     |
| Summary       | Returns status information for the connected databases and initialized database types.                                                                                                                                                                                                              |
| Package       | <code>sql</code>                                                                                                                                                                                                                                                                                    |
| Signature     | <code>status &amp;optional full =&gt;</code>                                                                                                                                                                                                                                                        |
| Arguments     | <code>full</code> A boolean.                                                                                                                                                                                                                                                                        |
| Values        | None.                                                                                                                                                                                                                                                                                               |
| Description   | The function <code>status</code> prints status information to the standard output, for the connected databases and initialized database types.<br><br>If <code>full</code> is <code>t</code> , detailed status information is printed. The default value of <code>full</code> is <code>nil</code> . |
| See also      | <code>connect</code><br><code>connected-databases</code><br><code>database-name</code><br><code>disconnect</code><br><code>find-database</code>                                                                                                                                                     |

|             |                           | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------------|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <b>stop-sql-recording</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Summary     |                           | Stops recording SQL commands or results traffic.                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Package     |                           | <code>sql</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Signature   |                           | <code>stop-sql-recording &amp;key type database =&gt;</code>                                                                                                                                                                                                                                                                                                                                                                                                           |
| Arguments   | <code>type</code>         | A keyword.                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|             | <code>database</code>     | A database.                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Values      |                           | None.                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Description |                           | <p>The function <code>stop-sql-recording</code> stops recording SQL commands or results traffic.</p> <p><code>type</code> is one of <code>:commands</code>, <code>:results</code> or <code>:both</code>. It determines whether the recording of SQL commands traffic, results traffic or both is stopped.</p> <p>The default value of <code>type</code> is <code>:commands</code>. The default value for <code>database</code> is <code>*default-database*</code>.</p> |
| See also    |                           | <code>add-sql-stream</code><br><code>delete-sql-stream</code><br><code>list-sql-streams</code><br><code>sql-recording-p</code><br><code>sql-stream</code><br><code>start-sql-recording</code>                                                                                                                                                                                                                                                                          |

|           |                              | <i>Function</i>                                                                    |
|-----------|------------------------------|------------------------------------------------------------------------------------|
|           | <b>string-needs-n-prefix</b> |                                                                                    |
| Summary   |                              | Returns whether a string needs the N syntax.                                       |
| Package   |                              | <code>sql</code>                                                                   |
| Signature |                              | <code>string-needs-n-prefix string &amp;key database =&gt; needs-n-prefix-p</code> |

*This chapter applies to the Enterprise Edition only*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                |             |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| Arguments   | <i>string</i>                                                                                                                                                                                                                                                                                                                                                                                                                  | A string.   |
|             | <i>database</i>                                                                                                                                                                                                                                                                                                                                                                                                                | A database. |
| Values      | <i>needs-n-prefix-p</i>                                                                                                                                                                                                                                                                                                                                                                                                        | A boolean.  |
| Description | The function <b>string-needs-n-prefix</b> returns true if <i>string</i> needs to be prefixed by N when passed to <i>database</i> (default <b>*default-database*</b> ).                                                                                                                                                                                                                                                         |             |
| Notes       | The function <b>string-prefix-with-n-if-needed</b> can be used to add the prefix if needed. The function <b>sql-expression</b> with <b>:n-qualified</b> can be used to unconditionally add the prefix.<br><br>At the time of writing, the prefix is required only when <i>database</i> is a connection to Microsoft SQL Server, and <i>string</i> contains characters which are not recognized by the code page of the server. |             |
| See also    | <b>string-prefix-with-n-if-needed</b><br><b>sql-expression</b><br>“SQL string literals” on page 366                                                                                                                                                                                                                                                                                                                            |             |

## **string-prefix-with-n-if-needed** *Function*

|           |                                                                                                   |                                              |
|-----------|---------------------------------------------------------------------------------------------------|----------------------------------------------|
| Summary   | Adds the N syntax to a string if needed.                                                          |                                              |
| Package   | <b>sql</b>                                                                                        |                                              |
| Signature | <b>string-prefix-with-n-if-needed</b> <i>string</i> & <b>key</b> <i>database</i> => <i>result</i> |                                              |
| Arguments | <i>string</i>                                                                                     | A string.                                    |
|           | <i>database</i>                                                                                   | A database.                                  |
| Values    | <i>result</i>                                                                                     | A string or a <b>sql-expression-object</b> . |

|             |                                                                                                                                                                                                                                                                                          |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | The function <code>string-prefix-with-n-if-needed</code> checks if <i>string</i> , when passed to <i>database</i> , needs to be prefixed by N. If the prefix is required, it returns a <code>sql-expression-object</code> with the string prefixed. Otherwise it returns <i>string</i> . |
| Notes       | <code>string-prefix-with-n-if-needed</code> is equivalent to:<br><br><code>(if (string-needs-n-prefix string :database database)       (sql-expression :n-qualified string)       string)</code>                                                                                         |
| See also    | “SQL string literals” on page 366<br><code>string-needs-n-prefix</code>                                                                                                                                                                                                                  |

|                 | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                       |              |                         |                 |             |              |                                                   |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------------------|-----------------|-------------|--------------|---------------------------------------------------|
| Summary         | A predicate for the existence of a table.                                                                                                                                                                                                                                                                                                                                                                                             |              |                         |                 |             |              |                                                   |
| Package         | <code>sql</code>                                                                                                                                                                                                                                                                                                                                                                                                                      |              |                         |                 |             |              |                                                   |
| Signature       | <code>table-exists-p table &amp;key database owner =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                |              |                         |                 |             |              |                                                   |
| Arguments       | <table> <tr> <td><i>table</i></td> <td>A potential table name.</td> </tr> <tr> <td><i>database</i></td> <td>A database.</td> </tr> <tr> <td><i>owner</i></td> <td><code>nil</code>, <code>:all</code> or a string.</td> </tr> </table>                                                                                                                                                                                                | <i>table</i> | A potential table name. | <i>database</i> | A database. | <i>owner</i> | <code>nil</code> , <code>:all</code> or a string. |
| <i>table</i>    | A potential table name.                                                                                                                                                                                                                                                                                                                                                                                                               |              |                         |                 |             |              |                                                   |
| <i>database</i> | A database.                                                                                                                                                                                                                                                                                                                                                                                                                           |              |                         |                 |             |              |                                                   |
| <i>owner</i>    | <code>nil</code> , <code>:all</code> or a string.                                                                                                                                                                                                                                                                                                                                                                                     |              |                         |                 |             |              |                                                   |
| Values          | <i>result</i> A boolean.                                                                                                                                                                                                                                                                                                                                                                                                              |              |                         |                 |             |              |                                                   |
| Description     | <p>The function <code>table-exists-p</code> determines whether there is a table named <i>table</i> in database <i>database</i>.</p> <p>If <i>owner</i> is <code>nil</code>, only user-owned tables are considered. This is the default.</p> <p>If <i>owner</i> is <code>:all</code>, all tables are considered.</p> <p>If <i>owner</i> is a string, this denotes a username and only tables owned by <i>owner</i> are considered.</p> |              |                         |                 |             |              |                                                   |

*This chapter applies to the Enterprise Edition only*

The default value of *database* is **\*default-database\***.

See also [list-tables](#)

## update-instance-from-records

## *Generic Function*

**Summary**      Updates a View Class instance.

## Package sq1

**Signature** `update-instance-from-records instance &key database => instance`

**Arguments**      *instance*      An instance of a View Class

*database* A database

**Values**      *instance*      The updated View Class instance.

**Description** The generic function `update-instance-from-records` updates the values in the slots of the View Class instance *instance* using the data in the database *database*.

*database* defaults to the database that *instance* is associated with, or the value of **\*default-database\***. If *instance* is associated with a database, then *database* must be that same database.

The argument *slot* is the CLOS slot name; the corresponding column names are derived from the View Class definition.

The update is not recursive on joins. Join slots (that is, slots with `:db-kind :join`) are updated, but the joined objects are not updated.

See also [def-view-class](#)  
[update-slot-from-record](#)

| update-objects-joins | Function                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |                             |              |                                           |                |            |                   |                                                 |                |                                               |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-----------------------------|--------------|-------------------------------------------|----------------|------------|-------------------|-------------------------------------------------|----------------|-----------------------------------------------|
| Summary              | Updates the remote join slots.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                |                             |              |                                           |                |            |                   |                                                 |                |                                               |
| Signature            | <code>update-objects-joins <i>objects</i> &amp;<i>key slots force-p class-name max-len</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                |                             |              |                                           |                |            |                   |                                                 |                |                                               |
| Arguments            | <table border="0"> <tr> <td style="vertical-align: top;"><i>objects</i></td><td>A list of database objects.</td></tr> <tr> <td style="vertical-align: top;"><i>slots</i></td><td>A list of slot names, or <code>t</code>.</td></tr> <tr> <td style="vertical-align: top;"><i>force-p</i></td><td>A boolean.</td></tr> <tr> <td style="vertical-align: top;"><i>class-name</i></td><td>The class of the objects, or <code>nil</code>.</td></tr> <tr> <td style="vertical-align: top;"><i>max-len</i></td><td>A non-negative integer, or <code>nil</code>.</td></tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <i>objects</i> | A list of database objects. | <i>slots</i> | A list of slot names, or <code>t</code> . | <i>force-p</i> | A boolean. | <i>class-name</i> | The class of the objects, or <code>nil</code> . | <i>max-len</i> | A non-negative integer, or <code>nil</code> . |
| <i>objects</i>       | A list of database objects.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                |                             |              |                                           |                |            |                   |                                                 |                |                                               |
| <i>slots</i>         | A list of slot names, or <code>t</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                |                             |              |                                           |                |            |                   |                                                 |                |                                               |
| <i>force-p</i>       | A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                |                             |              |                                           |                |            |                   |                                                 |                |                                               |
| <i>class-name</i>    | The class of the objects, or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                |                             |              |                                           |                |            |                   |                                                 |                |                                               |
| <i>max-len</i>       | A non-negative integer, or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                |                             |              |                                           |                |            |                   |                                                 |                |                                               |
| Description          | <p>The function <code>update-objects-joins</code> updates the remote join slots, that is those slots defined without <code>:retrieval :immediate</code>.</p> <p>This is an optimization function which can improve the efficiency of an application by reducing the number of queries of the database. For each slot, it queries the database using the data from all the objects, and then assigns the appropriate value to each object.</p> <p><i>objects</i> is a list of database objects. If <i>class-name</i> is non-<code>nil</code>, then all the database objects are of this class. If <i>class-name</i> is <code>nil</code>, then all the database objects are of the class of the first database object in the list <i>objects</i>.</p> <p>If <i>objects</i> is <code>nil</code>, then <code>update-objects-joins</code> does nothing.</p> <p><i>class-name</i> specifies a class containing all the database objects in the list <i>objects</i>. If <i>class-name</i> is <code>nil</code> (the default) then the class of the first database object is used.</p> <p><i>slots</i> provides a list of the names of slots to update. Each of these slots should be a remote join slot (as defined above).</p> <p><i>slots</i> can also be <code>t</code>, meaning update all the remote join slots. The default value of <i>slots</i> is <code>t</code>.</p> |                |                             |              |                                           |                |            |                   |                                                 |                |                                               |

*This chapter applies to the Enterprise Edition only*

*force-p* controls whether to force the update of all values in the objects. If *force-p* is `nil`, then slots which are already are not updated. The default value of *force-p* is `t`.

*max-len*, if non-nil, is a maximum number of objects from which to use data in a single query. If the length of the list *objects* is greater than *max-len* then `update-objects-joins` performs multiple queries using the data from no more than *max-len* objects in each query. This is useful if the DBMS may reject large queries, but it will increase the number of queries and hence reduce overall performance to some extent. The default value of *max-len* is the value of the variable  
`*default-update-objects-max-len*`.

See also      `*default-update-objects-max-len*`  
                `def-view-class`

|                       |                   | <i>Function</i>                                                                            |
|-----------------------|-------------------|--------------------------------------------------------------------------------------------|
| <b>update-records</b> |                   |                                                                                            |
| Summary               |                   | Changes the values of fields in a table.                                                   |
| Package               |                   | <code>sql</code>                                                                           |
| Signature             |                   | <code>update-records table &amp;key attributes values av-pairs where database =&gt;</code> |
| Arguments             | <i>table</i>      | A database table.                                                                          |
|                       | <i>attributes</i> | A set of columns.                                                                          |
|                       | <i>values</i>     | A set of values.                                                                           |
|                       | <i>av-pairs</i>   | An association list alternative to <i>attributes</i> and <i>values</i> .                   |
|                       | <i>where</i>      | A condition.                                                                               |
|                       | <i>database</i>   | A database.                                                                                |
| Values                |                   | None.                                                                                      |

|             |                                                                                                                                                                                                                              |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | The function <code>update-records</code> changes the values of existing fields in <i>table</i> with columns specified by <i>attributes</i> and <i>values</i> (or <i>av-pairs</i> ) where the <i>where</i> condition is true. |
| See also    | <code>delete-instance-records</code><br><code>delete-records</code><br><code>insert-records</code><br><code>update-records-from-instance</code>                                                                              |

## update-records-from-instance *Generic Function*

|                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                 |                              |                 |             |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------------------------------|-----------------|-------------|
| Summary         | Updates a set of specified records in a database.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                 |                              |                 |             |
| Package         | <code>sql</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                 |                              |                 |             |
| Signature       | <code>update-records-from-instance instance &amp;key database =&gt;</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                 |                              |                 |             |
| Arguments       | <table> <tr> <td><i>instance</i></td> <td>An instance of a View Class.</td> </tr> <tr> <td><i>database</i></td> <td>A database.</td> </tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <i>instance</i> | An instance of a View Class. | <i>database</i> | A database. |
| <i>instance</i> | An instance of a View Class.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                 |                              |                 |             |
| <i>database</i> | A database.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                              |                 |             |
| Values          | None.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                 |                              |                 |             |
| Description     | <p>The generic function <code>update-records-from-instance</code> updates the records in <i>database</i> represented by <i>instance</i>. If the instance is already associated with a database, that database is used, and <i>database</i> is ignored. If <i>instance</i> is not yet associated with a database, a record is created for <i>instance</i> in the appropriate table of <i>database</i> and the instance becomes associated with that database.</p> <p><code>update-records-from-instance</code> only updates the records from the base slots of <i>instance</i> - it does not look at the join slots.</p> |                 |                              |                 |             |

*This chapter applies to the Enterprise Edition only*

See also [def-view-class](#)  
[delete-instance-records](#)  
[update-records](#)

## update-record-from-slot

## *Generic Function*

**Summary** Updates an individual data item from a slot.

## Package sq1

**Signature**      `update-record-from-slot instance slot &key database`

**Arguments**      *instance*      An instance of a View Class.

*slot* A slot.

*database* A database

Values      None.

**Description** The generic function `update-record-from-slot` updates an individual data item in the column represented by *slot*. The *database* is only used if *instance* is not yet associated with any database, in which case a record is created in *database*. Only *slot* is initialized in this case; other columns in the underlying database receive default values. The argument *slot* is the CLOS slot name; the corresponding column names are derived from the View Class definition.

See also [def-view-class](#)  
[update-records-from-instance](#)

## update-slot-from-record

## Generic Function

**Summary** Updates a slot in a View Class instance.

|                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                 |                              |             |              |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------------------------------|-------------|--------------|
| Package         | <code>sql</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                 |                              |             |              |
| Signature       | <code>update-slot-from-record instance slot =&gt; instance</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                 |                              |             |              |
| Arguments       | <table> <tr> <td><i>instance</i></td><td>An instance of a View Class.</td></tr> <tr> <td><i>slot</i></td><td>A slot name.</td></tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                         | <i>instance</i> | An instance of a View Class. | <i>slot</i> | A slot name. |
| <i>instance</i> | An instance of a View Class.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                 |                              |             |              |
| <i>slot</i>     | A slot name.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                 |                              |             |              |
| Values          | <i>instance</i> The updated View Class instance.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                 |                              |             |              |
| Description     | <p>The generic function <code>update-slot-from-record</code> updates the value in the slot <i>slot</i> of the View Class instance <i>instance</i> using the records in the database.</p> <p><i>instance</i> must be associated with a database.</p> <p>The argument <i>slot</i> is the CLOS slot name; the corresponding column names are derived from the View Class definition.</p> <p>The update is not recursive on joins. Join slots (that is, slots with <code>:db-kind :join</code>) are updated, but the joined objects are not updated.</p> |                 |                              |             |              |
| See also        | <code>def-view-class</code><br><code>update-instance-from-records</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                              |             |              |

### \*use-n-syntax-for-non-ascii-strings\* Variable

|               |                                                                                                                                                                                     |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary       | Control whether the symbolic SQL syntax uses the N syntax for non-ASCII SQL string literals.                                                                                        |
| Package       | <code>sql</code>                                                                                                                                                                    |
| Initial Value | <code>nil</code>                                                                                                                                                                    |
| Description   | The variable <code>*use-n-syntax-for-non-ascii-strings*</code> controls whether SQL string literals containing non-ASCII characters are put into SQL expressions with the N syntax. |

*This chapter applies to the Enterprise Edition only*

When `*use-n-syntax-for-non-ascii-strings*` is `nil` (the default), all string literals are produced without the `N` syntax. When `*use-n-syntax-for-non-ascii-strings*` is `non-nil`, non-ASCII string literals are produced with the `N` syntax.

A non-ASCII string is any string that contains character codes out of the ASCII range 0 to 127.

For example:

```
(sql:sql-operation '= [name] "hhh<Greek>"')
=>
#<SQL-RELATIONAL-EXP "(NAME = 'hhh<Greek>')">

(let ((sql:*use-n-syntax-for-non-ascii-strings* t))
  (sql:sql-operation '= [name] "hh<Greek>"))
=>
#<SQL-RELATIONAL-EXP "(NAME = N'hh<Greek>')">
```

For the symbolic SQL "[...]" syntax , the effect of `*use-n-syntax-for-non-ascii-strings*` occurs at macro expansion time. Therefore, if you use the symbolic SQL syntax and want to make of use `*use-n-syntax-for-non-ascii-strings*`, then you need to set it before compiling your code.

See “SQL string literals” on page 366 for details.

Notes Microsoft SQL Server is currently the only SQL backend that requires the `N` syntax.

`*use-n-syntax-for-non-ascii-strings*` does not affect what `sql-expression` with `:string` does.

| with-sqlite-blob | Macro                                                 |
|------------------|-------------------------------------------------------|
| Summary          | Execute code with an open handle to a BLOB in SQLite. |
| Package          | <code>sql</code>                                      |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                   |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|
| Signature   | <code>with-sqlite-blob (<i>blob-var</i> <i>table-name</i> <i>column-name</i> <i>rowid</i> &amp;<i>key</i><br/><i>database</i> <i>owner</i> <i>read-only</i>) &amp;<i>body</i> <i>body</i> =&gt; <i>results-of-body</i></code>                                                                                                                                                                                                                                                                                                                                                         |                                   |
| Arguments   | <i>blob-var</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | A symbol.                         |
|             | <i>table-name</i> , <i>column-name</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Strings.                          |
|             | <i>rowid</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | An integer.                       |
|             | <i>database</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | A SQLite database.                |
|             | <i>owner</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | A string.                         |
|             | <i>read-only</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | A generalized boolean.            |
|             | <i>body</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Lisp forms.                       |
| Values      | <i>results-of-body</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Multiple values of any Lisp type. |
| Description | <p>The macro <code>with-sqlite-blob</code> opens a BLOB by calling <code>sqlite-open-blob</code> with <i>database</i>, <i>owner</i>, <i>table-name</i>, <i>column-name</i>, <i>rowid</i> and <i>read-only</i>, binds <i>blob-var</i> to the resulting <code>sqlite-blob</code>, and evaluates the forms in <i>body</i> (as an implicit <code>progn</code>) inside the binding and inside an <code>unwind-protect</code> that closes <i>blob-var</i> on exit.</p> <p>The return values of <code>with-sqlite-blob</code>, <i>results-of-body</i>, are whatever <i>body</i> returns.</p> |                                   |
| Notes       | <p>Because <code>with-sqlite-blob</code> guarantees to close the BLOB when it exits, you should use it in preference to calling <code>sqlite-open-blob</code> directly.</p>                                                                                                                                                                                                                                                                                                                                                                                                           |                                   |
| See also    | <code>sqlite-open-blob</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                   |

## with-transaction

Summary      Performs a body of code within a transaction for a database.

*This chapter applies to the Enterprise Edition only*

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                |                       |             |                   |                            |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-------------|-------------------|----------------------------|
| Package               | sql                                                                                                                                                                                                                                                                                                                                                                                                                            |                       |             |                   |                            |
| Signature             | <code>with-transaction &amp;key database &amp;body body =&gt; results</code>                                                                                                                                                                                                                                                                                                                                                   |                       |             |                   |                            |
| Arguments             | <table><tr><td><code>database</code></td><td>A database.</td></tr><tr><td><code>body</code></td><td>A set of Lisp expressions.</td></tr></table>                                                                                                                                                                                                                                                                               | <code>database</code> | A database. | <code>body</code> | A set of Lisp expressions. |
| <code>database</code> | A database.                                                                                                                                                                                                                                                                                                                                                                                                                    |                       |             |                   |                            |
| <code>body</code>     | A set of Lisp expressions.                                                                                                                                                                                                                                                                                                                                                                                                     |                       |             |                   |                            |
| Values                | <code>results</code><br>The values returned by <code>body</code> .                                                                                                                                                                                                                                                                                                                                                             |                       |             |                   |                            |
| Description           | <p>The macro <code>with-transaction</code> executes <code>body</code> within a transaction for <code>database</code> (which defaults to <code>*default-database*</code>). The transaction is committed if the body finishes successfully (without aborting or throwing), otherwise the database is rolled back.</p> <p><code>with-transaction</code> returns the value or multiple values returned from <code>body</code>.</p> |                       |             |                   |                            |
| Example               | The following example shows how to use <code>with-transaction</code> to insert a new record, updates the department number of employees from 40 to 50, and removes employees whose salary is higher than 300,000. If an error occurs anywhere in the body and an <code>abort</code> or <code>throw</code> is executed, none of the updates are committed.                                                                      |                       |             |                   |                            |
|                       | <pre>(with-transaction   (insert-record :into [empl]                  :attributes '(x y z)                  :values '(a b c))   (update-records [emp]                  :attributes [dept]                  :values 50                  :where [= [dept] 40])   (delete-records :from [emp]                  :where [&gt; [salary] 300000]))</pre>                                                                              |                       |             |                   |                            |
| See also              | <code>commit</code><br><code>rollback</code>                                                                                                                                                                                                                                                                                                                                                                                   |                       |             |                   |                            |



# 48

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## The STREAM Package

This chapter describes the symbols available in the `stream` package that provide users with the functionality to define their own streams for use by the standard I/O functions.

This is discussed in detail in Chapter 24, “User Defined Streams”.

| buffered-stream | <i>Class</i>                                                                                                               |
|-----------------|----------------------------------------------------------------------------------------------------------------------------|
| Summary         | A stream class giving access to stream buffers.                                                                            |
| Package         | <code>stream</code>                                                                                                        |
| Superclasses    | <code>fundamental-stream</code>                                                                                            |
| Subclasses      | <code>lob-stream</code><br><code>string-stream</code><br><code>socket-stream</code>                                        |
| Initargs        | <code>:direction</code> One of <code>:input</code> , <code>:output</code> or <code>:io</code> . This argument is required. |

**:element-type** One of **base-char**, **bmp-char**, **simple-char** or **character**.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The class <b>buffered-stream</b> provides default methods for the majority of the functions in the User Defined Streams protocol. The default methods implement buffered I/O, requiring the user to define only the methods <b>stream-read-buffer</b>, <b>stream-write-buffer</b> and <b>stream-element-type</b> for each subclass of <b>buffered-stream</b>. You are at liberty to redefine other methods in subclasses as long as they obey the rules outlined here. For example it is usually desirable to implement methods on <b>stream-listen</b>, <b>stream-check-eof-no-hang</b> and <b>close</b> as well.</p> <p>The initargs are handled by the method <code>(method initialize-instance :after (buffered-stream))</code> as follows:</p> <p>Input and/or output buffers are created based on the value <i>direction</i>. There is no default value, and you must supply a value.</p> <p><i>element-type</i> determines the <b>stream-element-type</b> of the stream. The default is <b>base-char</b>. For binary streams, use <b>base-char</b>.</p> <p>All the methods in the User Defined Streams protocol are defined for <b>buffered-stream</b> as follows:</p> <ul style="list-style-type: none"> <li>• The methods on <b>stream-read-char</b>, <b>stream-read-line</b>, <b>stream-read-sequence</b>, <b>stream-unread-char</b>, <b>stream-read-char-no-hang</b>, <b>stream-clear-input</b> handle input from the buffer. They each call <b>stream-fill-buffer</b> to fill the empty buffer as required.</li> <li>• The methods on <b>stream-write-char</b>, <b>stream-write-string</b>, <b>stream-write-sequence</b>, <b>stream-clear-output</b>, <b>stream-finish-output</b>, <b>stream-force-output</b> and <b>stream-line-column</b> handle output to the buffer. They each call <b>stream-flush-buffer</b> to make the buffer empty as required.</li> </ul> |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

- There are `:around` methods on `stream-listen` and `close` which handle the buffer.
- The methods on `input-stream-p`, `output-stream-p` return the appropriate values based on the value of the `:direction` initarg.
- The `open-stream-p` method returns true if `close` has not been called.

Example See the extended example in

```
(example-edit-file "streams/buffered-stream")
```

See also `close`  
`stream-flush-buffer`  
`stream-fill-buffer`  
`stream-listen`  
`stream-read-buffer`  
`stream-write-buffer`  
`with-stream-input-buffer`

## **fundamental-binary-input-stream** *Class*

Summary A stream class for binary input.

Package `stream`

Superclasses `fundamental-binary-stream`  
`fundamental-input-stream`

Subclasses None.

Description The class `fundamental-binary-input-stream` provides a class for generating customized binary input stream classes. A method for `stream-read-byte` should be provided when using this class.

See also      **`fundamental-binary-stream`**  
**`fundamental-input-stream`**  
**`stream-read-byte`**

## **`fundamental-binary-output-stream`** *Class*

Summary      A stream class for binary output.

Package      **`stream`**

Superclasses    **`fundamental-binary-stream`**  
**`fundamental-output-stream`**

Description     The class **`fundamental-binary-output-stream`** provides a class for generating customized binary output stream classes. A method for **`stream-write-byte`** should be provided.

See also      **`fundamental-binary-stream`**  
**`fundamental-output-stream`**  
**`stream-write-byte`**

## **`fundamental-binary-stream`** *Class*

Summary      A class for binary streams.

Package      **`stream`**

Superclasses    **`fundamental-stream`**

Subclasses     **`fundamental-binary-input-stream`**  
**`fundamental-binary-output-stream`**

Description     The class **`fundamental-binary-stream`** is the superclass of the binary input and output stream classes. A method for **`stream-element-type`** should be provided for concrete subclasses of this class.

See also      **fundamental-binary-input-stream**  
                **fundamental-binary-output-stream**  
                **fundamental-stream**  
                **stream-element-type**

## **fundamental-character-input-stream** *Class*

Summary      A class that should be included in stream classes for character input.

Package      **stream**

Superclasses      **fundamental-character-stream**  
                    **fundamental-input-stream**

Subclasses      None.

Description      The class **fundamental-character-input-stream** provides default methods for generic functions used for character input, and should therefore be included by stream classes concerned with character input. The user can provide methods for these generic functions specialized on the user-defined class. Methods for other generic functions must be provided by the user.

There is an example in “Defining a new stream class” on page 400.

See also      **fundamental-character-stream**  
                **fundamental-input-stream**  
                **stream-clear-input**  
                **stream-listen**  
                **stream-peek-char**  
                **stream-read-char**  
                **stream-read-char-no-hang**  
                **stream-read-line**

**stream-read-sequence**  
**stream-unread-char**

## **fundamental-character-output-stream** *Class*

|              |                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary      | A class that should be included in stream classes for character output.                                                                                                                                                                                                                                                                                                                                                                                       |
| Package      | <b>stream</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Superclasses | <b>fundamental-character-stream</b><br><b>fundamental-output-stream</b>                                                                                                                                                                                                                                                                                                                                                                                       |
| Subclasses   | None.                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Description  | The class <b>fundamental-character-output-stream</b> provides default methods for generic functions used for character output, and should therefore be included by stream classes concerned with character output. The user can provide methods for these generic functions specialized on the user-defined class. Methods for other generic functions must be provided by the user.<br><br>There is an example in “Defining a new stream class” on page 400. |
| See also     | <b>fundamental-character-stream</b><br><b>fundamental-input-stream</b><br><b>stream-clear-output</b><br><b>stream-finish-output</b><br><b>stream-force-output</b><br><b>stream-start-line-p</b><br><b>stream-terpri</b><br><b>stream-line-column</b><br><b>stream-write-char</b><br><b>stream-write-sequence</b><br><b>stream-write-string</b>                                                                                                                |

## **fundamental-character-stream** *Class*

|              |                                                                                                                                                                                                                     |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary      | A class whose inclusion provides a method for <b>stream-element-type</b> that returns <b>character</b> .                                                                                                            |
| Package      | <b>stream</b>                                                                                                                                                                                                       |
| Superclasses | <b>fundamental-stream</b>                                                                                                                                                                                           |
| Subclasses   | <b>fundamental-character-input-stream</b><br><b>fundamental-character-output-stream</b>                                                                                                                             |
| Description  | The class <b>fundamental-character-stream</b> is a superclass for character streams. Its inclusion provides a method for the generic function <b>stream-element-type</b> that returns the symbol <b>character</b> . |
| See also     | <b>fundamental-character-input-stream</b><br><b>fundamental-character-output-stream</b><br><b>fundamental-stream</b><br><b>stream-element-type</b>                                                                  |

## **fundamental-input-stream** *Class*

|              |                                                                                                                                                                                   |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary      | A class whose inclusion causes <b>input-stream-p</b> to return t.                                                                                                                 |
| Package      | <b>stream</b>                                                                                                                                                                     |
| Superclasses | <b>fundamental-stream</b>                                                                                                                                                         |
| Subclasses   | <b>fundamental-binary-input-stream</b><br><b>fundamental-character-input-stream</b>                                                                                               |
| Description  | The class <b>fundamental-input-stream</b> is a superclass to the binary and character input classes. Its inclusion causes the generic function <b>input-stream-p</b> to return t. |

See also      **fundamental-binary-input-stream**  
**fundamental-character-input-stream**  
**fundamental-stream**  
**input-stream-p**

## **fundamental-output-stream** *Class*

Summary      A class whose inclusion causes **output-stream-p** to return t.

Package      **stream**

Superclasses    **fundamental-stream**

Subclasses     **fundamental-binary-output-stream**  
**fundamental-character-output-stream**

Description     The class **fundamental-output-stream** is a superclass to the binary and character output classes. Its inclusion causes the generic function **output-stream-p** to return t.

See also      **fundamental-binary-output-stream**  
**fundamental-character-output-stream**  
**fundamental-stream**  
**input-stream-p**

## **fundamental-stream** *Class*

Summary      A class whose inclusion causes **streamp** to return t.

Package      **stream**

Superclasses    **standard-object**  
**stream**

|             |                                                                                                                                                                                                                            |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Subclasses  | <code>fundamental-binary-stream</code><br><code>fundamental-character-stream</code><br><code>fundamental-input-stream</code><br><code>fundamental-output-stream</code>                                                     |
| Description | The class <code>fundamental-stream</code> is a superclass to the fundamental input, output, character and binary streams. Its inclusion causes <code>streamp</code> to return <code>t</code> .                             |
| See also    | <code>close</code><br><code>fundamental-binary-stream</code><br><code>fundamental-character-stream</code><br><code>fundamental-input-stream</code><br><code>fundamental-output-stream</code><br><code>open-stream-p</code> |

## stream-advance-to-column

## *Generic Function*

|             |                                                                                                                                                                                                                                                                                                                            |             |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| Summary     | Writes the required number of blank spaces to ensure that the next character will be written in a given column.                                                                                                                                                                                                            |             |
| Package     | <code>stream</code>                                                                                                                                                                                                                                                                                                        |             |
| Signature   | <code>stream-advance-to-column stream column =&gt; result</code>                                                                                                                                                                                                                                                           |             |
| Arguments   | <code>stream</code>                                                                                                                                                                                                                                                                                                        | A stream.   |
|             | <code>column</code>                                                                                                                                                                                                                                                                                                        | An integer. |
| Values      | <code>result</code>                                                                                                                                                                                                                                                                                                        | A boolean.  |
| Description | The generic function <code>stream-advance-to-column</code> writes enough blank spaces to <code>stream</code> to ensure that the next character is written at <code>column</code> . The generic function returns <code>t</code> if the operation is successful, or <code>nil</code> if it is not supported for this stream. |             |

This function is intended for use by `print` and `format ~t`. The default method uses `stream-line-column` and repeated calls to `stream-write-char` with a `#\Space` character, and returns `nil` if `stream-line-column` returns `nil`.

See also [stream-line-column](#)

## stream-check-eof-no-hang

## *Generic Function*

**Summary**      Determines whether a stream is at end of file.

## Package stream

Signature `stream-check-eof-no-hang stream => result`

Arguments      *stream*      An input stream.

Values              *result*              nil or :eof.

**Description** The generic function `stream-check-eof-no-hang` determines if the data source of the stream is at end of file, without hanging.

*stream* should be an instance of a subclass of `buffered-stream`.

*result* is `:eof` if *stream* is at end of file and `nil` otherwise.

There is a built-in method specialized on `buffered-stream` which returns `:eof` in all cases.

See also [buffered-stream](#)

## stream-clear-input

## *Generic Function*

**Summary**      Implements `clear-input`.

|             |                                                                                                                                                                                     |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>stream</code>                                                                                                                                                                 |
| Signature   | <code>stream-clear-input stream =&gt; nil</code>                                                                                                                                    |
| Arguments   | <code>stream</code> A stream.                                                                                                                                                       |
| Values      | <code>nil</code>                                                                                                                                                                    |
| Description | The generic function <code>stream-clear-input</code> implements <code>clear-input</code> . The default method is defined on <code>fundamental-input-stream</code> and does nothing. |
| See also    | <code>fundamental-input-stream</code>                                                                                                                                               |

## **stream-clear-output**

## *Generic Function*

|             |                                                                                                                                                                                |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Implements <code>clear-output</code> .                                                                                                                                         |
| Package     | <code>stream</code>                                                                                                                                                            |
| Signature   | <code>stream-clear-output stream =&gt; nil</code>                                                                                                                              |
| Arguments   | <code>stream</code> A stream.                                                                                                                                                  |
| Values      | <code>nil</code>                                                                                                                                                               |
| Description | The generic function <code>stream-clear-output</code> implements <code>clear-output</code> . The default method is on <code>fundamental-output-stream</code> and does nothing. |
|             | There is an example in “Stream output” on page 402.                                                                                                                            |
| See also    | <code>fundamental-output-stream</code>                                                                                                                                         |

**stream-file-position** *Generic Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                       |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| Summary     | Returns or changes the current position within a stream.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                       |
| Package     | <code>stream</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                       |
| Signature   | <code>stream-file-position stream =&gt; position</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                       |
| Signature   | <code>(setf stream-file-position) position-spec stream =&gt; success-p</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                       |
| Arguments   | <code>stream</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | A stream.                             |
|             | <code>position-spec</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | A file position designator.           |
| Values      | <code>position</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | A file position or <code>nil</code> . |
|             | <code>success-p</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | A generalized boolean.                |
| Description | <p>The generic function <code>stream-file-position</code> implements <code>file-position</code>.<br/> <code>stream-file-position</code> is called when <code>file-position</code> is called with one argument.<br/> <code>(setf stream:stream-file-position)</code> is called when <code>file-position</code> is called with two arguments.</p> <p>The return value is returned by <code>file-position</code>. For the setf function, this is a slight anomaly because setf functions normally return the new value. However in this case it should return the <code>success-p</code> value mandated by the ANSI Common Lisp standard.</p> <p>The default methods specialized on <code>stream</code> return <code>nil</code>.</p> |                                       |

**stream-fill-buffer** *Generic Function*

|         |                          |
|---------|--------------------------|
| Summary | Fills the stream buffer. |
| Package | <code>stream</code>      |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                        |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Signature   | <code>stream-fill-buffer stream =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                        |
| Arguments   | <code>stream</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | An input stream.       |
| Values      | <code>result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | A generalized boolean. |
| Description | <p>The generic function <code>stream-fill-buffer</code> is called by the reading functions to fill an empty stream buffer from the underlying data source.</p> <p><code>stream</code> should be an instance of a subclass of <code>buffered-stream</code>.</p> <p><code>stream-fill-buffer</code> should block until some data is available or return false at end of file. If data is available, it should place it in a buffer, set the stream's input buffer, index and limit appropriately and return a true value. The existing stream buffer can be reused if desired but the index and limit must be updated. The buffer must be of type <code>simple-string</code>, whose element type matches that given when the stream was constructed.</p> <p>There is a built-in method specialized on <code>buffered-stream</code> which usually suffices. It calls <code>stream-read-buffer</code> with the whole buffer and returns false if this call returns 0. If not, the input index is set to 0 and the input limit is set to the value returned by <code>stream-read-buffer</code>.</p> |                        |
| See also    | <a href="#"><code>buffered-stream</code></a><br><a href="#"><code>stream-read-buffer</code></a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                        |

|           | <i>Generic Function</i>                            |
|-----------|----------------------------------------------------|
| Summary   | Implements <code>finish-output</code> .            |
| Package   | <code>stream</code>                                |
| Signature | <code>stream-finish-output stream =&gt; nil</code> |

|             |                  |                                                                                                                                                                                                                                             |
|-------------|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arguments   | <i>stream</i>    | A stream.                                                                                                                                                                                                                                   |
| Values      | <code>nil</code> |                                                                                                                                                                                                                                             |
| Description |                  | The generic function <code>stream-finish-output</code> implements <code>finish-output</code> . The default method is on <code>fundamental-output-stream</code> and does nothing.<br><br>There is an example in “Stream output” on page 402. |
| See also    |                  | <code>fundamental-output-stream</code>                                                                                                                                                                                                      |

## **stream-flush-buffer**

*Generic Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                        |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Summary     | Flushes a stream's buffer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                        |
| Package     | <code>stream</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                        |
| Signature   | <code>stream-flush-buffer stream =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                        |
| Arguments   | <i>stream</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | An output stream.      |
| Values      | <i>result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | A generalized boolean. |
| Description | <p>The generic function <code>stream-flush-buffer</code> is called by the writing functions to flush a stream buffer to the underlying data sink.</p> <p><i>stream</i> should be an instance of a subclass of <code>buffered-stream</code>.</p> <p>Before returning, <code>stream-flush-buffer</code> must set the output index of <i>stream</i> so that more characters can be written to the buffer. If desired, the output buffer and limit can be set too.</p> <p>There is a built-in method specialized on <code>buffered-stream</code> which usually suffices. It calls <code>stream-write-buffer</code> with</p> |                        |

the currently active part of the stream's output buffer and sets the output index to 0.

*result* is true if the buffer was flushed.

See also      **buffered-stream**  
                 **stream-write-buffer**

## stream-force-output

*Generic Function*

Summary      Implements **force-output**.

Package      **stream**

Signature      **stream-force-output stream => nil**

Arguments      **stream**      A stream.

Values      **nil**

Description      The generic function **stream-force-output** implements **force-output**. The default method is on **fundamental-output-stream** and does nothing.

There is an example in “Stream output” on page 402.

See also      **fundamental-output-stream**

## stream-fresh-line

*Generic Function*

Summary      Used by **fresh-line** to start a new line on a given stream.

Package      **stream**

Signature      **stream-fresh-line stream => bool**

|             |               |                                                                                                                                                                                                                                                              |
|-------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arguments   | <i>stream</i> | A stream.                                                                                                                                                                                                                                                    |
| Values      | <i>bool</i>   | A generalized boolean.                                                                                                                                                                                                                                       |
| Description |               | The generic function <b>stream-fresh-line</b> is used by <b>fresh-line</b> to start a new line on a stream. The default method uses <b>stream-start-line-p</b> and <b>stream-terpri</b> . The result value is <b>t</b> if a new line is output successfully. |
| See also    |               | <b>stream-start-line-p</b><br><b>stream-terpri</b>                                                                                                                                                                                                           |

## **stream-line-column**

*Generic Function*

|             |                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------|--------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Returns the column number where the next character will be written.      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Package     | <b>stream</b>                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Signature   | <b>stream-line-column</b> <i>stream</i> => <i>column</i>                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Arguments   | <i>stream</i>                                                            | A stream.                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Values      | <i>column</i>                                                            | An integer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Description |                                                                          | The generic function <b>stream-line-column</b> returns the column number where the next character will be written from <i>stream</i> , or <b>nil</b> if this is not meaningful for the stream. This function is used in the implementation of <b>print</b> and the <b>format ~t</b> directive. A method for this function must be defined for every character output stream class that is defined, although at its simplest it may be defined to always return <b>nil</b> . |
| See also    | <b>fundamental-character-output-stream</b><br><b>stream-start-line-p</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

## **stream-listen**

## *Generic Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                        |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Summary     | A function used by <code>listen</code> that returns <code>t</code> if there is input available.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                        |
| Package     | <code>stream</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                        |
| Signature   | <code>stream-listen stream =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                        |
| Arguments   | <code>stream</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | A stream.              |
| Values      | <code>result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | A generalized boolean. |
| Description | <p>The generic function <code>stream-listen</code> is called to determine if there is data immediately available on the stream <code>stream</code>, without hanging.</p> <p><code>result</code> should be true if there is input, and <code>nil</code> otherwise (including at end of file).</p> <p>This method must be implemented for subclasses of <code>buffered-stream</code> that handle input.</p> <p>There is a built-in primary method specialized on <code>buffered-stream</code> which returns <code>nil</code>. There is a built-in <code>:around</code> method specialized on <code>buffered-stream</code> which checks for input in the buffer and calls the next method if the buffer is empty. Thus a primary method specialized on a subclass of <code>buffered-stream</code> need only check the underlying data source.</p> <p>The built-in method on <code>fundamental-input-stream</code> uses <code>stream-read-char-no-hang</code> and <code>stream-unread-char</code>. Most streams should define their own method as this is usually trivial and more efficient than the method provided.</p> |                        |
| See also    | <code>buffered-stream</code><br><code>stream-read-char-no-hang</code><br><code>stream-unread-char</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                        |

| <b>stream-output-width</b> |                     | <i>Generic Function</i>                                                                                                                                                                                                                                                                                                                                                                                            |
|----------------------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary                    |                     | Used by the pretty printer to determine the output width when <code>*print-right-margin*</code> is <code>nil</code> .                                                                                                                                                                                                                                                                                              |
| Package                    | <code>stream</code> |                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Signature                  |                     | <code>stream-output-width stream =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                               |
| Arguments                  | <code>stream</code> | A stream.                                                                                                                                                                                                                                                                                                                                                                                                          |
| Values                     | <code>result</code> | An integer or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                   |
| Description                |                     | The generic function <code>stream-output-width</code> is used by the pretty printer to determine the output width when <code>*print-right-margin*</code> is <code>nil</code> . It returns <code>result</code> , the integer width of <code>stream</code> in units of ems, or <code>nil</code> if the width is not known. The default method provided by <code>fundamental-stream</code> returns <code>nil</code> . |
| See also                   |                     | <code>fundamental-stream</code>                                                                                                                                                                                                                                                                                                                                                                                    |

| <b>stream-peek-char</b> |                     | <i>Generic Function</i>                                                                                                                  |
|-------------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Summary                 |                     | A generic function used by <code>peek-char</code> that returns a character on a given stream without removing it from the stream buffer. |
| Package                 | <code>stream</code> |                                                                                                                                          |
| Signature               |                     | <code>stream-peek-char stream =&gt; result</code>                                                                                        |
| Arguments               | <code>stream</code> | A stream.                                                                                                                                |
| Values                  | <code>result</code> | A character or <code>:EOF</code> symbol.                                                                                                 |

|             |                                                                                                                                                                                                                                                                                                                                     |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | The generic function <code>stream-peek-char</code> is used to implement <code>peek-char</code> , and corresponds to a peek-type of <code>nil</code> . The default method reads a character from the stream without removing it from the stream buffer, by using <code>stream-read-char</code> and <code>stream-unread-char</code> . |
| See also    | <code>stream-listen</code><br><code>stream-read-char</code><br><code>stream-unread-char</code>                                                                                                                                                                                                                                      |

## **stream-read-buffer**

*Generic Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                             |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|
| Summary     | Reads data into the stream buffer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                             |
| Package     | <code>stream</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                             |
| Signature   | <code>stream-read-buffer stream buffer start end =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                             |
| Arguments   | <code>stream</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | An input stream.                                            |
|             | <code>buffer</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A stream buffer.                                            |
|             | <code>start, end</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Bounding indexes for a subsequence of <code>buffer</code> . |
| Values      | <code>result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A non-negative integer.                                     |
| Description | <p>The generic function <code>stream-read-buffer</code> is called by <code>stream-fill-buffer</code> to place characters into the region of the buffer <code>buffer</code> bounded by <code>start</code> and <code>end</code>.</p> <p><code>stream</code> should be an instance of a subclass of <code>buffered-stream</code>.</p> <p><code>stream-read-buffer</code> should block until some data is available. <code>result</code> should be the number of characters actually placed in the buffer (0 if at end of file). This method must be</p> |                                                             |

implemented for subclasses of `buffered-stream` that handle input.

See also [buffered-stream](#)  
[stream-fill-buffer](#)

## stream-read-byte *Generic Function*

**Summary** A generic function used by `read-byte` to read an integer or `:eof` symbol from a binary stream.

## Package stream

Signature **stream-read-byte** *stream* => *result*

**Arguments**      *stream*      An input stream.

Values            *result*            An integer or :eof.

**Description** The generic function `stream-read-byte` is used by `read-byte`, and returns either an integer read from the binary stream specified by `stream`, or the keyword :`eof`.

A method must be implemented for all binary subclasses of `buffered-stream` that handle input. A typical implementation will call `stream-read-char` and convert the character to an integer using `char-code`.

A method should be defined for a subclass of `fundamental-binary-input-stream`.

See also [buffered-stream](#)  
[fundamental-binary-input-stream](#)  
[fundamental-binary-stream](#)  
[stream-read-char](#)

## **stream-read-char**

## *Generic Function*

|             |                                                                                                                                                                                                                                                                                                |                                 |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| Summary     | Read one character from a stream.                                                                                                                                                                                                                                                              |                                 |
| Package     | <b>stream</b>                                                                                                                                                                                                                                                                                  |                                 |
| Signature   | <b>stream-read-char <i>stream</i> =&gt; <i>character</i></b>                                                                                                                                                                                                                                   |                                 |
| Arguments   | <i>stream</i>                                                                                                                                                                                                                                                                                  | An input stream.                |
| Values      | <i>character</i>                                                                                                                                                                                                                                                                               | A character or the :EOF symbol. |
| Description | The generic function <b>stream-read-char</b> reads one item from <i>stream</i> . The item read is either a character or the end of file symbol :EOF if the stream is at the end of a file. Every subclass of <b>fundamental-character-input-stream</b> must define a method for this function. |                                 |
| See also    | <b>fundamental-character-input-stream</b><br><b>stream-unread-char</b>                                                                                                                                                                                                                         |                                 |

## **stream-read-char-no-hang**

## *Generic Function*

|             |                                                                                                                               |                                             |
|-------------|-------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|
| Summary     | Returns either a character from the stream, an :eof if the end-of-file is reached, or nil if no input is currently available. |                                             |
| Package     | <b>stream</b>                                                                                                                 |                                             |
| Signature   | <b>stream-read-char-no-hang <i>stream</i> =&gt; <i>result</i></b>                                                             |                                             |
| Arguments   | <i>stream</i>                                                                                                                 | An input stream.                            |
| Values      | <i>result</i>                                                                                                                 | Either a character, an :EOF symbol, or nil. |
| Description | The generic function <b>stream-read-char-no-hang</b> implements <b>read-char-no-hang</b> . It returns either a character read |                                             |

from the stream, or `:eof` if end-of-file is reached, or `nil` if no input is available. The default method provided by `fundamental-character-input-stream` simply calls `stream-read-char` which is sufficient for file streams, but interactive streams should define their own method.

## See also

`fundamental-character-input-stream`  
`stream-read-char`

| <b>stream-read-line</b> | <i>Generic Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary                 | Returns a string read from a stream.                                                                                                                                                                                                                                                                                                                                                                                                       |
| Package                 | <code>stream</code>                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Signature               | <code>stream-read-line stream =&gt; result terminated</code>                                                                                                                                                                                                                                                                                                                                                                               |
| Arguments               | <code>stream</code> An input stream.                                                                                                                                                                                                                                                                                                                                                                                                       |
| Values                  | <code>result</code> A string or <code>:eof</code> .<br><code>terminated</code> A boolean.                                                                                                                                                                                                                                                                                                                                                  |
| Description             | <p>The generic function <code>stream-read-line</code> reads a line of characters from <code>stream</code> and returns this line as a string. If the string is terminated by an end-of-file instead of a newline then <code>terminated</code> is <code>t</code>.</p> <p>The default method uses repeated calls to <code>stream-read-char</code>, and uses <code>stream-element-type</code> to determine the element-type of its result.</p> |
| See also                | <code>fundamental-character-input-stream</code><br><code>stream-element-type</code><br><code>stream-read-char</code>                                                                                                                                                                                                                                                                                                                       |

## **stream-read-sequence**

## *Generic Function*

**Summary**     Reads a number of items from a stream into a sequence.

**Package**     **stream**

**Signature**     **stream-read-sequence stream sequence start end => index**

**Arguments**     **stream**     A stream.

**sequence**     A sequence.

**start**     An integer.

**end**     An integer.

**Values**     **index**     An integer.

**Description**     The generic function **stream-read-sequence** reads from *stream* into *sequence*. Elements from the *start* of *sequence* are replaced by elements from *stream* until *end* in *sequence* or the end-of-file in *stream* is reached. The index of the first element in *sequence* that is not replaced is returned.

A default method is provided by **fundamental-character-input-stream** which makes repeated calls to **stream-read-char** and uses **(setf elt)** to insert characters into *sequence*. A default method is provided by **fundamental-binary-input-stream** that makes repeated calls to **stream-read-byte** and also uses **(setf elt)** to insert bytes into *sequence*. Note that this may lead to error if the sequence is of inappropriate type.

**See also**     **fundamental-binary-input-stream**  
                  **fundamental-character-input-stream**  
                  **stream-read-byte**  
                  **stream-read-char**

**stream-read-timeout** *Generic Function*

|             |                                                                                                                                                                                                                                                       |                                   |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|
| Summary     | Accesses the read-timeout property of a socket stream.                                                                                                                                                                                                |                                   |
| Package     | <b>stream</b>                                                                                                                                                                                                                                         |                                   |
| Signature   | <b>stream-read-timeout</b> <i>stream</i> => <i>timeout</i>                                                                                                                                                                                            |                                   |
| Arguments   | <i>stream</i>                                                                                                                                                                                                                                         | A socket stream.                  |
| Values      | <i>timeout</i>                                                                                                                                                                                                                                        | A positive number or <b>nil</b> . |
| Description | <p>The generic function <b>stream-read-timeout</b> reads the current <i>read-timeout</i> of an instance of <b>comm:socket-stream</b>.</p> <p>(<b>setf stream-read-timeout</b>) sets the read-timeout of an instance of <b>comm:socket-stream</b>.</p> |                                   |
| See also    | <a href="#"><b>socket-stream</b></a><br><a href="#"><b>open-tcp-stream</b></a>                                                                                                                                                                        |                                   |

**stream-start-line-p** *Generic Function*

|             |                                                                                                                                                   |            |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Summary     | A generic function that returns <b>t</b> if the stream is positioned at the beginning of a line.                                                  |            |
| Package     | <b>stream</b>                                                                                                                                     |            |
| Signature   | <b>stream-start-line-p</b> <i>stream</i> => <i>result</i>                                                                                         |            |
| Arguments   | <i>stream</i>                                                                                                                                     | A stream.  |
| Values      | <i>result</i>                                                                                                                                     | A boolean. |
| Description | The generic function <b>stream-start-line-p</b> returns <b>t</b> if <i>stream</i> is positioned at the beginning of a line, and <b>nil</b> other- |            |

wise. It is permissible to define a method that always returns `nil`.

Note that although a value of 0 from `stream-line-column` also indicates the beginning of a line, there are cases where `stream-start-line-p` can be meaningfully implemented and `stream-line-column` cannot. For example, for a window using variable-width characters the column number is not very meaningful, whereas the beginning of a line has a clear meaning.

The default method for `stream-start-line-p` on class `fundamental-character-output-stream` uses `stream-line-column`. Therefore, if this is defined to return `nil`, a method should be provided for either `stream-start-line-p` or `stream-fresh-line`.

See also      `fundamental-character-output-stream`  
                 `stream-fresh-line`  
                 `stream-line-column`

## **stream-terpri** *Generic Function*

|             |                                                                                                                                                                                                                                       |           |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Summary     | Writes an end of line to a stream.                                                                                                                                                                                                    |           |
| Package     | <code>stream</code>                                                                                                                                                                                                                   |           |
| Signature   | <code>stream-terpri stream =&gt; nil</code>                                                                                                                                                                                           |           |
| Arguments   | <code>stream</code>                                                                                                                                                                                                                   | A stream. |
| Values      | <code>nil</code>                                                                                                                                                                                                                      |           |
| Description | The generic function <code>stream-terpri</code> writes an end of line to <code>stream</code> , as for <code>terpri</code> . The default method for <code>stream-terpri</code> is ( <code>stream-write-char stream #\Newline</code> ). |           |

See also [\*\*stream-write-char\*\*](#)

## **stream-unread-char** *Generic Function*

|             |                                                                                                                                                                                                                                 |              |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| Summary     | Undoes the last call to <b>stream-read-char</b> .                                                                                                                                                                               |              |
| Package     | <b>stream</b>                                                                                                                                                                                                                   |              |
| Signature   | <b>stream-unread-char stream character =&gt; nil</b>                                                                                                                                                                            |              |
| Arguments   | <i>stream</i>                                                                                                                                                                                                                   | A stream.    |
|             | <i>character</i>                                                                                                                                                                                                                | A character. |
| Values      | <b>nil</b>                                                                                                                                                                                                                      |              |
| Description | The generic function <b>stream-unread-char</b> undoes the last call to <b>stream-read-char</b> , as in <b>unread-char</b> . Every subclass of <b>fundamental-character-input-stream</b> must define a method for this function. |              |
| See also    | <a href="#"><b>fundamental-character-input-stream</b></a>                                                                                                                                                                       |              |

## **stream-write-buffer** *Generic Function*

|           |                                                    |                                                       |
|-----------|----------------------------------------------------|-------------------------------------------------------|
| Summary   | Writes a part of stream's buffer.                  |                                                       |
| Package   | <b>stream</b>                                      |                                                       |
| Signature | <b>stream-write-buffer stream buffer start end</b> |                                                       |
| Arguments | <i>stream</i>                                      | An output stream.                                     |
|           | <i>buffer</i>                                      | A stream buffer.                                      |
|           | <i>start, end</i>                                  | Bounding indexes for a subsequence of <i>buffer</i> . |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The generic function <code>stream-write-buffer</code> is called by <code>stream-flush-buffer</code> to write the region of the buffer bounded by <code>start</code> and <code>end</code> to the stream's underlying data sink.</p> <p><code>stream</code> should be an instance of a subclass of <code>buffered-stream</code>.</p> <p>This method must be implemented for subclasses of <code>buffered-stream</code> that handle output.</p> |
| See also    | <p><code>buffered-stream</code></p> <p><code>stream-flush-buffer</code></p>                                                                                                                                                                                                                                                                                                                                                                     |

## **stream-write-byte** *Generic Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| Summary     | A generic function used by <code>write-byte</code> to write an integer to a binary stream.                                                                                                                                                                                                                                                                                                                                                                 |             |
| Package     | <code>stream</code>                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |
| Signature   | <code>stream-write-byte stream integer =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                 |             |
| Arguments   | <code>stream</code>                                                                                                                                                                                                                                                                                                                                                                                                                                        | A stream.   |
|             | <code>integer</code>                                                                                                                                                                                                                                                                                                                                                                                                                                       | An integer. |
| Values      | <code>result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                        | An integer. |
| Description | <p>The generic function <code>stream-write-byte</code> is used by <code>write-byte</code>, and writes the integer <code>integer</code> to the binary stream specified by <code>stream</code>.</p> <p>A method must be implemented for all binary subclasses of <code>buffered-stream</code> that handle output. A typical implementation will convert the integer to a character using <code>code-char</code> and call <code>stream-write-char</code>.</p> |             |

A method should be defined for all subclasses of **fundamental-binary-output-stream**.

See also      **buffered-stream**  
**fundamental-binary-output-stream**  
**fundamental-binary-stream**  
**stream-write-char**

## **stream-write-char** *Generic Function*

Summary      Writes a character to a specified stream.

Package      **stream**

Signature      **stream-write-char stream character => character**

Arguments      **stream**      A stream.  
**character**      A character.

Values      **character**      A character.

Description      The generic function **stream-write-char** writes *character* to *stream*. Every subclass of **fundamental-character-output-stream** must have a method defined for this function.  
There is an example in “Stream output” on page 402.

See also      **fundamental-character-output-stream**

## **stream-write-sequence** *Generic Function*

Summary      Writes a subsequence of a sequence to a stream.

Package      **stream**

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| Signature   | <code>stream-write-sequence <i>stream sequence start end =&gt; result</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |
| Arguments   | <i>stream</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | A stream.   |
|             | <i>sequence</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | A sequence. |
|             | <i>start</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | An integer. |
|             | <i>end</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | An integer. |
| Values      | <i>result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | A sequence. |
| Description | <p>The generic function <code>stream-write-sequence</code> is used by <code>write-sequence</code> to write a subsequence of <code>sequence</code> delimited by <code>start</code> and <code>end</code> to <code>stream</code>.</p> <p>A default method is provided by <code>fundamental-character-output-stream</code> that tests each element of <code>sequence</code> in turn, and then uses <code>stream-write-char</code> or produces an error. A default method is provided by <code>fundamental-binary-output-stream</code> that tests each element of <code>sequence</code> in turn, and then uses <code>stream-write-byte</code> or produces an error.</p> |             |
| See also    | <code>fundamental-binary-output-stream</code><br><code>fundamental-character-output-stream</code><br><code>stream-read-sequence</code><br><code>stream-write-byte</code><br><code>stream-write-char</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |

|           | <b>Generic Function</b>                                                                    |
|-----------|--------------------------------------------------------------------------------------------|
| Summary   | Used by <code>write-string</code> to write a string to a character output stream.          |
| Package   | <code>stream</code>                                                                        |
| Signature | <code>stream-write-string <i>stream string &amp;optional start end =&gt; result</i></code> |

|             |                                                                                                                                                                                                                                                                                                                                                                                                      |             |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| Arguments   | <i>stream</i>                                                                                                                                                                                                                                                                                                                                                                                        | A stream.   |
|             | <i>string</i>                                                                                                                                                                                                                                                                                                                                                                                        | A string.   |
|             | <i>start</i>                                                                                                                                                                                                                                                                                                                                                                                         | An integer. |
|             | <i>end</i>                                                                                                                                                                                                                                                                                                                                                                                           | An integer. |
| Values      | <i>result</i>                                                                                                                                                                                                                                                                                                                                                                                        | A string.   |
| Description | <p>The generic function <b>stream-write-string</b> is used by <b>write-string</b> to write <i>string</i> to <i>stream</i>. The string can, optionally, be delimited by <i>start</i> and <i>end</i>.</p> <p>The default method provided by <b>fundamental-character-output-stream</b> uses repeated calls to <b>stream-write-char</b>.</p> <p>There is an example in “Stream output” on page 402.</p> |             |
| See also    | <b>fundamental-character-output-stream</b><br><b>stream-write-char</b>                                                                                                                                                                                                                                                                                                                               |             |

## with-stream-input-buffer *Macro*

|           |                                                                                                                       |                                     |
|-----------|-----------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| Summary   | Allows access to the input buffer.                                                                                    |                                     |
| Package   | <b>stream</b>                                                                                                         |                                     |
| Signature | <b>with-stream-input-buffer</b> ( <i>buffer index limit</i> ) <b>stream &amp;body</b><br><i>body</i> => <i>result</i> |                                     |
| Arguments | <i>buffer, index, limit</i>                                                                                           | Variables.                          |
|           | <i>stream</i>                                                                                                         | An input stream.                    |
|           | <i>body</i>                                                                                                           | Code.                               |
| Values    | <i>result</i>                                                                                                         | The value returned by <i>body</i> . |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The macro <code>with-stream-input-buffer</code> allows access to the state of the input buffer for the given buffered stream.</p> <p><code>stream</code> should be an instance of a subclass of <code>buffered-stream</code>.</p> <p>Within the code <code>body</code>, the variables <code>buffer</code>, <code>index</code> and <code>limit</code> are bound to the buffer of <code>stream</code>, its current index and the limit of the buffer. Setting <code>buffer</code>, <code>index</code> or <code>limit</code> will change the values in the stream <code>stream</code> but note that other changes to these values (for example, by calling other stream functions) will not affect the values bound within the macro. See the example for a typical use which shows how this restriction can be handled.</p> <p>The buffer is always of type <code>simple-string</code>. The <code>stream-element-type</code> of <code>stream</code> depends on how it was constructed.</p> <p>The index is the position of the next element to be read from the buffer and the limit is the position of the element after the end of the buffer. Therefore there is no data in the buffer when <code>index</code> is greater than or equal to <code>length</code>.</p> |
| Example     | This example function returns a string with exactly four characters read from a buffered stream. If <code>end-of-file</code> is reached before four characters have been read, it returns <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

```
(defun read-4-chars (stream)
  (declare (type stream:buffered-stream stream))
  (let ((res (make-string 4))
        (elt 0))
    ;; Outer loop handles buffer filling.
    (loop
      ;; Inner loop handles buffer scanning.
      (loop (stream:with-stream-input-buffer (buf ind
lim) stream
        (when (>= ind lim)
          ;; End of buffer: try to refill.
          (return))
        (setf (schar res elt) (schar buf ind))
        (incf elt)
        (incf ind)
        (when (= elt 4)
          (return-from read-4-chars res))))
      (unless (stream:stream-fill-buffer stream)
        (return-from read-4-chars nil)))))
```

See also      **buffered-stream**  
**with-stream-output-buffer**

## with-stream-output-buffer

*Macro*

Summary      Allows access to the output buffer.

Package      **stream**

Signature      **with-stream-output-buffer** (*buffer index limit*) **stream &body body** => *result*

Arguments      *buffer, index, limit*

### Variables

*stream*      An output stream

*body*      Code

Values      *result*      The value returned by body.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The macro <code>with-stream-output-buffer</code> allows access to the state of the output buffer for the given buffered stream. <code>stream</code> should be an instance of a subclass of <code>buffered-stream</code>.</p> <p>Within the code <code>body</code>, the variable names <code>buffer</code>, <code>index</code> and <code>limit</code> are bound to the buffer of <code>stream</code>, its current index and the limit of the buffer. Setting <code>buffer</code>, <code>index</code> or <code>limit</code> will change the values in the stream <code>stream</code> but note that other changes to these values (for example, by calling other stream functions) will not affect the values bound within the macro. See the example for a typical use which shows how this restriction can be handled.</p> <p>The buffers are always of type <code>simple-string</code>. The <code>stream-element-type</code> of <code>stream</code> depends on how the stream was constructed.</p> <p>The index is the position of the next free element in the buffer and the limit is the position of the element after the end of the buffer. Therefore the buffer is full when <code>index</code> is greater than or equal to <code>length</code>.</p> |
| Example     | This example function writes a four character string to a buffered stream.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

```
(defun write-4-chars (stream string)
  (declare (type stream:buffered-stream stream))
  (let ((elt 0))
    ;; Outer loop handles buffer flushing.
    (loop
      ;; Inner loop handles buffer updating.
      (loop (stream:with-stream-output-buffer (buf ind
lim) stream
        (when (>= ind lim)
          ;; Buffer full: try to flush.
          (return))
        (setf (schar buf ind) (schar string elt))
        (incf elt)
        (incf ind)
        (when (= elt 4)
          (return-from write-4-chars))))
      (stream:stream-flush-buffer stream))))
```

See also

**buffered-stream**  
**with-stream-input-buffer**

# 49

---

## The SYSTEM Package

This chapter describes symbols available in the **SYSTEM** package.

Various uses of the symbols documented here are discussed throughout this manual.

|             |                                                                               | <i>Function</i>                                                                                                                                 |
|-------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | 64-bit LispWorks only: Returns if the object is allocated in its own segment. |                                                                                                                                                 |
| Package     | <code>system</code>                                                           |                                                                                                                                                 |
| Signature   | <code>allocated-in-its-own-segment-p <i>object</i> =&gt; <i>result</i></code> |                                                                                                                                                 |
| Arguments   | <i>object</i>                                                                 | Any object.                                                                                                                                     |
| Values      | <i>result</i>                                                                 | A boolean.                                                                                                                                      |
| Description |                                                                               | The function <code>allocated-in-its-own-segment-p</code> returns true if <i>object</i> is allocated in its own own segment and false otherwise. |

|          |                                                                                                                                                                                                                                   |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | An object is allocated in its own segment if it is "very large". Currently that means larger than 64 MB for the ordinary 64-bit GC, or larger than 1 MB for the Mobile GC.                                                        |
|          | <code>allocated-in-its-own-segment-p</code> is intended to help to decide whether to call the functions that are useful only for such objects ( <code>make-object-permanent</code> and <code>release-object-and-nullify</code> ). |
| See also | <code>make-object-permanent</code><br><code>release-object-and-nullify</code><br>"Mobile GC technical details" on page 154                                                                                                        |

|             |                                                                                                                                                             | <i>Function</i>                                                                                                                                                                                                                                                                                      |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Allows control over which generation objects are allocated in, in 64-bit LispWorks.                                                                         |                                                                                                                                                                                                                                                                                                      |
| Package     | <code>system</code>                                                                                                                                         |                                                                                                                                                                                                                                                                                                      |
| Signature   | <code>apply-with-allocation-in-gen-num what gen-num func &amp;rest args =&gt; results</code>                                                                |                                                                                                                                                                                                                                                                                                      |
| Arguments   | <p><code>what</code></p> <p><code>gen-num</code></p> <p><code>func</code></p> <p><code>args</code></p>                                                      | <p>One of the keywords <code>:cons</code>, <code>:symbol</code>, <code>:function</code>, <code>:non-pointer</code> and <code>:other</code>.</p> <p>An integer in the inclusive range [0,7], or <code>nil</code>.</p> <p>A function designator.</p> <p>The arguments passed to <code>func</code>.</p> |
| Values      | <code>results</code>                                                                                                                                        | The values returned from the call to <code>func</code> with <code>args</code> .                                                                                                                                                                                                                      |
| Description | The function <code>apply-with-allocation-in-gen-num</code> applies the function <code>func</code> to <code>args</code> such that objects of allocation type |                                                                                                                                                                                                                                                                                                      |

*what* are allocated in generation *gen-num*, in 64-bit LispWorks.

See also the keyword :**allocation** to **make-array**, which catches the most common cases.

It is probably quite rare that it is useful to use this function, unless the function allocates a lot, and you are certain that every object that is allocated of the allocation type is long-lived, which is normally difficult to tell.

Notes

1. Allocation of interned symbols is controlled separately by **\*symbol-alloc-gen-num\***.
2. In 32-bit LispWorks the argument *what* is ignored and the effect is like that of the macro **allocation-in-gen-num**.
3. In the Mobile GC, *gen-num* must be 0, 1 or 2.

See also

**allocation-in-gen-num**  
**make-array**  
**\*symbol-alloc-gen-num\***

## approaching-memory-limit

*Condition*

Summary

The class of conditions signalled when 32-bit LispWorks approaches its memory limit.

Package

**system**

Superclasses

**storage-condition**

Subclasses

None.

Description

The condition class **approaching-memory-limit** is used for signalling an error when 32-bit LispWorks approaches its memory limit.

|          |                                                                                                  |
|----------|--------------------------------------------------------------------------------------------------|
| Notes    | <code>approaching-memory-limit</code> is not relevant to 64-bit Lisp-Works.                      |
| See also | “Approaching the memory limit” on page 142<br><code>set-approaching-memory-limit-callback</code> |

**atomic-decf****atomic-incf***Macros*

|             |                                                                                                                                                                                                                                                                                                                                |                                                                            |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|
| Summary     | Like <code>incf</code> and <code>decf</code> , but does the operation atomically.                                                                                                                                                                                                                                              |                                                                            |
| Package     | <code>system</code>                                                                                                                                                                                                                                                                                                            |                                                                            |
| Signatures  | <code>atomic-decf place &amp;optional delta =&gt; new-value</code><br><code>atomic-incf place &amp;optional delta =&gt; new-value</code>                                                                                                                                                                                       |                                                                            |
| Arguments   | <code>place</code>                                                                                                                                                                                                                                                                                                             | One of the specific set of places defined for low level atomic operations. |
|             | <code>delta</code>                                                                                                                                                                                                                                                                                                             | A number, default value 1.                                                 |
| Values      | <code>new-value</code>                                                                                                                                                                                                                                                                                                         | A number                                                                   |
| Description | <p>The macro <code>atomic-decf</code> is like <code>decf</code> and <code>atomic-incf</code> is like <code>incf</code>, except that they are guaranteed atomic for a suitable place.</p> <p><code>place</code> must be one of the places described in “Low level atomic operations” on page 299, or expand to one of them.</p> |                                                                            |
| Notes       | Unlike <code>atomic-fixnum-decf</code> and <code>atomic-fixnum-incf</code> , these macros can deal with any number.                                                                                                                                                                                                            |                                                                            |
| See also    | <code>atomic-fixnum-decf</code><br><code>atomic-fixnum-incf</code><br><code>low-level-atomic-place-p</code>                                                                                                                                                                                                                    |                                                                            |

## **atomic-exchange** *Macro*

|             |                                                                                                                                                                                                                                                                                                               |                                                                            |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|
| Summary     | Atomically exchange a place value with a new value, returning the old value.                                                                                                                                                                                                                                  |                                                                            |
| Package     | <code>system</code>                                                                                                                                                                                                                                                                                           |                                                                            |
| Signature   | <code>atomic-exchange place new-value =&gt; old-value</code>                                                                                                                                                                                                                                                  |                                                                            |
| Arguments   | <i>place</i>                                                                                                                                                                                                                                                                                                  | One of the specific set of places defined for low level atomic operations. |
|             | <i>new-value</i>                                                                                                                                                                                                                                                                                              | An object.                                                                 |
| Values      | <i>old-value</i>                                                                                                                                                                                                                                                                                              | An object.                                                                 |
| Description | The macro <code>atomic-exchange</code> exchanges the value in <i>place</i> with <i>new-value</i> , returning the <i>old-value</i> . The operation is guaranteed to be atomic.<br><br><i>place</i> must be one of the places described in “Low level atomic operations” on page 299, or expand to one of them. |                                                                            |
| See also    | <code>compare-and-swap</code><br><code>low-level-atomic-place-p</code>                                                                                                                                                                                                                                        |                                                                            |

## **atomic-fixnum-decf**

## **atomic-fixnum-incf**

*Macros*

|           |                                                                                                                                                                      |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary   | Like <code>decf</code> and <code>incf</code> , but does the operation atomically.                                                                                    |
| Package   | <code>system</code>                                                                                                                                                  |
| Signature | <code>atomic-fixnum-decf place &amp;optional fixnum-delta =&gt; new-value</code><br><code>atomic-fixnum-incf place &amp;optional fixnum-delta =&gt; new-value</code> |

|             |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arguments   | <i>place</i>        | One of the specific set of places defined for low level atomic operations.                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|             | <i>fixnum-delta</i> | A fixnum, default value 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Values      | <i>new-value</i>    | A fixnum.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Description |                     | The macro <code>atomic-fixnum-decf</code> is like <code>decf</code> (for fixnums only) and <code>atomic-fixnum-incf</code> is like <code>incf</code> (for fixnums only), except that they are guaranteed atomic for a suitable place.<br><br><i>place</i> must be one of the places described in “Low level atomic operations” on page 299, or expand to one of them.<br><br>Both the value in the <i>place</i> and <i>fixnum-delta</i> must be fixnums. The arithmetic is done without checking for overflow. |
| See also    |                     | <code>atomic-decf</code><br><code>atomic-incf</code><br><code>low-level-atomic-place-p</code>                                                                                                                                                                                                                                                                                                                                                                                                                  |

|             |                | <i>Macro</i>                                                                                                          |
|-------------|----------------|-----------------------------------------------------------------------------------------------------------------------|
| Summary     |                | Like <code>pop</code> , but does the operation atomically.                                                            |
| Package     |                | <code>system</code>                                                                                                   |
| Signature   |                | <code>atomic-pop place =&gt; element</code>                                                                           |
| Arguments   | <i>place</i>   | One of the specific set of places defined for low level atomic operations.                                            |
| Values      | <i>element</i> | An object.                                                                                                            |
| Description |                | The macro <code>atomic-pop</code> is the same as <code>c1:pop</code> , but is guaranteed atomic for a suitable place. |

*place* must be one of the places described in “Low level atomic operations” on page 299, or expand to one of them.

See also      **atomic-push**  
                 **low-level-atomic-place-p**

## **atomic-push** *Macro*

|             |                                                                                                                                                                                                                                             |                                                                            |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|
| Summary     | Like <b>push</b> , but does the operation atomically.                                                                                                                                                                                       |                                                                            |
| Package     | <b>system</b>                                                                                                                                                                                                                               |                                                                            |
| Signature   | <b>atomic-push</b> <i>new-value place</i> => <i>new-place-value</i>                                                                                                                                                                         |                                                                            |
| Arguments   | <i>new-value</i>                                                                                                                                                                                                                            | An object.                                                                 |
|             | <i>place</i>                                                                                                                                                                                                                                | One of the specific set of places defined for low level atomic operations. |
| Values      | <i>new-place-value</i>                                                                                                                                                                                                                      | A list (the new value of place).                                           |
| Description | The macro <b>atomic-push</b> is the same as <b>c1:push</b> , but is guaranteed atomic for a suitable place.<br><br><i>place</i> must be one of the places described in “Low level atomic operations” on page 299, or expand to one of them. |                                                                            |
| Notes       | In many cases the natural inverse of <b>push</b> is <b>delete</b> , but there is no way to do <b>delete</b> atomically, except by using a separate <b>lock</b> , which must also be held while doing the <b>push</b> .                      |                                                                            |
| See also    | <b>atomic-pop</b><br><b>low-level-atomic-place-p</b>                                                                                                                                                                                        |                                                                            |

**augmented-string****simple-augmented-string***Types*

|             |                                                                                                                                                                             |                                               |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|
| Summary     | Deprecated synonyms for <code>text-string</code> and <code>simple-text-string</code> .                                                                                      |                                               |
| Package     | <code>system</code>                                                                                                                                                         |                                               |
| Signature   | <code>augmented-string length</code>                                                                                                                                        |                                               |
|             | <code>simple-augmented-string length</code>                                                                                                                                 |                                               |
| Arguments   | <code>length</code>                                                                                                                                                         | The length of the string (or *, meaning any). |
| Description | The types <code>augmented-string</code> and <code>simple-augmented-string</code> are deprecated synonyms for <code>text-string</code> and <code>simple-text-string</code> . |                                               |
| See also    | <code>text-string</code><br><code>simple-text-string</code>                                                                                                                 |                                               |

**augmented-string-p****simple-augmented-string-p***Functions*

|           |                                                                                            |                |
|-----------|--------------------------------------------------------------------------------------------|----------------|
| Summary   | Deprecated synonyms for <code>text-string-p</code> and <code>simple-text-string-p</code> . |                |
| Package   | <code>system</code>                                                                        |                |
| Signature | <code>augmented-string-p object =&gt; result</code>                                        |                |
|           | <code>simple-augmented-string-p object =&gt; result</code>                                 |                |
| Arguments | <code>object</code>                                                                        | A Lisp object. |
| Values    | <code>result</code>                                                                        | A boolean.     |

|             |                                                                                                                                                                                         |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | The functions <code>augmented-string-p</code> and <code>simple-augmented-string-p</code> are deprecated synonyms for <code>text-string-p</code> and <code>simple-text-string-p</code> . |
| See also    | <code>text-string-p</code><br><code>simple-text-string-p</code>                                                                                                                         |

## \*binary-file-type\* *Variable*

|               |                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary       | The default file type of binary files.                                                                                                                                                                                                                                                                                                                                                                         |
| Package       | <code>system</code>                                                                                                                                                                                                                                                                                                                                                                                            |
| Initial value | The initial value of <code>*binary-file-type*</code> depends on the host CPU and the LispWorks implementation. See “Naming conventions for FASL files” on page 648.                                                                                                                                                                                                                                            |
| Description   | <p>The variable <code>*binary-file-type*</code> is the file type that <code>load</code> and <code>require</code> recognize as a binary (FASL) file (in addition to any additional file types in <code>*binary-file-types*</code>).</p> <p>Normally you should not set <code>*binary-file-type*</code>. If you need to load files with another type, push that type on to <code>*binary-file-types*</code>.</p> |
| See also      | <code>*binary-file-types*</code><br><code>load-data-file</code>                                                                                                                                                                                                                                                                                                                                                |

## \*binary-file-types\* *Variable*

|               |                                                       |
|---------------|-------------------------------------------------------|
| Summary       | A list of file types that are loaded as binary files. |
| Package       | <code>system</code>                                   |
| Initial value | <code>nil</code>                                      |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The variable <b>*binary-file-types*</b> contains a list of strings naming file types which <b>load</b> and <b>require</b> recognize as binary (FASL) files. FASL files are the output of <b>compile-file</b>, <b>dump-forms-to-file</b> or <b>with-output-to-fasl-file</b>.</p> <p>You need to add a type to this list if you want load such files but they have an extension which is different from the default (the value of <b>*binary-file-type*</b>).</p> |
| See also    | <b>*binary-file-type*</b>                                                                                                                                                                                                                                                                                                                                                                                                                                          |

|                    |                                                                                                                                                                                                                                                               | <i>Function</i> |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>call-system</b> |                                                                                                                                                                                                                                                               |                 |
| Package            | <b>system</b>                                                                                                                                                                                                                                                 |                 |
| Signature          | <b>call-system</b> <i>command</i> & <b>key</b> <i>current-directory</i> <i>wait</i> <i>shell-type</i> => <i>status</i> , <i>signal-number</i>                                                                                                                 |                 |
| Arguments          | <p><i>command</i> A string, a list of strings, a simple-vector of strings, or <b>nil</b>.</p> <p><i>current-directory</i> A string. Implemented only on Microsoft Windows.</p> <p><i>wait</i> A boolean.</p> <p><i>shell-type</i> A string or <b>nil</b>.</p> |                 |
| Values             | <p><i>status</i> The exit status of the invoked shell or process.</p> <p><i>signal-number</i> On Unix-like systems, if the process was terminated by a signal this is the signal number, otherwise <b>nil</b>. Always <b>nil</b> on Microsoft Windows.</p>    |                 |
| Description        | <b>call-system</b> allows executables and DOS or Unix shell commands to be called from Lisp code as a separate OS process.                                                                                                                                    |                 |

The output goes to standard output, as the operating system sees it. (This normally means `*terminal-io*` in LispWorks.)

If *command* is a string then it is passed to the shell as the command to run, using the `-c` option, without any other arguments. The type of shell to run is determined by *shell-type* as described below. Note that for typical Unix shells, the string *command* may contain multiple commands separated by `:` (semicolon).

If *command* is a list then it becomes the argv of a command to run directly, without invoking a shell. The first element is the command to run directly and the other elements are passed as arguments on the command line (that is, element 0 has its name in `argv[0]` in C, and so on).

If *command* is a simple vector of strings, the element at index 0 is the command to run directly, without invoking a shell. The other elements are the complete set of arguments seen by the command (that is, element 1 becomes `argv[0]` in C, and so on).

If *command* is `nil`, then the shell is run.

On Microsoft Windows, if *command* is a string, LispWorks hides the first window of the execution of the command, because that is the console that `cmd.exe` starts in a DOS window. If the command itself is a console application, you may want to see the console. In this case run the command as a direct command. To do this, pass a list or a vector as described above. Conversely, if you run a console application and do not want to see the console, pass the command as a string.

On Microsoft Windows *current-directory* is the `lpCurrentDirectory` argument passed to `CreateProcess`. If this is not supplied, the `pathname-location` of the `current-pathname` is passed.

If *wait* is true, `call-system` does not return until the process has exited. The default for *wait* is `t`.

On non-Windows platforms, if *shell-type* is a string it specifies the shell. If *shell-type* is `nil` (the default) then the Bourne shell, `/bin/sh`, is used. The C shell may be obtained by passing `"/bin/csh"`.

On supported versions of Microsoft Windows if *shell-type* is `nil` then `cmd.exe` is used.

`call-system` returns the exit status of the process it created. Additionally on Unix-like systems if the process was terminated by a signal then `call-system` returns the number of that signal. For a discussion of these return values see “Interpreting the exit status” on page 462.

|                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes               | If you need to be able to check whether the child process is alive and maybe to kill it, use <code>open-pipe</code> with <code>:save-exit-status t</code> (and maybe <code>:direction :none</code> ) instead of <code>call-system</code> , and then use <code>pipe-exit-status</code> and maybe <code>pipe-kill-process</code> .                                                                                                                                                                                                                                                        |
| Compatibility notes | <ol style="list-style-type: none"> <li>1. The argument <code>:shell-type</code> is not implemented in LispWorks for Windows 4.4 and earlier, and <code>cmd.exe</code> is not used implicitly.</li> <li>2. On Microsoft Windows, LispWorks 5.0 and later use <i>shell-type</i> <code>cmd.exe</code> by default when <i>command</i> is a string. In LispWorks 5.x the user may see a DOS command window in this case, but LispWorks 6.0 and later explicitly hide the DOS window. To call your command directly <i>command</i> should be a list, as in the last example below.</li> </ol> |
| Example             | <p>On Unix:</p> <pre>(call-system (format nil "adb ~a &lt; ~a &gt; ~a"                       (namestring a)                       (namestring b)                       (namestring c)))</pre> <p>On Microsoft Windows:</p>                                                                                                                                                                                                                                                                                                                                                              |

```
(sys:call-system "sleep 3" :wait t)

(sys:call-system '("notepad" "myfile.txt"))
```

See also [open-pipe](#)  
[call-system-showing-output](#)  
[run-shell-command](#)  
“Interpreting the exit status” on page 462

## call-system-showing-output

## Function

Package `system`

Signature `call-system-showing-output command &key current-directory  
prefix show-cmd output-stream wait shell-type kill-process-on-abort  
=> status`

Arguments `command` A string, a list of strings, a simple-vector of strings, or `nil`.

`current-directory` A string. Supported only on Microsoft Windows.

`prefix` A string.

`show-cmd` A boolean.

`output-stream` An output stream or `nil`, `t` or `:tty`.

`wait` A boolean.

`shell-type` A string. Supported only on non-Windows platforms.

`kill-process-on-abort`

A generalized boolean.

Values `status` The exit status of the invoked shell or process.

| Description | <code>call-system-showing-output</code> is an extension to <code>call-system</code> which allows output to be redirected. On non-Windows platforms this means it can be redirected to places other than the shell process from which the LispWorks image was invoked. <code>call-system-showing-output</code> therefore allows the user to, for example, invoke a shell command and redirect the output to the current Listener window.<br><br>The argument <i>command</i> is interpreted as by <code>call-system</code> . On Microsoft Windows there is one difference: when <i>command</i> is a list or vector and the executable (that is, the first element of the sequence <i>command</i> ) in <code>call-system-showing-output</code> is not a GUI application, LispWorks hides the first window, which is the console that the executable will normally open. Note that for a non-direct command (that is, a string) LispWorks always hides the first window (which is the console) in both <code>call-system</code> and <code>call-system-showing-output</code> .<br><br><i>prefix</i> is a prefix to be printed at the start of any output line. The default value is " ; ".<br><br><i>show-cmd</i> specifies whether or not the <i>cmd</i> invoked will be printed as well as the output for that command. If <i>t</i> then <i>cmd</i> will be printed. The default value for <i>show-cmd</i> is <i>t</i> .<br><br><i>output-stream</i> specifies where the output will be sent to. If <i>output-stream</i> is an output stream, the output is written to it. If <i>output-stream</i> is <i>t</i> , the output is written to <code>*standard-output*</code> . If <i>output-stream</i> is <i>nil</i> , the output is collected as a string, and returned as a second value from <code>call-system-showing-output</code> . If <i>output-stream</i> is <code>:tty</code> , <code>call-system-showing-output</code> behaves like <code>call-system</code> . The default value is <code>*standard-output*</code> .<br><br>If <i>wait</i> is true, <code>call-system-showing-output</code> does not return until the process has exited. If <i>nil</i> , <code>call-system-showing-output</code> returns immediately and no output is shown. The default for <i>wait</i> is <i>t</i> . |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

*shell-type* is a string naming a UNIX shell. The default is "/bin/sh".

If *kill-process-on-abort* is true, then when **call-system-showing-output** is aborted the process is killed. The default value of *kill-process-on-abort* is nil.

**call-system-showing-output** returns the exit status of the shell invoked to execute the command on non-Windows platforms, or the process created on Microsoft Windows.

## Examples

### On Linux:

```
CL-USER 1 > (sys:call-system-showing-output "pwd"
  :prefix "***")
***pwd
***/amd/xanfs1-cam/u/ldisk/sp/lispsrc/v42/builds
0
```

```
CL-USER 2 > (sys:call-system-showing-output "pwd"
  :prefix "&&" :show-cmd nil)
&&/amd/xanfs1-cam/u/ldisk/sp/lispsrc/v42/builds
0
```

### On Microsoft Windows:

```
CL-USER 223 > (sys:call-system-showing-output
  "cmd /c type hello.txt"
  :prefix "***")
***cmd /c type hello.txt
***Hi there
0
```

```
CL-USER 224 > (sys:call-system-showing-output
  "cmd /c type hello.txt"
  :prefix "&&"
  :show-cmd nil)
&&Hi there
0
```

## See also

**call-system**  
**openpipe**  
**run-shell-command**

| cdr-assoc       | Accessor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |             |            |              |                      |             |                        |                 |                        |            |                        |              |                                              |              |            |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|------------|--------------|----------------------|-------------|------------------------|-----------------|------------------------|------------|------------------------|--------------|----------------------------------------------|--------------|------------|
| Summary         | A generalized reference for alist elements.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |            |              |                      |             |                        |                 |                        |            |                        |              |                                              |              |            |
| Package         | <code>system</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |            |              |                      |             |                        |                 |                        |            |                        |              |                                              |              |            |
| Signature       | $\text{cdr-assoc } \textit{item} \text{ } \textit{alist} \&\text{key } \textit{test} \text{ } \textit{test-not} \text{ } \textit{key} \Rightarrow \textit{result}$<br>$\text{setf } (\text{cdr-assoc } \textit{item} \text{ } \textit{place} \&\text{key } \textit{test} \text{ } \textit{test-not} \text{ } \textit{key}) \text{ } \textit{value} \Rightarrow \textit{value}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |            |              |                      |             |                        |                 |                        |            |                        |              |                                              |              |            |
| Arguments       | <table> <tr> <td><i>item</i></td><td>An object.</td></tr> <tr> <td><i>alist</i></td><td>An association list.</td></tr> <tr> <td><i>test</i></td><td>A function designator.</td></tr> <tr> <td><i>test-not</i></td><td>A function designator.</td></tr> <tr> <td><i>key</i></td><td>A function designator.</td></tr> <tr> <td><i>place</i></td><td>A setf place containing an association list.</td></tr> <tr> <td><i>value</i></td><td>An object.</td></tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <i>item</i> | An object. | <i>alist</i> | An association list. | <i>test</i> | A function designator. | <i>test-not</i> | A function designator. | <i>key</i> | A function designator. | <i>place</i> | A setf place containing an association list. | <i>value</i> | An object. |
| <i>item</i>     | An object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |            |              |                      |             |                        |                 |                        |            |                        |              |                                              |              |            |
| <i>alist</i>    | An association list.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |            |              |                      |             |                        |                 |                        |            |                        |              |                                              |              |            |
| <i>test</i>     | A function designator.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |            |              |                      |             |                        |                 |                        |            |                        |              |                                              |              |            |
| <i>test-not</i> | A function designator.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |            |              |                      |             |                        |                 |                        |            |                        |              |                                              |              |            |
| <i>key</i>      | A function designator.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |            |              |                      |             |                        |                 |                        |            |                        |              |                                              |              |            |
| <i>place</i>    | A setf place containing an association list.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |            |              |                      |             |                        |                 |                        |            |                        |              |                                              |              |            |
| <i>value</i>    | An object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |            |              |                      |             |                        |                 |                        |            |                        |              |                                              |              |            |
| Values          | <i>result</i> An object (from <i>alist</i> ) or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |            |              |                      |             |                        |                 |                        |            |                        |              |                                              |              |            |
| Description     | <p>The accessor <code>cdr-assoc</code> provides a generalized reference for elements in an association list. The arguments are all as specified for the Common Lisp function <code>assoc</code>. <code>cdr-assoc</code> and its setf expander read and write the <code>cdr</code> of an element in a manner consistent with the Common Lisp notion of places.</p> <p><code>cdr-assoc</code> returns the <code>cdr</code> of the first cons in the alist <i>alist</i> that matches <i>item</i> (tested using <i>test</i>, <i>test-not</i> and <i>key</i> as for <code>assoc</code>), or <code>nil</code> if no element of <i>alist</i> matches.</p> <p>Using <code>cdr-assoc</code> with <code>setf</code> modifies the first cons in the value of <i>place</i> that matches <i>item</i>, setting its <code>cdr</code> to <i>value</i>. If no element matches, then it pushes the value of <code>(cons item value)</code> onto the value of <i>place</i> and sets <i>place</i> to this new alist. This is similar to how <code>cl:getf</code> is defined.</p> |             |            |              |                      |             |                        |                 |                        |            |                        |              |                                              |              |            |

When *place* is a globally accessible place that may be read by another thread without synchronization (by a lock or other synchronization mechanism), you need to wrap *alist* by `globally-accessible`. See “Making an object’s contents accessible to other threads” on page 268 for a discussion.

#### Example

```
CL-USER 1 > (defvar *my-alist*
  (list (cons :foo 1)
        (cons :bar 2)))
*MY-ALIST*

CL-USER 2 > (setf (sys:cdr-assoc :bar
  *my-alist*) 3)
3

CL-USER 3 > *my-alist*
((:FOO . 1) (:BAR . 3))
```

### \*check-network-server\*

### Variable

#### Summary

Indicates the presence of a network license.

**Note:** LispWorks for UNIX only.

#### Package

`system`

#### Description

This should always be set to `t` for a site (that is, network) license — the licensing mechanism does not work in any other circumstances. Do not set the variable otherwise, as it overrides any useful diagnostics which may accompany keyfile errors. Not applicable to LispWorks for Linux, Windows, x86/x64 Solaris, FreeBSD, AIX or Macintosh.

### coerce-to-gesture-spec

### Function

#### Summary

Returns a Gesture Spec object.

#### Package

`system`

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                               |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|
| Signature   | <code>coerce-to-gesture-spec object &amp;optional errorp =&gt; gspec</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                               |
| Arguments   | <i>object</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | A character, keyword, Gesture Spec or string. |
|             | <i>errorp</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | A boolean.                                    |
| Values      | <i>gspec</i> A Gesture Spec object                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                               |
| Description | <p>The function <code>coerce-to-gesture-spec</code> returns a Gesture Spec object <i>gspec</i> which can be used to represent the key-stroke indicated by <i>object</i>.</p> <p>If <i>object</i> is a Lisp character, then <i>gspec</i>'s data is its <code>c1:char-code</code> and <i>gspec</i>'s modifiers are 0.</p> <p>If <i>object</i> is a keyword, then it must be one of the known Gesture Spec keywords and becomes <i>gspec</i>'s data. <i>gspec</i>'s modifiers is 0.</p> <p>If <i>object</i> is a string, then <code>coerce-to-gesture-spec</code> expects it to be a sequence of modifier key names separated by the - character, followed by a single character or a character name as returned by <code>name-char</code> or the name of one of the known Gesture Spec keywords. Then <i>gspec</i> contains the corresponding Gesture Spec keyword or <code>char-code</code> in its <i>data</i>, and the modifier keys are represented in its <i>modifiers</i>.</p> <p>If <i>object</i> is a Gesture Spec object, it is simply returned.</p> <p><code>coerce-to-gesture-spec</code> does not create wild gesture specs.</p> |                                               |

|          |                                                                                                                                                                                                                                                                                                  |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Examples | <pre>(sys:coerce-to-gesture-spec :F10) =&gt; #S(SYSTEM::GESTURE-SPEC :DATA :F10 :MODIFIERS 0)  (sys:coerce-to-gesture-spec "Ctrl-C") =&gt; #S(SYSTEM::GESTURE-SPEC :DATA 67 :MODIFIERS 2)  (sys:coerce-to-gesture-spec "Shift-F10") =&gt; #S(SYSTEM::GESTURE-SPEC :DATA :F10 :MODIFIERS 1)</pre> |
| See also | <a href="#">gesture-spec-control-bit</a><br><a href="#">gesture-spec-data</a><br><a href="#">gesture-spec-modifiers</a><br><a href="#">gesture-spec-p</a><br><a href="#">gesture-spec-to-character</a><br><a href="#">make-gesture-spec</a><br><a href="#">print-pretty-gesture-spec</a>         |

## compare-and-swap *Macro*

|           |                                                                    |                                                                            |
|-----------|--------------------------------------------------------------------|----------------------------------------------------------------------------|
| Summary   | Performs a conditional store, atomically.                          |                                                                            |
| Package   | <code>system</code>                                                |                                                                            |
| Signature | <code>compare-and-swap place compare new-value =&gt; result</code> |                                                                            |
| Arguments | <code>place</code>                                                 | One of the specific set of places defined for low level atomic operations. |
|           | <code>compare</code>                                               | An object.                                                                 |
|           | <code>new-value</code>                                             | An object.                                                                 |
| Values    | <code>result</code>                                                | A boolean.                                                                 |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The macro <code>compare-and-swap</code> compares the value in <i>place</i> with <i>compare</i>, and if they are the same (by <code>eq</code>), stores the <i>new-value</i> in <i>place</i>.</p> <p><code>compare-and-swap</code> returns non-nil if the store occurred, or <code>nil</code> if the store did not occur.</p> <p><i>place</i> must be one of the places described in “Low level atomic operations” on page 299, or expand to one of them.</p> <p>The operation is guaranteed to be atomic.</p> |
| See also    | <code>atomic-exchange</code><br><code>low-level-atomic-place-p</code>                                                                                                                                                                                                                                                                                                                                                                                                                                           |

|                                            | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                 |                    |                 |                    |                  |           |
|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------------------|-----------------|--------------------|------------------|-----------|
| <b>copy-preferences-from-older-version</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                 |                    |                 |                    |                  |           |
| Summary                                    | Copies uses preferences.                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                 |                    |                 |                    |                  |           |
| Package                                    | <code>system</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                    |                 |                    |                  |           |
| Signature                                  | <code>copy-preferences-from-older-version old-path new-path &amp;optional flag-name</code>                                                                                                                                                                                                                                                                                                                                                                                                      |                 |                    |                 |                    |                  |           |
| Arguments                                  | <table> <tr> <td><i>old-path</i></td><td>A preference path.</td></tr> <tr> <td><i>new-path</i></td><td>A preference path.</td></tr> <tr> <td><i>flag-name</i></td><td>A string.</td></tr> </table>                                                                                                                                                                                                                                                                                              | <i>old-path</i> | A preference path. | <i>new-path</i> | A preference path. | <i>flag-name</i> | A string. |
| <i>old-path</i>                            | A preference path.                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                 |                    |                 |                    |                  |           |
| <i>new-path</i>                            | A preference path.                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                 |                    |                 |                    |                  |           |
| <i>flag-name</i>                           | A string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                 |                    |                 |                    |                  |           |
| Description                                | <p>The function <code>copy-preferences-from-older-version</code> copies uses preferences from one part of the registry to another.</p> <p><i>old-path</i> and <i>new-path</i> are the paths of preferences for the old and the new version, corresponding to the paths that were passed to <code>(setf product-registry-path)</code>.</p> <p><i>flag-name</i> is a name of the flag to use to record in the registry that the copy is already done. <i>flag-name</i> must be a valid regis-</p> |                 |                    |                 |                    |                  |           |

try value name on Microsoft Windows, and a valid filename on all other platforms. The default value of *flag-name* is the string "copied-old-preferences".

`copy-preferences-from-older-version` performs several checks:

1. It checks whether it already copied to *new-path* in the current session, and if so does nothing.
  2. It checks whether the *flag-name* entry exists, and if so it does nothing.
  3. It checks whether another call to `copy-preferences-from-older-version` is already executing (in another thread), and if so it just waits for the other call to finish.

Then if all the checks above indicate that copying is still needed, `copy-preferences-from-older-version` copies the values from the tree below `old-path` to a tree below `new-path`. It traverses the entire tree below `old-path`, and checks each key to see if it has any values.

For a key that has values, it checks whether the key exists under *new-path*, and if the key exists it does not copy any of the values for this key, though it still traverses and maybe copies its subkeys. If the key does not exist under *new-path*, it creates the key and copies the values.

Because it makes checks before doing any work, `copy-preferences-from-older-version` is an inexpensive call that can be used freely.

| See also                        | <a href="#">product-registry-path</a><br><a href="#">user-preference</a>  |
|---------------------------------|---------------------------------------------------------------------------|
| <b>count-gen-num-allocation</b> | <i>Function</i>                                                           |
| Summary                         | Returns the amount of allocated data in a generation in 64-bit LispWorks. |

|             |                                                                                                                                                                                                                                                                                                                    |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>system</code>                                                                                                                                                                                                                                                                                                |
| Signature   | <code>count-gen-num-allocation gen-num &amp;optional include-lower-generations</code>                                                                                                                                                                                                                              |
| Arguments   | <p><i>gen-num</i> An integer between 0 and 7, inclusive.</p> <p><i>include-lower-generations</i> A generalized boolean.</p>                                                                                                                                                                                        |
| Values      | <i>allocation</i> An integer.                                                                                                                                                                                                                                                                                      |
| Description | The function <code>count-gen-num-allocation</code> returns the amount of allocated data in generation <i>gen-num</i> . If <i>include-lower-generations</i> is non-nil, the returned value <i>allocation</i> also includes the data in the younger generations.                                                     |
| Notes       | <p><code>count-gen-num-allocation</code> is implemented only in 64-bit LispWorks. It is not relevant to the Memory Management API in 32-bit implementations, where you can use <code>room-values</code> instead.</p> <p>On the Mobile GC, the <i>gen-num</i> argument can be 0, 1, 2 or 3 (3 means permanent).</p> |
| See also    | <code>room-values</code>                                                                                                                                                                                                                                                                                           |

|                                                   |                                                                                                                           |
|---------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| <b>*debug-initialization-errors-in-snap-shot*</b> | <i>Variable</i>                                                                                                           |
| Summary                                           | Controls use of the snapshot debugger.                                                                                    |
| Package                                           | <code>system</code>                                                                                                       |
| Initial value                                     | <code>t</code>                                                                                                            |
| Description                                       | The variable <code>*debug-initialization-errors-in-snap-shot*</code> controls whether, in an image which is configured to |

start the LispWorks IDE automatically, an error during initialization is handled and displayed in a snapshot debugger after the IDE starts.

If the value of `*debug-initialization-errors-in-snapshot*` is `nil` LispWorks behaves like LispWorks 5.0 and previous versions. That is, it attempts to enter the command line debugger.

|                 | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                 |                 |                                                  |                |                          |               |                                       |               |                                                                   |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------------------------------------------------|----------------|--------------------------|---------------|---------------------------------------|---------------|-------------------------------------------------------------------|
| Summary         | Provides a default end of line style for a file.                                                                                                                                                                                                                                                                                                                |                 |                                                  |                |                          |               |                                       |               |                                                                   |
| Package         | <code>system</code>                                                                                                                                                                                                                                                                                                                                             |                 |                                                  |                |                          |               |                                       |               |                                                                   |
| Signature       | <code>default-eol-style pathname ef-spec buffer length =&gt; new-ef-spec</code>                                                                                                                                                                                                                                                                                 |                 |                                                  |                |                          |               |                                       |               |                                                                   |
| Arguments       | <table><tr><td><i>pathname</i></td><td>Pathname identifying location of <i>buffer</i>.</td></tr><tr><td><i>ef-spec</i></td><td>An external format spec.</td></tr><tr><td><i>buffer</i></td><td>A buffer whose contents are examined.</td></tr><tr><td><i>length</i></td><td>Length (an integer) up to which <i>buffer</i> should be examined.</td></tr></table> | <i>pathname</i> | Pathname identifying location of <i>buffer</i> . | <i>ef-spec</i> | An external format spec. | <i>buffer</i> | A buffer whose contents are examined. | <i>length</i> | Length (an integer) up to which <i>buffer</i> should be examined. |
| <i>pathname</i> | Pathname identifying location of <i>buffer</i> .                                                                                                                                                                                                                                                                                                                |                 |                                                  |                |                          |               |                                       |               |                                                                   |
| <i>ef-spec</i>  | An external format spec.                                                                                                                                                                                                                                                                                                                                        |                 |                                                  |                |                          |               |                                       |               |                                                                   |
| <i>buffer</i>   | A buffer whose contents are examined.                                                                                                                                                                                                                                                                                                                           |                 |                                                  |                |                          |               |                                       |               |                                                                   |
| <i>length</i>   | Length (an integer) up to which <i>buffer</i> should be examined.                                                                                                                                                                                                                                                                                               |                 |                                                  |                |                          |               |                                       |               |                                                                   |
| Values          | <i>new-ef-spec</i> A new external format spec created by merging <i>ef-spec</i> with the encoding that was found.                                                                                                                                                                                                                                               |                 |                                                  |                |                          |               |                                       |               |                                                                   |
| Description     | Merge <i>ef-spec</i> with <code>(:default :eol-style :crlf)</code> on Microsoft Windows, <code>(:default :eol-style :lf)</code> on non-Windows platforms. This is usually used as the last function on its list.                                                                                                                                                |                 |                                                  |                |                          |               |                                       |               |                                                                   |
| See also        | <code>*file-eol-style-detection-algorithm*</code>                                                                                                                                                                                                                                                                                                               |                 |                                                  |                |                          |               |                                       |               |                                                                   |

| <b>*default-stack-group-list-length*</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <i>Variable</i> |
|------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Summary                                  | The size of the stack cache.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |
| Package                                  | <code>system</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                 |
| Initial value                            | 10                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                 |
| Description                              | This variable determines the maximum size of the stack cache.<br><br>Process stacks are cached and reused. When a process dies, its stack is put in the stack cache for future reuse if there are currently less than <b>*default-stack-group-list-length*</b> stacks in the cache. Therefore if your application repeatedly creates and discards more than 10 processes you should consider increasing the value of this variable.<br><br>Note that stacks are allocated in generation 2, hence a program with a high turnover of processes may need to call <code>(gc-generation t)</code> periodically unless all the stacks of dead processes are reused. |                 |
|                                          | The default stack size is 64 KB on all 32-bit LispWorks x86 platforms.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                 |
| See also                                 | <code>mark-and-sweep</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                 |

| <b>define-atomic-modify-macro</b> |                                                                                                       | <i>Macro</i> |
|-----------------------------------|-------------------------------------------------------------------------------------------------------|--------------|
| Summary                           | An atomic version of <code>define-modify-macro</code> .                                               |              |
| Package                           | <code>system</code>                                                                                   |              |
| Signature                         | <code>define-atomic-modify-macro name lambda-list function &amp;optional doc-string =&gt; name</code> |              |
| Arguments                         | <code>name</code>                                                                                     | A symbol.    |

|             |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <i>lambda-list</i> | A <code>define-modify-macro</code> lambda list.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|             | <i>function</i>    | A symbol.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|             | <i>doc-string</i>  | A string, not evaluated.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Values      | <i>name</i>        | A symbol.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Description |                    | <p>The macro <code>define-atomic-modify-macro</code> has the same syntax as <code>cl:define-modify-macro</code>, and performs a similar operation.</p> <p>The resulting macro <i>name</i> can be used only on one of the specific set of places defined for low level atomic operations as listed in “Low level atomic operations” on page 299. The macro <i>name</i> reads the value of the <i>place</i>, calls the function <i>function</i>, and then writes the result of the function call if the value in <i>place</i> has not changed since it was first read. If that value did change, the operation is repeated until it succeeds.</p> <p>Note that this means:</p> <ol style="list-style-type: none"> <li>1. The function <i>function</i> may be called more than once for each invocation of the defined macro. Therefore <i>function</i> should not have any side effects.</li> <li>2. <i>function</i> must be thread-safe, because it may run concurrently in several threads if the defined macro <i>name</i> is used from several threads simultaneously.</li> <li>3. It is possible in principle for the value to change more than once between reading the <i>place</i> and writing the new value. This may end up resetting the value in <i>place</i> to its original value, and hence the operation will succeed. This is equivalent to the code being invoked after the last change, unless <i>function</i> itself looks at <i>place</i>, which may cause inconsistent results.</li> </ol> |
| See also    |                    | <code>low-level-atomic-place-p</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

|             | <b>define-top-loop-command</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <i>Macro</i>                                                                                                                                                                                     |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Defines a top level loop command.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                  |
| Package     | <code>system</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                  |
| Signature   | $\text{define-top-loop-command } \textit{name-and-options} \textit{lambda-list} \textit{form}^*$ $\textit{name-and-options} ::= \textit{name}$ $  (\textit{name} \textit{option}^*)$ $\textit{option} ::= (:aliases \textit{alias}^*)$ $  (:result-type \textit{result-type})$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                  |
| Arguments   | $\textit{name}$ $\textit{alias}$ $\textit{lambda-list}$ $\textit{result-type}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | A keyword naming the command.<br>A keyword naming an alias for the command.<br>A destructuring lambda list.<br>One of the symbols <code>values</code> , <code>eval</code> and <code>nil</code> . |
| Description | <p>The macro <code>define-top-loop-command</code> defines a top level loop command called <i>name</i> which takes the parameters specified by <i>lambda-list</i>. If <code>&amp;whole</code> is used in <i>lambda-list</i> then the variable will be bound to a list containing the whole command line, including the command name, but the command name is not included in <i>lambda-list</i> otherwise.</p> <p>If any aliases are specified in <i>option</i>, these keywords will also invoke the command.</p> <p>When the command is used, each form is evaluated in sequence with the variables from <i>lambda-list</i> bound to the subsequent forms on the command line.</p> <p>If <i>result-type</i> is <code>values</code> (the default), then the values of the last form will be returned to the top level loop.</p> |                                                                                                                                                                                                  |

If *result-type* is `eval`, then the value of the last form should be a form and is evaluated by the top level loop as if it had been entered at the prompt.

If *result-type* is `nil`, then the last form should return two values. If the second value is `nil` then the first value is treated as a list of values to returned to the top level loop. If the second value is non-nil then the first value should be a form and is evaluated by the top level loop as if it had been entered at the prompt.

Notes      For details of pre-defined top level loop commands, enter `:?` at the Listener prompt.

Example    Given this definition:

```
(define-top-loop-command (:lave
                           (:result-type eval)) (form)
                           (reverse form))
```

then the command line

```
:lave (1 2 list)
```

will evaluate the form `(list 2 1)`.

Here are definitions for two commands both of which will run `apropos`:

```
(define-top-loop-command (:apropos-eval
                           (:result-type eval))
                           (&rest args)
                           ` (apropos ,@args))

(define-top-loop-command :apropos-noeval (&rest args)
                           (apply 'apropos args))
```

The first one will evaluate the arguments before calling `apropos` whereas the second one will just pass the forms, so

```
:apropos-noeval foo
```

will find all the symbols containing the string `foo`, whereas

```
(setq foo "bar")
```

```
:apropos-eval foo
```

will find all the symbols containing the string `bar`.

|                         |                 |
|-------------------------|-----------------|
| <b>detect-eol-style</b> | <i>Function</i> |
|-------------------------|-----------------|

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| Summary     | Detects the end of line style of a file.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                |
| Package     | <code>system</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                |
| Signature   | <code>detect-eol-style pathname ef-spec buffer length =&gt; new-ef-spec</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                |
| Arguments   | <code>pathname</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Pathname identifying location of <i>buffer</i> .                                               |
|             | <code>ef-spec</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | An external format spec.                                                                       |
|             | <code>buffer</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | A buffer whose contents are examined.                                                          |
|             | <code>length</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Length (an integer) up to which <i>buffer</i> should be examined.                              |
| Values      | <code>new-ef-spec</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | A new external format spec created by merging <i>ef-spec</i> with the encoding that was found. |
| Description | When the encoding in <i>ef-spec</i> has foreign type ( <code>unsigned-byte 8</code> ), search <i>buffer</i> up to <i>length</i> for the first occurrence of the byte ( <code>10</code> ). If found, and it is preceded in <i>buffer</i> by ( <code>13</code> ), merge <i>ef-spec</i> with<br><code>(:default :eol-style :crlf)</code><br>If found and is not preceded by ( <code>13</code> ), merge <i>ef-spec</i> with<br><code>(:default :eol-style :lf)</code><br>Thus a complete external format spec is constructed. Otherwise, return <i>ef-spec</i> . |                                                                                                |

When the encoding in *ef-spec* has foreign type (`unsigned-byte 16`), search *buffer* up to *length* for the first occurrence of the byte sequence (13 0 10). If found, merge *ef-spec* with

```
(:default :eol-style :crlf)
```

If (13 0 10) is not found, search *buffer* up to *length* for (10 0) or (0 10). If found, merge *ef-spec* with

```
(:default :eol-style :lf)
```

Thus a complete external format spec is constructed. Otherwise, return *ef-spec*.

See also      **\*file-eol-style-detection-algorithm\***

## **detect-japanese-encoding-in-file**                          *Function*

|           |                                                                                                    |                                                                                                         |
|-----------|----------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| Summary   | Determines which type of Japanese encoding is used in a buffer.                                    |                                                                                                         |
| Package   | <code>system</code>                                                                                |                                                                                                         |
| Signature | <code>detect-japanese-encoding-in-file pathname ef-spec buffer<br/>length =&gt; new-ef-spec</code> |                                                                                                         |
| Arguments | <code>pathname</code>                                                                              | Pathname identifying location of <i>buffer</i> .                                                        |
|           | <code>ef-spec</code>                                                                               | An external format spec.                                                                                |
|           | <code>buffer</code>                                                                                | A buffer whose contents are examined.                                                                   |
|           | <code>length</code>                                                                                | Length (an integer) up to which <i>buffer</i> should be examined.                                       |
| Values    | <code>new-ef-spec</code>                                                                           | A new external format spec created by merging <i>ef-spec</i> with the Japanese encoding that was found. |

|             |                                                                                                                                                                                                                                                                                                                           |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | Assume the encoding is one of <code>:jis</code> , <code>:sjis</code> , <code>:euc</code> , <code>:unicode</code> and <code>:ascii</code> , and try to determine which of these it is, by looking for distinctive byte sequences in <i>buffer</i> up to <i>length</i> . If found, merge <i>ef-spec</i> with that encoding. |
| See also    | <code>*file-encoding-detection-algorithm*</code>                                                                                                                                                                                                                                                                          |

**detect-unicode-bom****detect-utf32-bom****detect-utf8-bom***Functions*

|             |                                                                                                                                                                                                                                                     |                                                                                                |  |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|--|
| Summary     | Looks for the Unicode Byte Order Mark, which if found is assumed to indicate the matching Unicode encoding.                                                                                                                                         |                                                                                                |  |
| Package     | <code>system</code>                                                                                                                                                                                                                                 |                                                                                                |  |
| Signature   | <code>detect-unicode-bom pathname ef-spec buffer length =&gt; new-ef-spec</code><br><code>detect-utf32-bom pathname ef-spec buffer length =&gt; new-ef-spec</code><br><code>detect-utf8-bom pathname ef-spec buffer length =&gt; new-ef-spec</code> |                                                                                                |  |
| Arguments   | <i>pathname</i>                                                                                                                                                                                                                                     | Pathname identifying the location of <i>buffer</i> .                                           |  |
|             | <i>ef-spec</i>                                                                                                                                                                                                                                      | An external format spec.                                                                       |  |
|             | <i>buffer</i>                                                                                                                                                                                                                                       | A buffer whose contents are examined.                                                          |  |
|             | <i>length</i>                                                                                                                                                                                                                                       | Length (an integer) up to which <i>buffer</i> should be examined.                              |  |
| Values      | <i>new-ef-spec</i>                                                                                                                                                                                                                                  | A new external format spec created by merging <i>ef-spec</i> with the encoding that was found. |  |
| Description | These functions are called as part of <code>open</code> 's encoding detection routine, and try to detect the encoding if it is not already supplied in the <i>external-format</i> argument.                                                         |                                                                                                |  |

`detect-unicode-bom` tries to detect UTF-16 encoding.

`detect-utf32-bom` tries to detect UTF-32 encoding.

`detect-utf8-bom` tries to detect UTF-8 encoding.

These functions work by checking whether the file starts with the Unicode character `#xFEFF` (BOM) encoded in the relevant encoding, and if it does assumes the file is encoded in this encoding. `detect-unicode-bom` and `detect-utf32-bom` also deduce the direction (little-endian or big-endian).

Note that files starting with `0xFF 0xFE 0x00 0x00` can match both UTF-16 and UTF-32 little-endian. By default `detect-utf32-bom` is applied first, because it precedes `detect-unicode-bom` in `*file-encoding-detection-algorithm*`. You can change this behavior by altering the order of functions in `*file-encoding-detection-algorithm*`.

See also `*file-encoding-detection-algorithm*`

## **\*directory-link-transparency\*** *Variable*

**Summary** Controls whether `directory` returns truenames on Unix-like systems.

**Package** `system`

**Initial value** `t` on non-Windows platforms, `nil` on Microsoft Windows.

**Description** In line with the ANSI Common Lisp standard, `directory` returns truenames by default.

Setting `*directory-link-transparency*` to `nil` allows you to get the old behavior of `directory`, whereby soft links are not resolved in the pathnames returned.

**\*directory-link-transparency\*** is the default value of the *link-transparency* argument to **directory**.

See also      **directory**

## ensure-loads-after-loads *Function*

Summary      Ensures all following loads in the program are executed after all prior loads.

Package      **system**

Signature      **ensure-loads-after-loads => nil**

Description      **ensure-loads-after-loads** is a synchronization function which ensures order of memory between operations in different threads.

See “Ensuring order of memory between operations in different threads” on page 301 for a full description and example.

Notes      You should have a good understanding of multiprocessing issues at the CPU level to write code that actually needs this.

See also      **ensure-memory-after-store**  
**ensure-stores-after-memory**  
**ensure-stores-after-stores**

## ensure-memory-after-store *Function*

Summary      Ensures all following stores and loads in the program are executed after all prior stores.

Package      **system**

|             |                                                                                                                                                                                                                                                                           |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signature   | <code>ensure-memory-after-store =&gt; nil</code>                                                                                                                                                                                                                          |
| Description | <code>ensure-memory-after-store</code> is a synchronization function which ensures order of memory between operations in different threads.<br><br>See “Ensuring order of memory between operations in different threads” on page 301 for a full description and example. |
| Notes       | You should have a good understanding of multiprocessing issues at the CPU level to write code that actually needs this.                                                                                                                                                   |
| See also    | <code>ensure-loads-after-loads</code><br><code>ensure-stores-after-memory</code><br><code>ensure-stores-after-stores</code>                                                                                                                                               |

|             | <i>Function</i>                                                                                                                                                                                                                                                            |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Ensures all following stores in the program are executed after all prior stores and loads.                                                                                                                                                                                 |
| Package     | <code>system</code>                                                                                                                                                                                                                                                        |
| Signature   | <code>ensure-stores-after-memory =&gt; nil</code>                                                                                                                                                                                                                          |
| Description | <code>ensure-stores-after-memory</code> is a synchronization function which ensures order of memory between operations in different threads.<br><br>See “Ensuring order of memory between operations in different threads” on page 301 for a full description and example. |
| Notes       | You should have a good understanding of multiprocessing issues at the CPU level to write code that actually needs this.                                                                                                                                                    |

See also      **`ensure-loads-after-loads`**  
**`ensure-memory-after-store`**  
**`ensure-stores-after-stores`**

## **ensure-stores-after-stores** *Function*

Summary      Ensures all following stores in the program are executed after all prior stores.

Package      **system**

Signature      **`ensure-stores-after-stores => nil`**

Description      **`ensure-stores-after-stores`** is a synchronization function which ensures order of memory between operations in different threads.  
 See “Ensuring order of memory between operations in different threads” on page 301 for a full description and example.

Notes      You should have a good understanding of multiprocessing issues at the CPU level to write code that actually needs this.

See also      **`ensure-loads-after-loads`**  
**`ensure-memory-after-store`**  
**`ensure-stores-after-memory`**

## **\*extended-spaces\*** *Variable*

Summary      Extends the notion of space to include more than just the space character.

Package      **system**

Initial value      **`nil`**

Description When this variable is true, the concept of “space” is extended from just `#\Space` to include other appropriate characters. The default is `nil`, for ANS compliance, but we recommend that you set it to `t`.

This variable controls how the format directives `~:C` and `~:@C` output graphic characters which have an empty glyph. When this variable is `t`, all such characters are output using the name:

```
(format nil "~:C" #\No-break-space)      -> "No-Break-
Space"
(format nil "~:C" (code-char #x3000)) -> "Ideographic-
Space"
```

When false, only one such character is output using the name:

```
(format nil "~:C" #\Space)           -> "Space"
(format nil "~:C" #\No-break-space) -> " "
(format nil "~:C" (code-char #x3000)) -> " "
```

It also affects `whitespace-char-p`.

See also `whitespace-char-p`

## \*file-encoding-detection-algorithm\*

*Variable*

Summary List of functions to call to work out an encoding.

Package `system`

Initial value  
`(find-filename-pattern-encoding-match
 find-encoding-option
 detect-utf32-bom
 detect-unicode-bom
 detect-utf8-bom
 specific-valid-file-encoding
 locale-file-encoding)`

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | Functions on this list take four arguments—the pathname of the file; an external format spec; a vector of element-type ( <code>unsigned-byte 8</code> ) which contains the first bytes of the file; and a non-negative integer which is the maximum extent of buffer to be searched. This length argument is 0 in the case that the file does not exist, or the direction is <code>:output</code> . They return an external format spec, which normally is either <code>ef-spec</code> unmodified, or the result of merging <code>ef-spec</code> with another external format spec via <code>merge-ef-specs</code> . |
|             | See the entry for <code>guess-external-format</code> for details of how <code>*file-encoding-detection-algorithm*</code> is used.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Notes       | For files starting with <code>0xff 0xfe 0x00 0x00</code> , both <code>detect-utf32-bom</code> and <code>detect-unicode-bom</code> may match it. <code>detect-utf32-bom</code> is called first so by default the encoding will be detected as <code>(:utf-32 :little-endian t)</code> . You can change this behavior by setting <code>*file-encoding-detection-algorithm*</code> to a re-ordered list.                                                                                                                                                                                                                |
| Example     | If you want <code>open</code> and so on, when opening a file for input, to inspect the attribute line and then fall back to a default if no attribute line is found, then set the variable to this value:                                                                                                                                                                                                                                                                                                                                                                                                            |
|             | <pre>(find-encoding-option locale-file-encoding)</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|             | There are further examples in “Guessing the external format” on page 448.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| See also    | <code>find-filename-pattern-encoding-match</code><br><code>find-encoding-option</code><br><code>detect-unicode-bom</code><br><code>detect-japanese-encoding-in-file</code><br><code>guess-external-format</code><br><code>locale-file-encoding</code>                                                                                                                                                                                                                                                                                                                                                                |

## **file-encoding-resolution-error** *Condition*

|              |                                                                                                                                                                                                                                                                                                  |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary      | An error type to signal when an external file format cannot be deduced.                                                                                                                                                                                                                          |
| Package      | <code>system</code>                                                                                                                                                                                                                                                                              |
| Superclasses | <code>error</code>                                                                                                                                                                                                                                                                               |
| Initargs     | <code>:ef-spec</code> An external format specification.                                                                                                                                                                                                                                          |
| Description  | An error type signaled when <code>open</code> , <code>load</code> or <code>compile-file</code> fail to detect an external format to use.<br><br>The <code>ef-spec</code> slot contains the incomplete external format specification argument constructed by <code>guess-external-format</code> . |
| See also     | <code>guess-external-format</code>                                                                                                                                                                                                                                                               |

## **\*file-eol-style-detection-algorithm\*** *Variable*

|               |                                                                                                                                                                                                                |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary       | List of functions for determining the end of line style of a file.                                                                                                                                             |
| Package       | <code>system</code>                                                                                                                                                                                            |
| Description   | Functions on this list satisfy the same specifications as for those in <b>*file-encoding-detection-algorithm*</b> . However they will only be passed an external format spec with the name already determined. |
| Initial value | <code>(detect-eol-style default-eol-style)</code>                                                                                                                                                              |
| See also      | <code>detect-eol-style</code><br><code>default-eol-style</code><br><code>guess-external-format</code>                                                                                                          |

**\*filename-pattern-encoding-matches\*** *Variable*

|               |                                                               |
|---------------|---------------------------------------------------------------|
| Summary       | An association of filename patterns to external format specs. |
| Package       | <code>system</code>                                           |
| Initial value | <code>(("TAGS" . (:latin-1 :eol-style :lf)))</code>           |
| Description   | An alist of filename patterns to external format specs.       |
| See also      | <b>*file-encoding-detection-algorithm*</b>                    |

**find-encoding-option** *Function*

|             |                                                                                                                                                         |                                                                                                                                                                          |  |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Summary     | Examines a buffer for an encoding option.                                                                                                               |                                                                                                                                                                          |  |
| Package     | <code>system</code>                                                                                                                                     |                                                                                                                                                                          |  |
| Signature   | <code>find-encoding-option pathname ef-spec buffer length =&gt; result</code>                                                                           |                                                                                                                                                                          |  |
| Arguments   | <i>pathname</i>                                                                                                                                         | Pathname identifying location of <i>buffer</i> .                                                                                                                         |  |
|             | <i>ef-spec</i>                                                                                                                                          | An external format spec.                                                                                                                                                 |  |
|             | <i>buffer</i>                                                                                                                                           | A buffer whose contents are examined.                                                                                                                                    |  |
|             | <i>length</i>                                                                                                                                           | Length (an integer) up to which <i>buffer</i> should be examined.                                                                                                        |  |
| Values      | <i>result</i>                                                                                                                                           | The result of reading the value returned from the <code>encoding</code> or <code>external-format</code> option as a Lisp expression in the <code>keyword</code> package. |  |
| Description | Looks in the file options (EMACS-style -*- line) for an option called <code>encoding</code> or <code>external-format</code> , with value <i>value</i> . |                                                                                                                                                                          |  |

If `encoding` or `external-format` is found, it reads `value` as a Lisp expression in the `keyword` package. If `coding` is found, it attempts to translate `value` from a GNU Emacs coding system name to a LispWorks external-format name.

It then merges the `ef-spec` with the external format spec derived from `value`, and returns the result as `result`. Thus it does not override a supplied `ef-spec`.

See also      **\*file-encoding-detection-algorithm\***

|             | <b>find-filename-pattern-encoding-match</b>                                                                                                                                                                                                                                                                                                              | <i>Function</i>                                                         |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| Summary     | Finds the encoding of a file based on the filename.                                                                                                                                                                                                                                                                                                      |                                                                         |
| Package     | <code>system</code>                                                                                                                                                                                                                                                                                                                                      |                                                                         |
| Signature   | <code>find-filename-pattern-encoding-match pathname ef-spec buffer length =&gt; new-ef-spec</code>                                                                                                                                                                                                                                                       |                                                                         |
| Arguments   | <code>pathname</code>                                                                                                                                                                                                                                                                                                                                    | Pathname identifying location of <code>buffer</code> .                  |
|             | <code>ef-spec</code>                                                                                                                                                                                                                                                                                                                                     | An external format spec.                                                |
|             | <code>buffer</code>                                                                                                                                                                                                                                                                                                                                      | A buffer whose contents are examined.                                   |
|             | <code>length</code>                                                                                                                                                                                                                                                                                                                                      | Length (an integer) up to which <code>buffer</code> should be examined. |
| Values      | <code>new-ef-spec</code>                                                                                                                                                                                                                                                                                                                                 | An external format spec.                                                |
| Description | Compares <code>pathname</code> (using <code>pathname-match-p</code> ) with elements of <b>*filename-pattern-encoding-matches*</b> .<br><br>If a match is found, merges <code>ef-spec</code> with the corresponding external format spec and returns the result as <code>new-ef-spec</code> . Thus it does not override a supplied <code>ef-spec</code> . |                                                                         |

See also \*file-encoding-detection-algorithm\*  
\*filename-pattern-encoding-matches\*

| gen-num-segments-fragmentation-state |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Function                                                                                                |
|--------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| Summary                              | Shows the fragmentation state in a generation in 64-bit Lisp-Works.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                         |
| Package                              | <b>system</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                         |
| Signature                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>gen-num-segments-fragmentation-state gen-num &amp;optional statics-too =&gt; fragmentation-state</b> |
| Arguments                            | <p><i>gen-num</i></p> <p><i>statics-too</i></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <p>A number.</p> <p>A generalized boolean?</p>                                                          |
| Values                               | <i>fragmentation-state</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | A list in which each element is a list of length 3.                                                     |
| Description                          | <p>The function <b>gen-num-segments-fragmentation-state</b> shows the fragmentation state in a generation in 64-bit Lisp-Works.</p> <p><b>gen-num-segments-fragmentation-state</b> returns a list, where each element is a sub-list showing the fragmentation state in a segment. The sub-list is of the form</p> <p><b>(allocation-type allocated free)</b></p> <p>where <i>allocation-type</i> is the allocation type of the segment, <i>allocated</i> is the amount of allocated data in the segment, and <i>free</i> is the total size of free areas in the segment that cannot be easily used.</p> <p>The ratio <b>free/allocated</b> is the ratio that is compared to the fragmentation threshold to decide whether to copy a segment</p> |                                                                                                         |

when doing a marking GC with copying (see `set-blocking-gen-num` and `marking-gc`).

Allocation types `:cons-static`, `:non-pointer-static`, `:mixed-static`, `:other-big` and `:non-pointer-big` are included in the result only if `statics-too` is non-nil. The default value of `statics-too` is `nil`.

|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | <ol style="list-style-type: none"><li>1. The implementation of <code>set-blocking-gen-num</code> is intended to solve any fragmentation issues automatically.</li><li>2. <code>gen-num-segments-fragmentation-state</code> is implemented only in 64-bit LispWorks. It does nothing in the Mobile GC and its return value is not meaningful. It is not relevant to the Memory Management API in 32-bit implementations, where <code>check-fragmentation</code> is available instead.</li></ol> |
| See also | <code>check-fragmentation</code><br><code>marking-gc</code><br><code>set-blocking-gen-num</code><br>“Guidance for control of the memory management system” on page 130                                                                                                                                                                                                                                                                                                                         |

|           |                                                      | <i>Function</i> |
|-----------|------------------------------------------------------|-----------------|
| Summary   | Returns the current generation number for an object. |                 |
| Package   | <code>system</code>                                  |                 |
| Signature | <code>generation-number object =&gt; integer</code>  |                 |
| Arguments | <code>object</code>                                  | A Lisp object.  |
| Values    | <code>integer</code>                                 | An integer.     |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | The function <code>generation-number</code> returns the generation number in which the Lisp object <i>object</i> currently is. See the discussion in Chapter 11, “Memory Management”.<br><br>If <i>object</i> is an immediate object then <code>generation-number</code> returns -1. immediates are objects which are not allocated, including fixnums, characters and short floats, and single floats in 64-bit LispWorks. |
| See also    | “Guidance for control of the memory management system” on page 130                                                                                                                                                                                                                                                                                                                                                          |

**gesture-spec-accelerator-bit**  
**gesture-spec-caps-lock-bit**  
**gesture-spec-control-bit**  
**gesture-spec-hyper-bit**  
**gesture-spec-meta-bit**  
**gesture-spec-shift-bit**  
**gesture-spec-super-bit**

### *Constants*

Summary      Used in the representation of keystrokes with the various modifier keys.

Package      `system`

Description      These constants are used to represent the accelerator and modifier keys in a Gesture Spec object, as follows:

**gesture-spec-accelerator-bit**

Accelerator key.

**gesture-spec-caps-lock-bit**

Caps Lock modifier key.

**gesture-spec-control-bit**

Control modifier key.

```
gesture-spec-hyper-bit
    Hyper modifier key.

gesture-spec-meta-bit
    Meta modifier key.

gesture-spec-shift-bit
    Shift modifier key.

gesture-spec-super-bit
    Super modifier key.
```

See the reference entry for `capi:output-pane` in the *CAPI User Guide and Reference Manual* for more information about the use of Gesture Specs.

- Notes
1. You may not construct a Gesture Spec with a `both-case-p` character represented in the *data* and with *modifiers* equal to `gesture-spec-shift-bit`. See `make-gesture-spec` for details and examples.
  2. The `gesture-spec-caps-lock-bit` is used to represent the state of Caps Lock, in situations where the bits are used to represent the keyboard state. It is not used in Gesture Specs that are generated by the system.
  3. The `gesture-spec-hyper-bit` is used to represent the Command key.
  4. The `gesture-spec-accelerator-bit` is a "virtual" bit. It corresponds to different keys on different GUI systems, currently these are `Command` on Cocoa, `Control` on GTK+ and `Control` on Windows.

- See also
- `coerce-to-gesture-spec`
  - `gesture-spec-modifiers`
  - `make-gesture-spec`

| <b>gesture-spec-data</b> | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary                  | Returns the key in a Gesture Spec object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Package                  | <b>system</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Signature                | <b><i>gesture-spec-data gspec =&gt; data</i></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Arguments                | <b>gspec</b> A Gesture Spec object                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Values                   | <b>data</b> A non-negative integer or a keyword.                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Description              | <p>The function <b>gesture-spec-data</b> returns an integer or keyword representing the key in the Gesture Spec object <i>gspec</i>.</p> <p>When <i>data</i> is an integer, it is a non-negative integer less than <b>c1:char-code-limit</b>, and <i>gspec</i> represents a keystroke with the key indicated by the character which is the value of <b>(code-char data)</b>.</p> <p><i>data</i> can also be a keyword such as <b>:f6</b>, when <i>gspec</i> represents a keystroke with <b>f6</b> pressed.</p> |
| See also                 | <b>gesture-spec-modifiers</b><br><b>make-gesture-spec</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

| <b>gesture-spec-modifiers</b> | <i>Function</i>                                       |
|-------------------------------|-------------------------------------------------------|
| Summary                       | Returns the modifiers in a Gesture Spec object.       |
| Package                       | <b>system</b>                                         |
| Signature                     | <b><i>gesture-spec-modifiers gspec =&gt; mods</i></b> |
| Arguments                     | <b>gspec</b> A Gesture Spec object                    |
| Values                        | <b>mods</b> An integer.                               |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | The function <code>gesture-spec-modifiers</code> returns an integer representing the modifiers in the Gesture Spec object <code>gspec</code> .<br><br>The value <code>mods</code> contains some (or none) of the constants <code>gesture-spec-accelerator-bit</code> , <code>gesture-spec-control-bit</code> , <code>gesture-spec-meta-bit</code> , <code>gesture-spec-hyper-bit</code> , <code>gesture-spec-shift-bit</code> and <code>gesture-spec-super-bit</code> , combined as if by <code>logior</code> . |
| See also    | <code>gesture-spec-accelerator-bit</code><br><code>gesture-spec-control-bit</code><br><code>gesture-spec-data</code><br><code>gesture-spec-meta-bit</code><br><code>gesture-spec-hyper-bit</code><br><code>gesture-spec-shift-bit</code><br><code>gesture-spec-super-bit</code><br><code>make-gesture-spec</code>                                                                                                                                                                                               |

|             | <i>Function</i>                                                                                                                       |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | The predicate for Gesture Spec objects.                                                                                               |
| Package     | <code>system</code>                                                                                                                   |
| Signature   | <code>gesture-spec-p object =&gt; result</code>                                                                                       |
| Arguments   | <code>object</code> A Lisp object                                                                                                     |
| Values      | <code>result</code> A boolean.                                                                                                        |
| Description | The function <code>gesture-spec-p</code> is the predicate for whether the <code>object</code> <i>object</i> is a Gesture Spec object. |
| See also    | <code>coerce-to-gesture-spec</code><br><code>make-gesture-spec</code>                                                                 |

| <b>gesture-spec-to-character</b> | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |              |                       |               |                        |
|----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-----------------------|---------------|------------------------|
| Summary                          | Returns the character corresponding to a Gesture Spec object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |              |                       |               |                        |
| Package                          | <b>system</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |              |                       |               |                        |
| Signature                        | <b>gesture-spec-to-character gspec &amp;key errorp =&gt; char</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |              |                       |               |                        |
| Arguments                        | <table border="0"> <tr> <td><b>gspec</b></td><td>A Gesture Spec object</td></tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>gspec</b> | A Gesture Spec object |               |                        |
| <b>gspec</b>                     | A Gesture Spec object                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |              |                       |               |                        |
| Values                           | <table border="0"> <tr> <td><b>char</b></td><td>A Lisp character.</td></tr> <tr> <td><b>errorp</b></td><td>A generalized boolean.</td></tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                 | <b>char</b>  | A Lisp character.     | <b>errorp</b> | A generalized boolean. |
| <b>char</b>                      | A Lisp character.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |              |                       |               |                        |
| <b>errorp</b>                    | A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |              |                       |               |                        |
| Description                      | <p>The function <b>gesture-spec-to-character</b> returns the Lisp <b>character</b> object corresponding to the Gesture Spec object <b>gspec</b>.</p> <p>A Gesture Spec with modifiers or data which is not an integer cannot be converted to a character. When supplied such a Gesture Spec, <b>gesture-spec-to-character</b> either signals an error (if <b>errorp</b> is true), or returns <b>nil</b> (if <b>errorp</b> is <b>nil</b>). The default value of <b>errorp</b> is <b>t</b>.</p> <p><b>gesture-spec-accelerator-bit</b> is ignored.</p> |              |                       |               |                        |
| Compatibility note               | In LispWorks 6.1 and earlier versions, <b>gesture-spec-to-character</b> allows modifiers and does not error when the data is not an integer. LispWorks 7.0 and later versions do not support character bits, therefore if <b>gspec</b> contains non-zero modifier bits, <b>gesture-spec-to-character</b> signals an error.                                                                                                                                                                                                                           |              |                       |               |                        |
| See also                         | <b>coerce-to-gesture-spec</b><br><b>make-gesture-spec</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |              |                       |               |                        |

|             | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Provides read access to the C stat structure which describes files.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|             | <b>Note:</b> not applicable on Microsoft Windows.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Package     | <code>system</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Signature   | <code>get-file-stat filename-or-fd =&gt; file-stat (errno)</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Arguments   | <p><code>filename-or-fd</code> A string denoting a file, or a file descriptor.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Values      | <p><code>file-stat</code> On success, an object representing the stat values. On failure, <code>nil</code> is returned together with a second value.</p> <p><code>errno</code> Indicates the errno value returned by the system call. This second value is returned only in the case of failure.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Description | <p><code>file-stat</code> is an object representing the stat values, as would be returned by the system call <code>stat</code> (for a filename) or the system call <code>fstat</code> (for an fd).</p> <p>The values in <code>file-stat</code> are the raw data, and it is the responsibility of the user to interpret them when needed. See the UNIX manual entry for <code>stat</code> for details.</p> <p>The values can be read from <code>file-stat</code> by these readers:</p> <ul style="list-style-type: none"> <li><code>sys:file-stat-inode</code><br/>The inode of the file.</li> <li><code>sys:file-stat-device</code><br/>The id of the device where the file is.</li> <li><code>sys:file-stat-owner-id</code><br/>The user id of the owner of the file.</li> </ul> |

**sys:file-stat-group-id**  
           The group id of the file's group.

**sys:file-stat-size**  
           The size of the file in bytes.

**sys:file-stat-blocks**  
           The number of 512-bytes blocks used by the file.

**sys:file-stat-mode**  
           The protection value of the file.

**sys:file-stat-last-access**  
           The time of the last access to the file in seconds from 1 January 1970.

**sys:file-stat-last-change**  
           The time of the last change in the data of the file in seconds from 1 January 1970.

**sys:file-stat-last-modify**  
           The time of the last modification of the file status in seconds from 1 January 1970.

**sys:file-stat-links**  
           The number of hard links to the file.

**sys:file-stat-device-type**  
           The device type (sometimes called Rdev).

| <b>get-folder-path</b> | <i>Function</i>                    |
|------------------------|------------------------------------|
| Summary                | Gets the path of a special folder. |
| Package                | <code>system</code>                |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|
| Signature   | <code>get-folder-path <i>what</i> &amp;key <i>create</i> =&gt; <i>result</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                |
| Arguments   | <i>what</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | A keyword.                                                     |
|             | <i>create</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | A boolean.                                                     |
| Values      | <i>result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | A directory pathname naming the path, or<br><code>nil</code> . |
| Description | <p>The function <code>get-folder-path</code> obtains the current value for various special folders often used by applications. It is useful because these paths may differ between versions of the operating system. <code>get-folder-path</code> is implemented all platforms, using system APIs on Microsoft Windows, Mac OS X and Android.</p> <p>On platforms other than Windows, Mac OS X and Android it is a dummy function, which makes a path to a directory inside the user's home directory that looks like <code>&lt;homedir&gt;/get-folder-path/&lt;symbol-name-down-cased&gt;</code>. This allows testing code that uses <code>get-folder-path</code> to work in the sense that files can be written and read from these directories.</p> <p><i>what</i> indicates the purpose of the special folder. For instance, <code>:common-appdata</code> means the folder containing application data for all users.</p> <p>The following values of <i>what</i> are recognized on Microsoft Windows and Mac OS X:</p> <ul style="list-style-type: none"> <li><code>:appdata</code>, <code>:documents</code>, <code>:my-documents</code>, <code>:common-appdata</code>, <code>:common-documents</code> and <code>:local-appdata</code>.</li> <li><code>:documents</code> is an alias for <code>:my-documents</code>.</li> </ul> <p>The following values are recognized on Microsoft Windows only: <code>:program-files</code>, <code>:programs</code> and <code>:common-programs</code>.</p> <p>The following values are recognized on Mac OS X only:</p> |                                                                |

```
:my-library, :my-appsupport, :my-preferences, :my-caches, :my-logs, :common-library, :common-appsupport, :common-preferences, :common-caches, :common-logs, :system-library.
```

On Mac OS X, `:appdata` is an alias for `:my-appsupport`, `:common-appdata` is an alias for `:common-appsupport`, and `:local-appdata` is an alias for `:common-appsupport`.

If the folder does not exist and `create` is true, the folder is created. If the folder does not exist and `create` is false, `result` is `nil`. The default value of `create` is false.

The following values of `what` are recognized on Android:

```
:appdata, :local-appdata
```

Both of these return the same directory. It is the directory which is returned by the `getFilesDir` on the application context. Note that this is a private directory, not visible to other applications.

```
:my-documents, :documents
```

On Android 4.4 and later this returns the "documents" directory in the "public external" directory (the result of calling `"android.os.Environment.getExternalStoragePublicDirectory"` with the value of `android.os.Environment.DIRECTORY_DOCUMENTS`). In previous versions it uses the "downloads" directory, because there does not seem to be another useful place for it.

**Note:** This is used as the home directory on Android, that is what `c1:user-homedir-pathname` returns.

```
:alarms, :dcim, :downloads, :movies, :music, :notifications, :pictures, :podcasts, :ringtones
```

Return the matching directory in the "public external" directory. This is the result of calling `"android.os.Environment.getExternalStoragePublicDirectory"` with the value of `android.os.Environment.DIRECTORY_<symbol-name>`, where `symbol-name` is the symbol name of the key-

word), for example `android.os.Environment.DIRECTORY_RINGTONES`.

**:common-appdata**

Returns the external storage directory of the application if it is accessible, otherwise returns `nil`. The external storage directory is the result of calling `getExternalFilesDir` on the application context with `null`.

Note that the application will need permission to access the external storage, by having `uses-permission android.permission.WRITE_EXTERNAL_STORAGE OR android.permission.READ_EXTERNAL_STORAGE` in the `AndroidManifest.xml` file.

Compatibility notes

1. In LispWorks 6.1 and earlier versions, `get-folder-path` is implemented only on Windows and Mac OS X.
2. In LispWorks 5.0 and previous versions, `get-folder-path` returns a string.

Example

This form constructs a pathname to a file `foo.lisp` in the user's documents directory:

```
(make-pathname  
  :name "foo"  
  :type "lisp"  
  :defaults  
  (sys:get-folder-path :my-documents))
```

See also

`get-user-profile-directory`

## **get-maximum-allocated-in-generation-2-after-gc**

*Function*

Summary

Mobile GC only: Returns the maximum number of allocated bytes in generation 2 immediately after a GC.

Package

`system`

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |          |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Signature   | <code>get-maximum-allocated-in-generation-2-after-gc</code><br><code>&amp;optional reset-p =&gt; other-size-in-bytes, cons-size-in-byte, gen-2-gc-count</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |          |
| Arguments   | <code>reset-p</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Boolean. |
| Values      | <code>other-size-in-bytes, cons-size-in-byte, gen-2-gc-count</code><br>Integers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |          |
| Description | <p>The function <code>get-maximum-allocated-in-generation-2-after-gc</code> returns the maximum bytes used by live objects in generation 2 immediately after any of the preceding GCs of generation 2 since the previous "reset" (a call to <code>get-maximum-allocated-in-generation-2-after-gc</code> with <code>reset-p</code> non-nil). It also returns the number of GCs of generation 2 since the previous reset.</p> <p><code>other-size-in-bytes</code> is the maximum size of live objects in Other segments (that is not Cons, Large or Static) immediately after any of these GCs, and <code>cons-size-in-byte</code> is the maximum size of live conses.</p> <p><code>gen-2-gc-count</code> if the number of GCs of generation 2 that have occurred since the last call with <code>reset-p</code> non-nil.</p> <p>The values of <code>other-size-in-bytes</code> and <code>cons-size-in-byte</code> match the values that would have been reported for generation 2 by <code>room</code>, if it had been called immediately after a GC of generation 2.</p> <p><code>reset-p</code> defaults to <code>nil</code>. When it is non-nil, the maximums and count are reset to 0.</p> |          |
| Notes       | The purpose of <code>get-maximum-allocated-in-generation-2-after-gc</code> is to give useful information for controlling generation 2, for example to decide what values to use in <code>set-expected-allocation-in-generation-2-after-gc</code> . This function is also useful for just counting the number of GCs of generation 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |          |

See also      **set-expected-allocation-in-generation-2-after-gc**  
              “Preventing/reducing GC of generation 2” on page 159

## **get-user-profile-directory** *Function*

|                     |                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary             | Gets the root of the user’s profile on a Windows system.                                                                                                                                                                                                                                                                                                                           |
| Package             | <b>system</b>                                                                                                                                                                                                                                                                                                                                                                      |
| Signature           | <b>get-user-profile-directory =&gt; result</b>                                                                                                                                                                                                                                                                                                                                     |
| Values              | <b>result</b> A directory pathname naming the path, or<br><b>nil</b> .                                                                                                                                                                                                                                                                                                             |
| Description         | The function <b>get-user-profile-directory</b> obtains the path to the current user’s profile folder on a Windows system. <b>get-user-profile-directory</b> is implemented only on Microsoft Windows.<br><br><i>result</i> names the root of the profile directory.<br><br>Note that the default path for each user’s profile may differ between versions of the operating system. |
| Compatibility notes | In LispWorks 5.0 and previous versions, <b>get-user-profile-directory</b> returns a string.                                                                                                                                                                                                                                                                                        |
| Example             | On Windows 10, Windows 8 and Windows 7:<br><br><pre>(sys:get-user-profile-directory) =&gt; #P"C:/Users/dubya/"</pre> On Windows XP (now unsupported):<br><br><pre>(sys:get-user-profile-directory) =&gt; #P"C:/Documents and Settings/dubya/"</pre>                                                                                                                                |
| See also            | <b>get-folder-path</b>                                                                                                                                                                                                                                                                                                                                                             |

|             |                                                                                                                                 | <i>Macro</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------|---------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | A wrapper <code>setf</code> place that ensures earlier stores are visible to other threads before storing into the inner place. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Package     | <code>system</code>                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Signature   | <code>globally-accessible place =&gt; value</code>                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Arguments   | <code>place</code>                                                                                                              | A generalized reference form as described in section 5.1.1 <i>Overview of Places and Generalized Reference</i> of the Common Lisp HyperSpec.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Values      | <code>value</code>                                                                                                              | Any Lisp object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Description |                                                                                                                                 | The macro <code>globally-accessible</code> expands to <code>place</code> . The effect of using ( <code>globally-accessible place</code> ) is the same as <code>place</code> , except when used inside <code>setf</code> or a related macro such as <code>push</code> or <code>incf</code> where it also ensures all stores are visible to other threads before modifying <code>place</code> . This includes all the stores that were made into the new value and, for a modifying macro or complex accessor, any stores that are done by the expansion.<br><br>See “Ensuring stores are visible to other threads” on page 271 for a full discussion when <code>globally-accessible</code> is needed.<br><br>When used with accessors that take a place as argument ( <code>getf</code> , <code>mask-field</code> , <code>ldb</code> or <code>cdr-assoc</code> ), <code>globally-accessible</code> needs to be used around innermost place, rather than the accessor, for example: |
|             |                                                                                                                                 | <pre>(setf (getf (sys:globally-accessible *a-global-symbol*)              key)       value)</pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|             |                                                                                                                                 | rather than:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

```
(setf ; WRONG
      (sys:globally-accessible
        (getf *a-global-symbol* key))
      value)
```

`globally-accessible` tries to avoid ensuring all stores when it is possible to avoid it, for example when used inside `pushnew` if the value is already in the list.

Notes You do not need to use `globally-accessible` when any of the following apply:

- *place* can be accessed only by the same thread that stores into it (so it is not globally accessible). This is the common situation for stores.
- Access to *place* (both read and writes) is synchronized between threads, normally by a `lock` but maybe by some other synchronization mechanism. This is the preferred way to access globally accessible cells.
- The store is done by one of: `(setf gethash)`, `vector-push`, `vector-push-extend`, `(setf symbol-function)`, `(setf macro-function)` and the hash-table or vector containing the globally accessible cell was not created as single-threaded.

In other cases (globally accessible cells which are read without synchronization), you probably need `globally-accessible`. See “Ensuring stores are visible to other threads” on page 271 for exact details.

See also “Ensuring stores are visible to other threads” on page 271

## guess-external-format

## *Function*

Summary Tries to work out the external format

Package `system`

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                   |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| Signature   | <code>guess-external-format pathname ef-spec buffer length -&gt; ef-spec</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                   |
| Arguments   | <code>pathname</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Pathname identifying location of <i>buffer</i> .                  |
|             | <code>ef-spec</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | An external format spec.                                          |
|             | <code>buffer</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A buffer whose contents are examined.                             |
|             | <code>length</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Length (an integer) up to which <i>buffer</i> should be examined. |
| Values      | <code>ef-spec</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | An external format spec.                                          |
| Description | <p>If <i>ef-spec</i> is complete, then it is returned. Otherwise <code>guess-external-format</code> calls, in turn, functions on the list <code>*file-encoding-detection-algorithm*</code>. If a complete external format spec is returned it is used, otherwise the return value is passed to the next function. If the name of the external format spec returned by the last function on this list is <code>:default</code>, an error of type <code>file-encoding-resolution-error</code> is signaled. Otherwise <code>guess-external-format</code> proceeds to guess the <i>eol-style</i>.</p> <p>To guess the <i>eol-style</i>, functions on the list <code>*file-eol-style-detection-algorithm*</code> are called in turn. If a complete external format spec is returned it is used, otherwise the return value is passed to the next function. If the external format spec returned by the last function on this list does not contain <code>:eol-style</code>, an error of type <code>file-encoding-resolution-error</code> is signaled.</p> |                                                                   |
| See also    | <ul style="list-style-type: none"> <li><code>*file-encoding-detection-algorithm*</code></li> <li><code>*file-eol-style-detection-algorithm*</code></li> <li><code>file-encoding-resolution-error</code></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                   |

| <b>immediatep</b> | <i>Function</i>                      |
|-------------------|--------------------------------------|
| Summary           | The predicate for immediate objects. |

|             |                                                                                                                                           |                |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| Package     | <code>system</code>                                                                                                                       |                |
| Signature   | <code>immediatp object =&gt; result</code>                                                                                                |                |
| Arguments   | <i>object</i>                                                                                                                             | A Lisp object. |
| Values      | <i>result</i>                                                                                                                             | A boolean.     |
| Description | The function <code>immediatp</code> returns <code>t</code> for "immediate" objects, that is objects that do not actually use heap memory. |                |

|             |                                                                                                                                                                                                        | <i>Macro</i>                                                                             |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| Summary     | Allocates the objects produced by the specified forms to the static area.<br><br>This macro is deprecated.                                                                                             |                                                                                          |
| Package     | <code>system</code>                                                                                                                                                                                    |                                                                                          |
| Signature   | <code>in-static-area &amp;rest body =&gt; result</code>                                                                                                                                                |                                                                                          |
| Arguments   | <i>body</i>                                                                                                                                                                                            | The forms for which you want the garbage collector to allocate space in the static area. |
| Values      | <i>result</i>                                                                                                                                                                                          | The result of executing <i>body</i> .                                                    |
| Description | Allocates the objects produced by the specified forms to the static area. Objects in the static area are not moved, though they are garbage collected when there is no longer a pointer to the object. |                                                                                          |
| Notes       | <code>in-static-area</code> is deprecated. Use <code>make-array</code> with <code>:allocation :static</code> where possible instead.                                                                   |                                                                                          |

In 64-bit LispWorks and the Mobile GC, `in-static-area` does not affect the allocation conses. There is no interface to make static conses in 64-bit LispWorks or the Mobile GC.

Example      `(system:in-static-area (make-string 10))`

See also     `enlarge-static`  
`make-array`  
`staticcp`

## **int32** *Type*

Summary     A type used to generate optimal 32-bit arithmetic code.

Package    `system`

Signature   `int32`

Description   The type `int32` is used to generate optimal 32-bit arithmetic code.

Objects of type `int32` are generated and can be manipulated using the functions in the INT32 API but the compiler can optimize such source code by eliminating the intermediate `int32` objects to produce efficient raw 32-bit code.

See the section “Fast 32-bit arithmetic” on page 472 for more information.

See also    `int32*`  
`+int32-0+`  
`+int32-1+`  
`int32-1+`  
`int32/=`  
`int32<<`  
`int32-aref`  
`int32-logand`

```
int32-minusp
int32-to-integer
integer-to-int32
make-simple-int32-vector
simple-int32-vector
```

**int32\***

**int32+**

**int32-**

**int32/**

*Functions*

Summary      The arithmetic operators for **int32** objects.

Package      **system**

Signatures    **int32\* x y => int32**  
**int32+ x y => int32**  
**int32- x y => int32**  
**int32/ x y => int32**

Arguments    **x**      An **int32** object or an integer of type  
**(signed-byte 32)**.

**y**      An **int32** object or an integer of type  
**(signed-byte 32)**.

Values        **int32**      An **int32** object.

Description    The function **int32\*** is the multiply operator for **int32** objects.

The function **int32+** is the add operator for **int32** objects.

The function **int32-** is the subtract operator for **int32** objects.

The function `int32/` is the divide operator for `int32` objects.

See the section “Fast 32-bit arithmetic” on page 472 for more information about the INT32 API.

See also [int32](#)

+int32-0+ *Symbol Macro*

Summary      Shorthand for `(sys:integer-to-int32 0)`.

## Package system

Description The symbol macro `+int32-0+` expands to `(sys:integer-to-int32 0)`.

See also [integer-to-int32](#)

+int32-1+ *Symbol Macro*

Summary      Shorthand for `(sys:integer-to-int32 1)`.

## Package system

Description The symbol macro `+int32-1+` expands to `(sys:integer-to-int32 1)`.

See also [integer-to-int32](#)

**int32-1+**

int32-1-

## *Functions*

**Summary** The operators for `int32` objects corresponding to the functions `1+` and `1-`.

|             |                                                                                                                                                                                                                                                                                          |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Package     | <code>system</code>                                                                                                                                                                                                                                                                      |
| Signatures  | <code>int32-1+ x =&gt; int32</code><br><code>int32-1- x =&gt; int32</code>                                                                                                                                                                                                               |
| Arguments   | <p><code>x</code> An <code>int32</code> object or an integer of type<br/> <code>(signed-byte 32)</code>.</p>                                                                                                                                                                             |
| Values      | <code>int32</code> An <code>int32</code> object.                                                                                                                                                                                                                                         |
| Description | <p>The functions <code>int32-1+</code> and <code>int32-1-</code> are the operators for <code>int32</code> objects corresponding to the functions <code>1+</code> and <code>1-</code>. See the section “Fast 32-bit arithmetic” on page 472 for more information about the INT32 API.</p> |
| See also    | <code>int32</code>                                                                                                                                                                                                                                                                       |

`int32/=`

`int32<`

`int32<=`

`int32=`

`int32>`

`int32>=`

### *Functions*

Summary The comparison operators for `int32` objects.

Package `system`

Signatures

|                                          |
|------------------------------------------|
| <code>int32/= x y =&gt; result</code>    |
| <code>int32&lt; x y =&gt; result</code>  |
| <code>int32&lt;= x y =&gt; result</code> |
| <code>int32= x y =&gt; result</code>     |

`int32> x y => result`

`int32>= x y => result`

|             |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arguments   | <code>x</code>      | An <code>int32</code> object or an integer of type<br>( <code>signed-byte 32</code> ).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|             | <code>y</code>      | An <code>int32</code> object or an integer of type<br>( <code>signed-byte 32</code> ).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Values      | <code>result</code> | A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Description |                     | <p>The function <code>int32/=</code> is the not equal comparison for <code>int32</code> objects.</p> <p>The function <code>int32&lt;</code> is the less than comparison for <code>int32</code> objects.</p> <p>The function <code>int32&lt;=</code> is the less than or equal comparison for <code>int32</code> objects.</p> <p>The function <code>int32=</code> is the equal comparison for <code>int32</code> objects.</p> <p>The function <code>int32&gt;</code> is the greater than comparison for <code>int32</code> objects.</p> <p>The function <code>int32&gt;=</code> is the greater than or equal comparison for <code>int32</code> objects.</p> <p>See the section “Fast 32-bit arithmetic” on page 472 for more information about the INT32 API.</p> |
| See also    |                     | <code>int32</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

## `int32<<`

## `int32>>`

## *Functions*

|         |                                                     |
|---------|-----------------------------------------------------|
| Summary | The shift operators for <code>int32</code> objects. |
|---------|-----------------------------------------------------|

|             |                                                                                                                                                                                                                                                                                                                        |                                                                                        |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| Package     | <code>system</code>                                                                                                                                                                                                                                                                                                    |                                                                                        |
| Signatures  | <code>int32&lt;&lt; x y =&gt; result</code><br><code>int32&gt;&gt; x y =&gt; result</code>                                                                                                                                                                                                                             |                                                                                        |
| Arguments   | <i>x</i>                                                                                                                                                                                                                                                                                                               | An <code>int32</code> object or an integer of type<br>( <code>signed-byte 32</code> ). |
|             | <i>y</i>                                                                                                                                                                                                                                                                                                               | An <code>int32</code> object or an integer of type<br>( <code>signed-byte 32</code> ). |
| Values      | <i>result</i>                                                                                                                                                                                                                                                                                                          | An <code>int32</code> object.                                                          |
| Description | <p>The function <code>int32&lt;&lt;</code> is a shift left operator for <code>int32</code> objects.</p> <p>The function <code>int32&gt;&gt;</code> is a shift right operator for <code>int32</code> objects.</p> <p>See the section “Fast 32-bit arithmetic” on page 472 for more information about the INT32 API.</p> |                                                                                        |
| See also    | <code>int32</code>                                                                                                                                                                                                                                                                                                     |                                                                                        |

|           |                                                                                                               | <i>Function</i>                       |
|-----------|---------------------------------------------------------------------------------------------------------------|---------------------------------------|
| Summary   | The accessor for a <code>simple-int32-vector</code> .                                                         |                                       |
| Package   | <code>system</code>                                                                                           |                                       |
| Signature | <code>int32-aref vector index =&gt; int32</code><br><code>(setf int32-aref) x vector index =&gt; int32</code> |                                       |
| Arguments | <i>vector</i>                                                                                                 | An <code>simple-int32-vector</code> . |
|           | <i>index</i>                                                                                                  | A non-negative fixnum.                |

|             |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <b>x</b>           | An <code>int32</code> object or an integer of type<br><code>(signed-byte 32)</code> .                                                                                                                                                                                                                                                                                                                                                                                    |
| Values      | <code>int32</code> | An <code>int32</code> object.                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Description |                    | The function <code>int32-aref</code> is the accessor for a <code>simple-int32-vector</code> . The reader returns an <code>int32</code> object for the value at index <code>index</code> in <code>vector</code> . The writer sets the value at index <code>index</code> in <code>vector</code> to the <code>int32</code> object or integer <code>x</code> supplied.<br><br>See the section “Fast 32-bit arithmetic” on page 472 for more information about the INT32 API. |
| See also    |                    | <code>int32</code><br><code>simple-int32-vector</code>                                                                                                                                                                                                                                                                                                                                                                                                                   |

[int32-logand](#)  
[int32-logandc1](#)  
[int32-logandc2](#)  
[int32-logbitp](#)  
[int32-logeqv](#)  
[int32-logior](#)  
[int32-lognand](#)  
[int32-lognor](#)  
[int32-lognot](#)  
[int32-logorc1](#)  
[int32-logorc2](#)  
[int32-logtest](#)  
[int32-logxor](#)

### *Functions*

|         |                                                               |
|---------|---------------------------------------------------------------|
| Summary | The bitwise logical operators for <code>int32</code> objects. |
| Package | <code>system</code>                                           |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signatures  | <pre>int32-logand x y =&gt; int32 int32-logandc1 x y =&gt; int32 int32-logandc2 x y =&gt; int32 int32-logbitp index x =&gt; result int32-logeqv x y =&gt; int32 int32-logior x y =&gt; int32 int32-lognand x y =&gt; int32 int32-lognor x y =&gt; int32 int32-lognot x =&gt; int32 int32-logorc1 x y =&gt; int32 int32-logorc2 x y =&gt; int32 int32-logtest x y =&gt; result int32-logxor x y =&gt; int32</pre>                                                |
| Arguments   | <p><i>x</i> An <code>int32</code> object or an integer of type (<code>signed-byte 32</code>).</p> <p><i>y</i> An <code>int32</code> object or an integer of type (<code>signed-byte 32</code>).</p> <p><i>index</i> An <code>int32</code> object or an integer of type (<code>signed-byte 32</code>).</p>                                                                                                                                                       |
| Values      | <p><i>int32</i> An <code>int32</code> object.</p> <p><i>result</i> An boolean.</p>                                                                                                                                                                                                                                                                                                                                                                              |
| Description | <p>The function <code>int32-logand</code> is the bitwise logical 'and' operator for <code>int32</code> objects.</p> <p>The function <code>int32-logandc1</code> is the bitwise logical operator for <code>int32</code> objects which 'ands' the complement of <i>x</i> with <i>y</i>.</p> <p>The function <code>int32-logandc2</code> is the bitwise logical operator for <code>int32</code> objects which 'ands' <i>x</i> with the complement of <i>y</i>.</p> |

The function `int32-logbitp` is the test for `int32` objects which returns `t` if if the bit at index `index` in `x` is 1, and `nil` if it is 0.

The function `int32-logeqv` is the bitwise logical operator for `int32` objects which returns the complement of the 'exclusive or' of `x` and `y`.

The function `int32-logior` is the bitwise logical 'inclusive or' operator for `int32` objects.

The function `int32-logand` is the bitwise logical operator for `int32` objects which returns the complement of the 'and' of `x` and `y`.

The function `int32-lognor` is the bitwise logical operator for `int32` objects which returns the complement of the 'inclusive or' of `x` and `y`.

The function `int32-lognot` is the bitwise logical operator for `int32` objects which returns the complement of its argument `x`.

The function `int32-logorc1` is the bitwise logical operator for `int32` objects which 'inclusive ors' the complement of `x` with `y`.

The function `int32-logorc2` is the bitwise logical operator for `int32` objects which 'inclusive ors' `x` with the complement of `y`.

The function `int32-logtest` is the bitwise test for `int32` objects which returns `t` if any of the bits designated by 1 in `x` is 1 in `y`, and returns `nil` otherwise.

The function `int32-logxor` is the bitwise logical 'exclusive or' operator for `int32` objects.

See the section "Fast 32-bit arithmetic" on page 472 for more information about the INT32 API.

See also      `int32`

**int32-minusp**  
**int32-plusp**  
**int32-zerop**

*Functions*

Summary      The `minusp`, `plusp` and `zerop` tests for an `int32` object.

Package      `system`

Signatures    `int32-minusp x => result`  
`int32-plusp x => result`  
`int32-zerop x => result`

Arguments     `x`                  An `int32` object or an integer of type  
`(signed-byte 32)`.

Values        `result`              A boolean.

Description     The function `int32-minusp` tests whether its argument `x` is  
`int32<` than the value of `+int32-0+`.

The function `int32-plusp` tests whether its argument `x` is  
`int32>` than the value of `+int32-0+`.

The function `int32-zerop` tests whether its argument `x` is  
`int32=` to the value of `+int32-0+`.

See the section “Fast 32-bit arithmetic” on page 472 for more  
information about the INT32 API.

See also      `int32`

**int32-to-int64**

*Function*

Summary      Converts from `int32` to `int64`.

Package      `system`

|             |                                                                                                                                                                |                               |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| Signature   | <code>int32-to-int64 x =&gt; y</code>                                                                                                                          |                               |
| Arguments   | <code>x</code>                                                                                                                                                 | An <code>int32</code> object. |
| Values      | <code>y</code>                                                                                                                                                 | An <code>int64</code> object. |
| Description | The function <code>int32-to-int64</code> converts the <code>int32</code> object <code>x</code> to the corresponding <code>int64</code> object <code>y</code> . |                               |
| See also    | <a href="#">int32</a><br><a href="#">int64</a><br><a href="#">int64-to-int32</a>                                                                               |                               |

## int32-to-integer *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                       |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Summary     | The destructor converting an <code>int32</code> object to an integer.                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                       |
| Package     | <code>system</code>                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                       |
| Signature   | <code>int32-to-integer int32 =&gt; integer</code>                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                       |
| Arguments   | <code>int32</code>                                                                                                                                                                                                                                                                                                                                                                                                                                          | An <code>int32</code> object or an integer of type<br><code>(signed-byte 32)</code> . |
| Values      | <code>integer</code>                                                                                                                                                                                                                                                                                                                                                                                                                                        | An integer of type <code>(signed-byte 32)</code> .                                    |
| Description | <p>The function <code>int32-to-integer</code> returns an integer <code>integer</code> of type <code>(signed-byte 32)</code> corresponding to the <code>int32</code> object <code>int32</code>. The argument <code>int32</code> can also be an integer of type <code>(signed-byte 32)</code>, in which case it is simply returned.</p> <p>An error is signaled if <code>int32</code> is not of type <code>int32</code> or <code>(signed-byte 32)</code>.</p> |                                                                                       |

See the section “Fast 32-bit arithmetic” on page 472 for more information about the INT32 API.

See also      [int32](#)

## **int64** *Type*

Summary      A type used to generate optimal 64-bit arithmetic code.

Package      [system](#)

Signature      [int64](#)

Description      The type `int64` is used to generate optimal 64-bit arithmetic code.

Objects of type `int64` are generated and can be manipulated using the functions in the INT64 API but the compiler can optimize such source code by eliminating the intermediate `int64` objects to produce efficient raw 64-bit code.

See the section “Fast 64-bit arithmetic” on page 474 for more information.

See also      [int64\\*](#)  
[+int64-0+](#)  
[+int64-1+](#)  
[int64-1+](#)  
[int64/=](#)  
[int64<<](#)  
[int64-aref](#)  
[int64-logand](#)  
[int64-minusp](#)  
[int64-to-integer](#)  
[integer-to-int64](#)  
[make-simple-int64-vector](#)  
[simple-int64-vector](#)

**int64\***  
**int64+**  
**int64-**  
**int64/** *Functions*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                       |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Summary     | The arithmetic operators for <code>int64</code> objects.                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                       |
| Package     | <code>system</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                       |
| Signatures  | <code>int64* x y =&gt; int64</code><br><code>int64+ x y =&gt; int64</code><br><code>int64- x y =&gt; int64</code><br><code>int64/ x y =&gt; int64</code>                                                                                                                                                                                                                                                                                                                                           |                                                                                       |
| Arguments   | <code>x</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | An <code>int64</code> object or an integer of type<br><code>(signed-byte 64)</code> . |
|             | <code>y</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | An <code>int64</code> object or an integer of type<br><code>(signed-byte 64)</code> . |
| Values      | <code>int64</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | An <code>int64</code> object.                                                         |
| Description | <p>The function <code>int64*</code> is the multiply operator for <code>int64</code> objects.</p> <p>The function <code>int64+</code> is the add operator for <code>int64</code> objects.</p> <p>The function <code>int64-</code> is the subtract operator for <code>int64</code> objects.</p> <p>The function <code>int64/</code> is the divide operator for <code>int64</code> objects.</p> <p>See the section “Fast 64-bit arithmetic” on page 474 for more information about the INT64 API.</p> |                                                                                       |
| See also    | <code>int64</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                       |

## **+int64-0+** *Symbol Macro*

|             |                                                                                             |
|-------------|---------------------------------------------------------------------------------------------|
| Summary     | Shorthand for ( <code>sys:integer-to-int64 0</code> ).                                      |
| Package     | <code>system</code>                                                                         |
| Description | The symbol macro <code>+int64-0+</code> expands to ( <code>sys:integer-to-int64 0</code> ). |
| See also    | <code>integer-to-int64</code>                                                               |

## **+int64-1+** *Symbol Macro*

|             |                                                                                             |
|-------------|---------------------------------------------------------------------------------------------|
| Summary     | Shorthand for ( <code>sys:integer-to-int64 1</code> ).                                      |
| Package     | <code>system</code>                                                                         |
| Description | The symbol macro <code>+int64-1+</code> expands to ( <code>sys:integer-to-int64 1</code> ). |
| See also    | <code>integer-to-int64</code>                                                               |

## **int64-1+**

## **int64-1-** *Functions*

|            |                                                                                                                   |
|------------|-------------------------------------------------------------------------------------------------------------------|
| Summary    | The operators for <code>int64</code> objects corresponding to the functions <code>1+</code> and <code>1-</code> . |
| Package    | <code>system</code>                                                                                               |
| Signatures | <code>int64-1+ x =&gt; int64</code><br><code>int64-1- x =&gt; int64</code>                                        |

|             |                    |                                                                                                                                                                                                                                                                                           |
|-------------|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arguments   | <code>x</code>     | An <code>int64</code> object or an integer of type<br>( <code>signed-byte 64</code> ).                                                                                                                                                                                                    |
| Values      | <code>int64</code> | An <code>int64</code> object.                                                                                                                                                                                                                                                             |
| Description |                    | The functions <code>int64-1+</code> and <code>int64-1-</code> are the operators for <code>int64</code> objects corresponding to the functions <code>1+</code> and <code>1-</code> .<br><br>See the section “Fast 64-bit arithmetic” on page 474 for more information about the INT64 API. |
| See also    |                    | <code>int64</code>                                                                                                                                                                                                                                                                        |

**int64/=****int64<****int64<=****int64=****int64>****int64>=***Functions*

Summary      The comparison operators for `int64` objects.

Package      `system`

Signatures    `int64/= x y => result`  
`int64< x y => result`  
`int64<= x y => result`  
`int64= x y => result`  
`int64> x y => result`  
`int64>= x y => result`

Arguments    `x`      An `int64` object or an integer of type  
(`signed-byte 64`).

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
|             | <i>y</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | An <code>int64</code> object or an integer of type<br>( <code>signed-byte 64</code> ).         |
| Values      | <i>result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | A boolean.                                                                                     |
| Description | The function <code>int64/=</code> is the not equal comparison for <code>int64</code> objects.<br><br>The function <code>int64&lt;</code> is the less than comparison for <code>int64</code> objects.<br><br>The function <code>int64&lt;=</code> is the less than or equal comparison for <code>int64</code> objects.<br><br>The function <code>int64=</code> is the equal comparison for <code>int64</code> objects.<br><br>The function <code>int64&gt;</code> is the greater than comparison for <code>int64</code> objects.<br><br>The function <code>int64&gt;=</code> is the greater than or equal comparison for <code>int64</code> objects. |                                                                                                |
|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | See the section “Fast 64-bit arithmetic” on page 474 for more information about the INT64 API. |
| See also    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <code>int64</code>                                                                             |

## `int64<<`

## `int64>>`

## *Functions*

|            |                                                                                            |
|------------|--------------------------------------------------------------------------------------------|
| Summary    | The shift operators for <code>int64</code> objects.                                        |
| Package    | <code>system</code>                                                                        |
| Signatures | <code>int64&lt;&lt; x y =&gt; result</code><br><code>int64&gt;&gt; x y =&gt; result</code> |

|             |               |                                                                                                                                                                                                                                                                                                                 |
|-------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arguments   | <b>x</b>      | An <code>int64</code> object or an integer of type<br>( <code>signed-byte 64</code> ).                                                                                                                                                                                                                          |
|             | <b>y</b>      | An <code>int64</code> object or an integer of type<br>( <code>signed-byte 64</code> ).                                                                                                                                                                                                                          |
| Values      | <b>result</b> | An <code>int64</code> object.                                                                                                                                                                                                                                                                                   |
| Description |               | The function <code>int64&lt;&lt;</code> is a shift left operator for <code>int64</code> objects.<br><br>The function <code>int64&gt;&gt;</code> is a shift right operator for <code>int64</code> objects.<br><br>See the section “Fast 64-bit arithmetic” on page 474 for more information about the INT64 API. |
| See also    |               | <code>int64</code>                                                                                                                                                                                                                                                                                              |

|             |                   | <i>Function</i>                                                                                                                                       |
|-------------|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <b>int64-aref</b> |                                                                                                                                                       |
| Summary     |                   | The accessor for a <code>simple-int64-vector</code> .                                                                                                 |
| Package     |                   | <code>system</code>                                                                                                                                   |
| Signature   |                   | <code>int64-aref vector index =&gt; int64</code><br><code>(setf int64-aref) x vector index =&gt; int64</code>                                         |
| Arguments   | <b>vector</b>     | An <code>simple-int64-vector</code> .                                                                                                                 |
|             | <b>index</b>      | A non-negative fixnum.                                                                                                                                |
|             | <b>x</b>          | An <code>int64</code> object or an integer of type<br>( <code>signed-byte 64</code> ).                                                                |
| Values      | <b>int64</b>      | An <code>int64</code> object.                                                                                                                         |
| Description |                   | The function <code>int64-aref</code> is the accessor for a <code>simple-int64-vector</code> . The reader returns an <code>int64</code> object for the |

value at index *index* in *vector*. The writer sets the value at index *index* in *vector* to the `int64` object or integer *x* supplied.

See the section “Fast 64-bit arithmetic” on page 474 for more information about the INT64 API.

See also

`int64`

`simple-int64-vector`

`int64-logand`

`int64-logandc1`

`int64-logandc2`

`int64-logbitp`

`int64-logeqv`

`int64-logior`

`int64-lognand`

`int64-lognor`

`int64-lognot`

`int64-logorc1`

`int64-logorc2`

`int64-logtest`

`int64-logxor`

*Functions*

Summary

The bitwise logical operators for `int64` objects.

Package

`system`

Signatures

`int64-logand x y => int64`

`int64-logandc1 x y => int64`

`int64-logandc2 x y => int64`

`int64-logbitp index x => result`

`int64-logeqv x y => int64`

```

int64-logior x y => int64
int64-logrand x y => int64
int64-lognor x y => int64
int64-lognot x => int64
int64-logorc1 x y => int64
int64-logorc2 x y => int64
int64-logtest x y => result
int64-logxor x y => int64

```

|             |               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arguments   | <i>x</i>      | An <b>int64</b> object or an integer of type<br><b>(signed-byte 64)</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|             | <i>y</i>      | An <b>int64</b> object or an integer of type<br><b>(signed-byte 64)</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|             | <i>index</i>  | An <b>int64</b> object or an integer of type<br><b>(signed-byte 64)</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Values      | <b>int64</b>  | An <b>int64</b> object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|             | <b>result</b> | An boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Description |               | <p>The function <b>int64-logand</b> is the bitwise logical 'and' operator for <b>int64</b> objects.</p> <p>The function <b>int64-logandc1</b> is the bitwise logical operator for <b>int64</b> objects which 'ands' the complement of <i>x</i> with <i>y</i>.</p> <p>The function <b>int64-logandc2</b> is the bitwise logical operator for <b>int64</b> objects which 'ands' <i>x</i> with the complement of <i>y</i>.</p> <p>The function <b>int64-logbitp</b> is the test for <b>int64</b> objects which returns <b>t</b> if if the bit at index <i>index</i> in <i>x</i> is 1, and <b>nil</b> if it is 0.</p> <p>The function <b>int64-logeqv</b> is the bitwise logical operator for <b>int64</b> objects which returns the complement of the 'exclusive or' of <i>x</i> and <i>y</i>.</p> |

The function `int64-logior` is the bitwise logical 'inclusive or' operator for `int64` objects.

The function `int64-logand` is the bitwise logical operator for `int64` objects which returns the complement of the 'and' of `x` and `y`.

The function `int64-lognor` is the bitwise logical operator for `int64` objects which returns the complement of the 'inclusive or' of `x` and `y`.

The function `int64-lognot` is the bitwise logical operator for `int64` objects which returns the complement of its argument `x`.

The function `int64-logorc1` is the bitwise logical operator for `int64` objects which 'inclusive ors' the complement of `x` with `y`.

The function `int64-logorc2` is the bitwise logical operator for `int64` objects which 'inclusive ors' `x` with the complement of `y`.

The function `int64-logtest` is the bitwise test for `int64` objects which returns `t` if any of the bits designated by 1 in `x` is 1 in `y`, and returns `nil` otherwise.

The function `int64-logxor` is the bitwise logical 'exclusive or' operator for `int64` objects.

See the section "Fast 64-bit arithmetic" on page 474 for more information about the INT64 API.

See also      `int64`

`int64-minusp`

`int64-plusp`

`int64-zerop`

*Functions*

Summary      The `minusp`, `plusp` and `zerop` tests for an `int64` object.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                       |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Package     | <code>system</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                       |
| Signatures  | <code>int64-minusp x =&gt; result</code><br><code>int64-plusp x =&gt; result</code><br><code>int64-zerop x =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                       |
| Arguments   | <code>x</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | An <code>int64</code> object or an integer of type<br><code>(signed-byte 64)</code> . |
| Values      | <code>result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | A boolean.                                                                            |
| Description | <p>The function <code>int64-minusp</code> tests whether its argument <code>x</code> is <code>int64&lt;</code> than the value of <code>+int64-0+</code>.</p> <p>The function <code>int64-plusp</code> tests whether its argument <code>x</code> is <code>int64&gt;</code> than the value of <code>+int64-0+</code>.</p> <p>The function <code>int64-zerop</code> tests whether its argument <code>x</code> is <code>int64=</code> to the value of <code>+int64-0+</code>.</p> <p>See the section “Fast 64-bit arithmetic” on page 474 for more information about the INT64 API.</p> |                                                                                       |
| See also    | <code>int64</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                       |

| <b>int64-to-int32</b> |                                                          | <i>Function</i>               |
|-----------------------|----------------------------------------------------------|-------------------------------|
| Summary               | Converts from <code>int64</code> to <code>int32</code> . |                               |
| Package               | <code>system</code>                                      |                               |
| Signature             | <code>int64-to-int32 x =&gt; y</code>                    |                               |
| Arguments             | <code>x</code>                                           | An <code>int64</code> object. |
| Values                | <code>y</code>                                           | An <code>int32</code> object. |

Description      The function `int64-to-int32` converts the `int64` object `x` to the corresponding `int32` object `y`.

See also      `int32`  
                 `int32-to-int64`  
                 `int64`

## **int64-to-integer** *Function*

Summary      The destructor converting an `int64` object to an integer.

Package      `system`

Signature      `int64-to-integer int64 => integer`

Arguments      `int64`      An `int64` object or an integer of type  
`(signed-byte 64)`.

Values      `integer`      An integer of type `(signed-byte 64)`.

Description      The function `int64-to-integer` returns an integer `integer` of type `(signed-byte 64)` corresponding to the `int64` object `int64`. The argument `int64` can also be an integer of type `(signed-byte 64)`, in which case it is simply returned.

An error is signaled if `int64` is not of type `int64` or `(signed-byte 64)`.

See the section “Fast 64-bit arithmetic” on page 474 for more information about the INT64 API.

See also      `int64`

## **integer-to-int32** *Function*

Summary      The constructor for `int32` objects.

|             |                                                                                                                                                                                                                                                                                                             |                                                     |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|
| Package     | <code>system</code>                                                                                                                                                                                                                                                                                         |                                                     |
| Signature   | <code>integer-to-int32 integer =&gt; int32</code>                                                                                                                                                                                                                                                           |                                                     |
| Arguments   | <code>integer</code>                                                                                                                                                                                                                                                                                        | An integer of type ( <code>signed-byte 32</code> ). |
| Values      | <code>int32</code>                                                                                                                                                                                                                                                                                          | An <code>int32</code> object.                       |
| Description | <p>The function <code>integer-to-int32</code> constructs an <code>int32</code> object from an integer. An error is signaled if <code>integer</code> is not of type (<code>signed-byte 32</code>).</p> <p>See the section “Fast 32-bit arithmetic” on page 472 for more information about the INT32 API.</p> |                                                     |
| See also    | <code>int32</code>                                                                                                                                                                                                                                                                                          |                                                     |

|             |                                                                                                                                                                                                                                                                                                             | <i>Function</i>                                     |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|
| Summary     | The constructor for <code>int64</code> objects.                                                                                                                                                                                                                                                             |                                                     |
| Package     | <code>system</code>                                                                                                                                                                                                                                                                                         |                                                     |
| Signature   | <code>integer-to-int64 integer =&gt; int64</code>                                                                                                                                                                                                                                                           |                                                     |
| Arguments   | <code>integer</code>                                                                                                                                                                                                                                                                                        | An integer of type ( <code>signed-byte 64</code> ). |
| Values      | <code>int64</code>                                                                                                                                                                                                                                                                                          | An <code>int64</code> object.                       |
| Description | <p>The function <code>integer-to-int64</code> constructs an <code>int64</code> object from an integer. An error is signaled if <code>integer</code> is not of type (<code>signed-byte 64</code>).</p> <p>See the section “Fast 64-bit arithmetic” on page 474 for more information about the INT64 API.</p> |                                                     |
| See also    | <code>int64</code>                                                                                                                                                                                                                                                                                          |                                                     |

## **\*line-arguments-list\*** *Variable*

**Summary** List of the command line arguments used when LispWorks was invoked.

**Package** `system`

**Initial value** `nil`

**Description** This variable contains a list of strings. These are the arguments with which LispWorks was called, in the same order. The first element is the executable itself.

You can implement command line processing in your application by testing elements in `*line-arguments-list*`. Use a string comparison function such as `string=` to compare them.

For a description of the command line arguments processed by LispWorks, see “The Command Line” on page 454.

**See also** `lisp-image-name`

## **load-data-file** *Function*

**Summary** Loads a binary data file created by `dump-forms-to-file` or `with-output-to-fasl-file`.

**Package** `system`

**Description** `load-data-file` is now exported from the `HCL` package, and has additional functionality since LispWorks 7.0

View the full manual entry for details: `load-data-file`.

| <b>locale-file-encoding</b> | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary                     | Provides an encoding corresponding to the current code page on Microsoft Windows, and the locale on Unix.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Package                     | <code>system</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Signature                   | <code>locale-file-encoding pathname ef-spec buffer length =&gt; new-ef-spec</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Arguments                   | <p><i>pathname</i> Pathname identifying location of <i>buffer</i>.</p> <p><i>ef-spec</i> An external format spec.</p> <p><i>buffer</i> A buffer whose contents are examined.</p> <p><i>length</i> Length (an integer) up to which <i>buffer</i> should be examined.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Values                      | <i>new-ef-spec</i> Default external format spec created by merging <i>ef-spec</i> with the encoding that was found.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Description                 | <p>The function <code>locale-file-encoding</code> consults the ANSI code page on Microsoft Windows. If the code page identifier is in <code>win32:*latin-1-code-pages*</code>, <code>locale-file-encoding</code> merges <i>ef-spec</i> with <code>:latin-1</code>. This external format writes Latin-1 on output, giving an error for any non-Latin-1 characters that are written. If the code page identifier is not in <code>win32:*latin-1-code-pages*</code> then <code>locale-file-encoding</code> merges <i>ef-spec</i> with an encoding corresponding to the current code page that gives an error for characters that cannot be encoded.</p> <p><code>locale-file-encoding</code> merges <i>ef-spec</i> with <code>:latin-1</code> on Unix.</p> |
| See also                    | <ul style="list-style-type: none"> <li><code>*file-encoding-detection-algorithm*</code></li> <li><code>*latin-1-code-pages*</code></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

```
*multibyte-code-page-ef*
safe-locale-file-encoding
```

## low-level-atomic-place-p *Function*

|             |                                                                                                                                                                                                                                                                                                                               |                       |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Summary     | The predicate for whether a place is suitable for use with the low-level atomic operators.                                                                                                                                                                                                                                    |                       |
| Signature   | <code>low-level-atomic-place-p <i>place</i> &amp;optional <i>environment</i> =&gt; <i>result</i></code>                                                                                                                                                                                                                       |                       |
| Arguments   | <i>place</i>                                                                                                                                                                                                                                                                                                                  | A place               |
|             | <i>environment</i>                                                                                                                                                                                                                                                                                                            | An environment object |
| Values      | <i>result</i>                                                                                                                                                                                                                                                                                                                 | A boolean             |
| Description | <p>The function <code>low-level-atomic-place-p</code> is the predicate for whether the place <i>place</i> is one of the places for which low-level atomic operations are defined, and is therefore suitable for use with those operators.</p> <p>These places are described in “Low level atomic operations” on page 299.</p> |                       |
| See also    | <code>atomic-decf</code><br><code>atomic-exchange</code><br><code>atomic-fixnum-decf</code><br><code>atomic-pop</code><br><code>atomic-push</code><br><code>compare-and-swap</code><br><code>define-atomic-modify-macro</code>                                                                                                |                       |

|             | <b>make-current-allocation-permanent</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <i>Function</i> |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Summary     | Mobile GC only: Makes all the objects currently in generation 2 permanent (non-GCable).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |
| Package     | <code>system</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                 |
| Signature   | <code>make-current-allocation-permanent &amp;key gc-p coalesce</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |
| Arguments   | <code>gc-p, coalesce</code><br>Booleans.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                 |
| Description | <p>The function <code>make-current-allocation-permanent</code> makes all the objects currently allocated in generation 2 permanent, which means that they will never be GCed.</p> <p>If <code>gc-p</code> is non-nil (the default) then <code>make-current-allocation-permanent</code> does an initial GC by calling <code>(gc-generation 2 :coalesce coalesce)</code>, which by default means that all currently live objects are promoted to generation 2, and hence are made permanent. <code>coalesce</code> defaults to <code>t</code>. See the documentation for <code>gc-generation</code> for details.</p> <p>For Static objects, only segments that are in generation 2 are made permanent (because static objects are never promoted between generations).</p> <p>The function <code>generation-number</code> returns 3 when its argument is a permanent object. <code>room</code> reports the Other and Cons objects that were made permanent under Permanent Other and Permanent Cons, except Large and Static, where (<code>room t</code>) reports permanent segments as being in generation 3.</p> <p>Making objects permanent saves work for the GC, but wastes some memory. Repeated calls to <code>make-current-allocation-permanent</code> wastes more memory. The operation itself is fast, but the initial GC takes time depending on the amount allocated.</p> |                 |

Notes      The operation is done by moving whole segments to the permanent segments, which means that any free area in the segments is moved as well and hence is wasted (permanently). It is therefore essential to reduce the free area in generation 2 before calling `make-current-allocation-permanent` by performing a GC of generation 2. Hence you should pass `gc-p nil` only if you already did the GC of generation 2 explicitly.

Passing `coalesce nil` means that currently live objects in generation 0 are not made permanent. This is useful for objects that are short-lived, but will cause young long-lived objects to stay in the GCed generations. The effect either way is unlikely to be large.

Note also that since permanent objects are not GCed, a permanent object that points to a non-permanent one will keep the non-permanent object live forever (unless the pointer is overwritten explicitly by the application). That will make the non-permanent object live forever as well, and hence add work for the GC.

The main effect of making objects permanent is to reduce the time and the memory peak required for GC of generation 2, so can have a very beneficial effect on performance. It is particularly useful if the relatively few objects are allocated after the call that live forever, so the size of generation 2 after a GC of generation 2 is relatively small. Using `make-current-allocation-permanent` is probably useful even if 20% of the permanent objects would have died after a while if left in the GCable generations. If the application does not create new permanent objects, but does have objects that live long enough to be promoted to generation 2 before dying ("generation leak"), it maybe useful to call `make-current-allocation-permanent` even if 50% of the objects would have died otherwise. These percentages should only be used as a guide.

`make-current-allocation-permanent` wastes the memory that is free in generation 2 before the operation. The amount of free memory after the initial GC is typically independent

of the amount allocated, and averages around 8 MB. Thus it is not useful to use `make-current-allocation-permanent` unless you have significantly more than 8 MB of permanent objects. The waste happens on each call to `make-current-allocation-permanent`, so you should minimize the number of calls and typically call it once in a run of the application.

The amount wasted in the permanent areas is the amount that `room` reports as free under Permanent Cons and Permanent Other, plus the size of the objects in these areas that are effectively dead (not pointed by any other live object). Since the GC does not collect the permanent objects, there is no easy way to know which of them are effectively dead. If you want to know that, you need to run the application without calling `make-current-allocation-permanent`, see how much is allocated in generation 2 in this case, and compare this to the amount allocated permanently when you do call `make-current-allocation-permanent`.

Large objects (currently that means larger than 1 MB) can be made permanent individually by `make-object-permanent` and `make-permanent-simple-vector`, and can be explicitly released and the memory returned to the operating system by using `release-object-and-nullify`.

See also

`gc-generation`  
`make-object-permanent`  
`make-permanent-simple-vector`  
`release-object-and-nullify`  
“Preventing/reducing GC of generation 2” on page 159  
“Mobile GC technical details” on page 154

## **make-gesture-spec**

## *Function*

Summary      Create a Gesture Spec object.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                     |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| Package     | <code>system</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |
| Signature   | <code>make-gesture-spec data modifiers &amp;optional can-shift-both-case-p =&gt; gspec</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                     |
| Arguments   | <code>data</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | A non-negative integer less than <code>c1:char-code-limit</code> , or a Gesture Spec keyword, or <code>nil</code> . |
|             | <code>modifiers</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | A non-negative integer less than 64, or <code>nil</code> .                                                          |
|             | <code>can-shift-both-case-p</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | A generalized boolean.                                                                                              |
| Values      | <code>gspec</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | A Gesture Spec object                                                                                               |
| Description | <p>The function <code>make-gesture-spec</code> returns a new Gesture Spec object <code>gspec</code>. This can be used to represent a keystroke consisting of the key indicated by <code>data</code>, modified by the modifier keys indicated by <code>modifiers</code>.</p> <p>If <code>data</code> is an integer, it represents the key (<code>code-char data</code>). If <code>data</code> is a keyword, it must be one of the known Gesture Spec keywords and represents the key with the same name. If <code>data</code> is <code>nil</code>, then <code>gspec</code> has a wild data component.</p> |                                                                                                                     |
|             | These are the Gesture Spec keywords:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                     |
|             | <code>:f1</code><br><code>:f2</code><br><code>:f3</code><br><code>:f4</code><br><code>:f5</code><br><code>:f6</code><br><code>:f7</code><br><code>:f8</code><br><code>:f9</code><br><code>:f10</code>                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                     |

```
:f11
:f12
:f13
:f14
:f15
:f16
:f17
:f18
:f19
:f20
:f21
:f22
:f23
:f24
:f25
:f26
:f27
:f28
:f29
:f30
:f31
:f32
:f33
:f34
:f35
:help
:left
:right
:up
:down
:home
```

:prior  
:next  
:end  
:begin  
:select  
:print  
:execute  
:insert  
:undo  
:redo  
:menu  
:find  
:cancel  
:break  
:clear  
:pause  
:kp-f1  
:kp-f2  
:kp-f3  
:kp-f4  
:kp-enter  
:applications-menu  
:print-screen  
:scroll-lock  
:sys-req  
:reset  
:stop  
:user  
:system  
:clear-line  
:clear-display

```
:insert-line
:delete-line
:insert-char
:delete-char
:prev-item
:next-item
```

Not all of these Gesture Spec keywords will be generated by all platforms and/or keyboards.

If *modifiers* is an integer, it represents modifier keys according to the values `gesture-spec-accelerator-bit`, `gesture-spec-control-bit`, `gesture-spec-hyper-bit`, `gesture-spec-meta-bit`, `gesture-spec-shift-bit`, and `gesture-spec-super-bit`. If *modifiers* is `nil`, then *gspec* has a wild modifiers component.

The gesture `Shift+x` could potentially be represented by the unmodified uppercase character `x`, or lowercase `x` with the `Shift` modifier. In order to ensure a consistent representation the latter form is not supported by Gesture Specs by default. That is, a `both-case-p` character may not be combined with the single modifier `Shift` in the accelerator argument. This can be overridden by passing a true value for `can-shift-both-case-p`.

A `both-case-p` character is allowed with `Shift` if there are other modifiers. See the below for examples.

Wild Gesture Specs can be useful when specifying an input model for a `capi:output-pane`.

#### Example

```
(sys:make-gesture-spec
 97
  (logior sys:gesture-spec-control-bit
          sys:gesture-spec-meta-bit))
```

A `both-case-p` character may not be combined with the single modifier `Shift` in the accelerator argument, so code like this signals an error:

```
(sys:make-gesture-spec
  (char-code #\x)
  sys:gesture-spec-shift-bit)
```

Instead you should use:

```
(sys:make-gesture-spec (char-code #\X) 0)
```

A **both-case-p** character is allowed with **Shift** if there are other modifiers:

```
(sys:make-gesture-spec
  (char-code #\x)
  (logior sys:gesture-spec-shift-bit
          sys:gesture-spec-meta-bit))
```

See also

**gesture-spec-accelerator-bit**  
**gesture-spec-control-bit**  
**gesture-spec-data**  
**gesture-spec-hyper-bit**  
**gesture-spec-meta-bit**  
**gesture-spec-modifiers**  
**gesture-spec-p**  
**gesture-spec-shift-bit**  
**gesture-spec-super-bit**  
**print-pretty-gesture-spec**

## make-object-permanent

## *Function*

Summary      Mobile GC only: Make a large object permanent.

Package      **system**

Signature      **make-object-permanent** *object* => *did-it-p*

Arguments      *object*      An object that is allocated in its own segment.

Values      *did-it-p*      A boolean.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The function <code>make-object-permanent</code> makes <i>object</i> permanent (if possible), which means that GC will never scan or free it (but will still follow pointers from it). That reduces the amount of work for the GC.</p> <p><code>make-object-permanent</code> can only make <i>object</i> permanent if it is allocated in its own segment, so it must be a large object (&gt; 1 MB).</p> <p><code>make-object-permanent</code> returns true if <i>object</i> was made permanent (or is already permanent) and false otherwise.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Notes       | <p>An object that has been made permanent will never be freed by the GC, so you must use <code>release-object-and-nullify</code> to free it.</p> <p>After the object is made permanent, the segment in which the object resides is reported by <code>(room t)</code> to be in generation 3.</p> <p><code>make-object-permanent</code> does not work (it just returns false) on an array that is displaced to a vector that is allocated on its own segment. To work it must be called on the vector itself.</p> <p>Large vectors that do not contain pointers (that is every vector except <code>simple-vector</code>) are not scanned by the GC, so making them permanent does not give a significant gain. Thus <code>make-object-permanent</code> is really useful only for <code>simple-vector</code> objects.</p> <p>If you make a new large <code>simple-vector</code> objects and want to make them permanent immediately, it is better to use <code>make-permanent-simple-vector</code>, because <code>make-object-permanent</code> causes the next GC to take more time, while <code>make-permanent-simple-vector</code> does not (unless supplied an initial-element which is not immediate or permanent).</p> |
| See also    | <p><code>make-permanent-simple-vector</code><br/> <code>release-object-and-nullify</code><br/> <code>allocated-in-its-own-segment-p</code><br/> “Special considerations for the Mobile GC” on page 157</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

|             | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Create a permanent (when possible) <b>simple-vector</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Package     | <b>system</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Signature   | <b>make-permanent-simple-vector size &amp;optional initial-element =&gt; simple-vector</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Arguments   | <p><b>size</b>            A fixnum.</p> <p><b>initial-element</b>    Any Lisp object.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Values      | <b>simple-vector</b> A <b>simple-vector</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Description | <p>The function <b>make-permanent-simple-vector</b> creates a <b>simple-vector</b> of length <b>size</b> with initial element <b>initial-element</b> as if by the call <b>(make-array size :initial-element initial-element)</b>, except that it is allocated as a permanent object when possible.</p> <p>When not in the Mobile GC, <b>simple-vector</b> is allocated in the highest generation number.</p> <p>In the Mobile GC, if <b>size</b> is larger than <b>(ash 1 17)</b> (#x20000, 131072), so <b>simple-vector</b> is allocated in its own segment, it is made permanent. Otherwise it is allocated n generation 2.</p> |
| Notes       | <p><b>make-permanent-simple-vector</b> is intended mainly for allocating large <b>simple-vector</b> objects in the Mobile GC (that is, those that can be made permanent). When not in the Mobile GC, it does not do anything that <b>make-array</b> cannot do, but it may be convenient sometimes.</p> <p>Note that, except for large <b>simple-vector</b> objects in the Mobile GC, <b>simple-vector</b> is not actually permanent, and a GC of the highest generation will scan it (or free it if nothing point to it).</p>                                                                                                     |

When *simple-vector* is permanent, and you do not need it any more, then you need to release it by `release-object-and-nullify`.

In the Mobile GC with large vectors, if *initial-element* is not supplied or it is an immediate or a permanent object, `make-permanent-simple-vector` is much better than using `make-object-permanent` after a call to `make-array`, because it knows that it does not contain pointers to a lower generation.

See also

`make-object-permanent`  
`release-object-and-nullify`  
`allocated-in-its-own-segment-p`  
“Special considerations for the Mobile GC” on page 157

## make-simple-int32-vector *Function*

|             |                                                                                                                                                                                                                                                                                |                                                                                       |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Summary     | The constructor for <code>simple-int32-vector</code> objects.                                                                                                                                                                                                                  |                                                                                       |
| Package     | <code>system</code>                                                                                                                                                                                                                                                            |                                                                                       |
| Signature   | <code>make-simple-int32-vector length &amp;key initial-contents initial-element =&gt; vector</code>                                                                                                                                                                            |                                                                                       |
| Arguments   | <code>length</code>                                                                                                                                                                                                                                                            | A non-negative fixnum.                                                                |
|             | <code>initial-contents</code>                                                                                                                                                                                                                                                  | A sequence of integers of type ( <code>signed-byte 32</code> ), or <code>nil</code> . |
|             | <code>initial-element</code>                                                                                                                                                                                                                                                   | An integer of type ( <code>signed-byte 32</code> ).                                   |
| Values      | <code>vector</code>                                                                                                                                                                                                                                                            | A <code>simple-int32-vector</code> .                                                  |
| Description | <p>The function <code>make-simple-int32-vector</code> is the constructor for <code>simple-int32-vector</code> objects.</p> <p>The argument <i>initial-contents</i>, if supplied, should be a sequence of length <i>length</i>. It specifies the contents of <i>vector</i>.</p> |                                                                                       |

The argument *initial-element*, if supplied, specifies the contents of *vector*.

An error is signaled if both *initial-contents* and *initial-element* are supplied.

See the section “Fast 32-bit arithmetic” on page 472 for more information about the INT32 API.

See also

`int32`  
`simple-int32-vector`

**make-simple-int64-vector** *Function*

Summary      The constructor for `simple-int64-vector` objects.

Package      `system`

Signature      `make-simple-int64-vector length &key initial-contents initial-element => vector`

Arguments      *length*      A non-negative fixnum.

*initial-contents*      A sequence of integers of type `(signed-byte 64)`, or `nil`.

*initial-element*      An integer of type `(signed-byte 64)`.

Values      *vector*      A `simple-int64-vector`.

Description      The function `make-simple-int64-vector` is the constructor for `simple-int64-vector` objects.

The argument *initial-contents*, if supplied, should be a sequence of length *length*. It specifies the contents of *vector*.

The argument *initial-element*, if supplied, specifies the contents of *vector*.

An error is signaled if both *initial-contents* and *initial-element* are supplied.

See the section “Fast 64-bit arithmetic” on page 474 for more information about the INT64 API.

See also **int64**  
**simple-int64-vector**

## **make-stderr-stream** *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                   |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| Summary     | Returns an output stream connected to stderr.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                   |
| Package     | <b>system</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                   |
| Signature   | <b>make-stderr-stream</b> => <b>stream</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                   |
| Arguments   | None.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                   |
| Values      | <b>stream</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | An output stream. |
| Description | <p>The function <b>make-stderr-stream</b> returns an output stream connected to stderr.</p> <p><b>make-stderr-stream</b> returns the same stream each time. Calling <b>close</b> on this stream has no effect (except that it forces the output).</p>                                                                                                                                                                                                                                                                             |                   |
| Notes       | <ol style="list-style-type: none"> <li>On Microsoft Windows, if the stderr is not redirected on the command line then output to the stderr stream appears in a console.</li> </ol> <p>The console window will be created if it does not exist. That is not desirable for typical (non-console) applications. Therefore writing to the stderr stream is probably useful only in a console application (see the <b>:console</b> keyword argument in <b>save-image</b>), or when you know that stderr is going to be redirected.</p> |                   |

2. Ensure your delivered Windows application calls `make-stderr-stream` at run time rather than in the build script, because it contains the handle of Windows stderr.
3. On Mac OS X, applications that are launched from the desktop have their stderr redirected to the "console messages".

## **make-typed-aref-vector**

## *Function*

|             |                                                                                                                                                                                                                                                                                                      |  |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Summary     | Makes a vector that can be accessed efficiently.                                                                                                                                                                                                                                                     |  |
| Package     | <code>system</code>                                                                                                                                                                                                                                                                                  |  |
| Signature   | <code>make-typed-aref-vector byte-length =&gt; vector</code>                                                                                                                                                                                                                                         |  |
| Arguments   | <code>byte-length</code> A non-negative fixnum.                                                                                                                                                                                                                                                      |  |
| Values      | <code>vector</code> A vector.                                                                                                                                                                                                                                                                        |  |
| Description | <p>The function <code>make-typed-aref-vector</code> returns a vector which is suitable for efficient access at compiler optimization level safety = 0.</p> <p><code>byte-length</code> is measured in 8-bit bytes.</p> <p>Use <code>typed-aref</code> to access <code>vector</code> efficiently.</p> |  |
| Notes       | <p>Declaring the result of <code>make-typed-aref-vector</code> as <code>c1:dynamic-extent</code> causes it to allocate the array on the stack (in LispWorks 7.0 and later versions).</p>                                                                                                             |  |
| Examples    | <p>To make a typed vector of the type (<code>unsigned-byte 32</code>) or <code>single-float</code> with length 10:</p> <pre>(make-typed-aref-vector (* 10 4))</pre> <p>To make a typed vector of the type <code>double-float</code> with length 10:</p>                                              |  |

```
(make-typed-aref-vector (* 10 8))
```

See also

**typed-aref**

“Optimized integer arithmetic and integer vector access” on page 472

|                        |                 |
|------------------------|-----------------|
| <b>map-environment</b> | <i>Function</i> |
|------------------------|-----------------|

|         |                                                     |
|---------|-----------------------------------------------------|
| Summary | Maps functions over the bindings in an environment. |
|---------|-----------------------------------------------------|

|         |               |
|---------|---------------|
| Package | <b>system</b> |
|---------|---------------|

|           |                                                                 |
|-----------|-----------------------------------------------------------------|
| Signature | <b>map-environment env &amp;key variable function block tag</b> |
|-----------|-----------------------------------------------------------------|

|           |                                         |
|-----------|-----------------------------------------|
| Arguments | <i>env</i> An environment or <b>nil</b> |
|-----------|-----------------------------------------|

|                 |                       |
|-----------------|-----------------------|
| <i>variable</i> | A function designator |
|-----------------|-----------------------|

|                 |                       |
|-----------------|-----------------------|
| <i>function</i> | A function designator |
|-----------------|-----------------------|

|              |                       |
|--------------|-----------------------|
| <i>block</i> | A function designator |
|--------------|-----------------------|

|            |                       |
|------------|-----------------------|
| <i>tag</i> | A function designator |
|------------|-----------------------|

|             |                                                                                                                                                                                                                                                                                 |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | The function <b>map-environment</b> calls <i>variable</i> for each local variable binding in <i>env</i> , <i>function</i> for each local function binding in <i>env</i> , <i>block</i> for each block binding in <i>env</i> and <i>tag</i> for each tag binding in <i>env</i> . |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                 |                                                               |
|-----------------|---------------------------------------------------------------|
| <i>variable</i> | is called with the following arguments: <i>name kind info</i> |
|-----------------|---------------------------------------------------------------|

|             |                            |
|-------------|----------------------------|
| <i>name</i> | A symbol naming a variable |
|-------------|----------------------------|

|             |                                                                                                                                           |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| <i>kind</i> | One of <b>:special</b> , <b>:symbol-macro</b> or <b>:lexical</b> , which specifies the kind of binding (see <b>variable-information</b> ) |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------|

|             |                                                                                                 |
|-------------|-------------------------------------------------------------------------------------------------|
| <i>info</i> | The symbol-macro expansion if <i>kind</i> is <b>:symbol-macro</b> and is unspecified otherwise. |
|-------------|-------------------------------------------------------------------------------------------------|

*function* is called with the following arguments: *name kind info*

|             |                                                                                                                                      |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------|
| <i>name</i> | A symbol naming a function.                                                                                                          |
| <i>kind</i> | One of <code>:macro</code> or <code>:function</code> , which specifies the kind of binding (see <code>function-information</code> ). |
| <i>info</i> | The macro expansion function if <i>kind</i> is <code>:macro</code> and is unspecified otherwise.                                     |

*block* is called with the following arguments: *name kind info*

|             |                                 |
|-------------|---------------------------------|
| <i>name</i> | A symbol naming a block.        |
| <i>kind</i> | The keyword <code>:block</code> |
| <i>info</i> | Unspecified.                    |

*tag* is called with the following arguments: *name kind info*

|             |                               |
|-------------|-------------------------------|
| <i>name</i> | A symbol naming a tag.        |
| <i>kind</i> | The keyword <code>:tag</code> |
| <i>info</i> | Unspecified                   |

See also

`augment-environment`  
`declaration-information`  
`define-declaration`  
`function-information`  
`variable-information`

## marking-gc

## *Function*

Summary

Performs a Marking GC in 64-bit LispWorks.

Package

`system`

Signature

`marking-gc gen-num &key what-to-copy max-size max-size-to-copy fragmentation-threshold`

Arguments

*gen-num* An integer in the inclusive range [0,7].

|             |                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <i>what-to-copy</i>            | One of the keywords : <b>cons</b> , : <b>symbol</b> , : <b>function</b> , : <b>non-pointer</b> , : <b>other</b> , : <b>weak</b> , : <b>all</b> or : <b>default</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|             | <i>max-size-to-copy</i>        | A positive number or <b>nil</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|             | <i>max-size</i>                | A synonym for <i>max-size-to-copy</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|             | <i>fragmentation-threshold</i> | A number in the inclusive range [0, 10].                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Description |                                | <p>The function <b>marking-gc</b> garbage collects (GCs) the generation specified by <i>gen-num</i>, and all younger generations. It uses mark and sweep, rather than copy.</p> <p>Mark and sweep garbage collection uses less virtual memory during its operation, but leaves the memory fragmented, which has a detrimental effect on the performance of the system afterwards. It is therefore not used automatically by the system, except to garbage collect static objects.</p> <p><b>marking-gc</b> is useful when you want to GC a generation which contains large amount (gigabytes) of data, to make sure there are no spurious pointers from this generation to a younger generation, and you do not expect many objects in the large generation to be collected. In this scenario, a Copying GC would use virtual memory which is almost double the size of the large generation during its operation, and so would possibly cause heavy paging.</p> <p>Marking GC causes fragmentation. You can reduce the amount of fragmentation by supplying either (or both) of the arguments <i>what-to-copy</i> and <i>max-size-to-copy</i>. These specify that part of the data should be collected by copying instead. Using some copying GC rather than mark and sweep will reduce the amount of fragmentation.</p> <p><i>what-to-copy</i> specifies the allocation type to copy. It can be one of the main allocation types or :<b>weak</b>, meaning copy only objects in segments of that type. <i>what-to-copy</i> can also be :<b>all</b>, meaning copy objects in all segments. If <i>what-to-copy</i> is</p> |

`:default` then each call to `marking-gc` chooses one of the main allocation types or `:weak` to copy, and successive calls with `:default` cycle through these allocation types.

`max-size-to-copy` can be used to limit the amount that is copied, and thus limit the virtual memory that the operation needs. If `max-size-to-copy` is non-nil, it specifies the limit, in gigabytes, of memory that can be used for copying. If there is more than `max-size-to-copy` gigabytes of data of the type `what-to-copy`, the rest of this data is garbage collected by marking. The default value of `max-size-to-copy` is `nil`, which means there is no limit on the amount that is copied.

`fragmentation-threshold` should be a number between 0 and 10. It specifies a minimum ratio between the free area in a segment that cannot be easily used for more allocation and the allocated area in this segment. Segments that are below this threshold are not copied. The default value of `fragmentation-threshold` is 1.

**Notes** `marking-gc` is implemented only in 64-bit LispWorks. It is not relevant to the Memory Management API in 32-bit implementations.

In the Mobile GC, `marking-gc` is equivalent to `(gc-generation gen-num)`.

**See also** `gc-generation`  
`set-blocking-gen-num`  
“Guidance for control of the memory management system”  
on page 130

## **memory-growth-margin** *Function*

**Summary** Returns the difference between the top of the Lisp heap and a maximum memory limit in 32-bit LispWorks.

**Package** `system`

|             |                                                                                                                                                                                                                                                                                                                                                                            |                                           |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| Signature   | <code>memory-growth-margin =&gt; result</code>                                                                                                                                                                                                                                                                                                                             |                                           |
| Values      | <code>result</code>                                                                                                                                                                                                                                                                                                                                                        | An integer address, or <code>nil</code> . |
| Description | <p>If a limit on the maximum memory has been set by <code>set-maximum-memory</code>, then <code>memory-growth-margin</code> returns the difference between the current top of the Lisp heap and that limit. That is, the amount by which the heap can grow.</p> <p>Otherwise <code>memory-growth-margin</code> returns <code>nil</code>. This is the default behavior.</p> |                                           |
| Notes       | <p><code>memory-growth-margin</code> is implemented only in 32-bit LispWorks. It is not relevant to the Memory Management API in 64-bit implementations.</p>                                                                                                                                                                                                               |                                           |
| See also    | <p><code>set-maximum-memory</code><br/> <a href="#">“Memory Management in 32-bit LispWorks” on page 135</a></p>                                                                                                                                                                                                                                                            |                                           |

| <b>merge-ef-specs</b> |                                                                          | <i>Function</i>                                                                                                  |
|-----------------------|--------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| Summary               | Creates a new external format spec from two other external format specs. |                                                                                                                  |
| Package               | <code>system</code>                                                      |                                                                                                                  |
| Signature             | <code>merge-ef-specs ef-spec1 ef-spec2 =&gt; ef-spec</code>              |                                                                                                                  |
| Arguments             | <code>ef-spec1</code>                                                    | An external format spec.                                                                                         |
|                       | <code>ef-spec2</code>                                                    | An external format spec.                                                                                         |
| Values                | <code>ef-spec</code>                                                     | The resultant external format spec created from information in <code>ef-spec1</code> and <code>ef-spec2</code> . |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The function <code>merge-ef-specs</code> returns an external format spec constructed by adding information not supplied in <i>ef-spec1</i> from <i>ef-spec2</i>.</p> <p>Each external format spec argument is either a symbol or a list.</p> <p>If <i>ef-spec1</i> and <i>ef-spec2</i> have the same value for their name component (whether they are lists or symbols), return <i>ef-spec1</i> combined with any parameters from <i>ef-spec2</i> that are not specified in <i>ef-spec1</i>.</p> <p>Otherwise, if <i>ef-spec1</i> is <code>:default</code> or a list beginning with <code>:default</code>, return <i>ef-spec2</i> with parameters modified to be a union of the parameters from <i>ef-spec1</i> and <i>ef-spec2</i>, with those from <i>ef-spec1</i> taking priority.</p> <p>Otherwise, return <i>ef-spec1</i> with any <code>:eol-style</code> parameter from <i>ef-spec2</i> if <i>ef-spec1</i> does not specify <code>:eol-style</code>.</p> |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|             | <i>Function</i>                                                                                                                                                                        |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Returns true when using the Mobile GC, otherwise false.                                                                                                                                |
| Package     | <code>system</code>                                                                                                                                                                    |
| Signature   | <code>mobile-gc-p =&gt; result</code>                                                                                                                                                  |
| Values      | <code>result</code> A boolean.                                                                                                                                                         |
| Description | The function <code>mobile-gc-p</code> is a predicate that returns true when 64-bit LispWorks is using the Mobile GC and false otherwise. In 32-bit LispWorks, it always returns false. |
| See also    | “The Mobile GC” on page 151                                                                                                                                                            |

|             | <b>mobile-gc-sweep-objects</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <i>Function</i> |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Summary     | Mobile GC only: Sweeps objects for the Mobile GC.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                 |
| Package     | <code>system</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                 |
| Signature   | <code>mobile-gc-sweep-objects function &amp;key permanent permanent-weak permanent-non-pointer permanent-new long-lived static large gen-0 gen-1 gen-2</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                 |
| Arguments   | <p><i>function</i>      A function or fbound symbol that takes one argument.</p> <p><i>permanent, permanent-weak, permanent-non-pointer, permanent-new, long-lived, static, large, gen-0, gen-1, gen-2</i></p> <p>Booleans.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |
| Description | <p>The function <code>mobile-gc-sweep-objects</code> sweeps objects in the manner that <code>sweep-all-objects</code> and <code>sweep-gen-num-objects</code> do, but gives you a better control over which objects are swept. It is therefore most efficient for sweeping certain subsets of the objects.</p> <p><i>function</i> is called with each object that matches the criteria specified by non-nil values of the keyword arguments.</p> <p>Permanent objects are objects that the GC does not scan or free, which include objects that were alive when the image was delivered and objects that were alive when <code>make-current-allocation-permanent</code> was called. Large objects that were made permanent by <code>make-object-permanent</code> or <code>make-permanent-simple-vector</code> are also permanent, but in <code>mobile-gc-sweep-objects</code> sweeping them is controlled by <code>large</code>.</p> <p><i>permanent</i> defaults to <code>nil</code>. It controls whether sweeping includes permanent objects that contain pointers, and is also the default value for <code>permanent-weak</code>, <code>permanent-non-pointer</code> and <code>permanent-new</code>. <code>permanent-weak</code> controls sweeping of per-</p> |                 |

manent weak objects. *permanent-non-pointer* control sweeping of permanent objects that do not contain pointers. *permanent-new* controls sweeping of objects that were made permanent by a call to `make-current-allocation-permanent`.

*long-lived* defaults to `nil`, and is used as the default value for *gen-2*, *gen-1*, *large* and *static*. *gen-0* defaults to `nil`. Therefore, if *long-lived* is non-nil and no other keyword arguments are supplied, then all non permanent objects are swept except those in generation 0.

*gen-2*, *gen-1*, *gen-0*, *large* and *static* control the sweeping of ordinary objects in generation 2, generation 1, generation 0, large objects and static objects respectively.

Notes With the default values of the keywords, `mobile-gc-sweep-objects` does nothing.

`mobile-gc-sweep-objects` is useful for sweeping specific objects, for example all static objects. For this case, it is much more efficient than using `sweep-all-objects` and checking each object using `staticp`.

`mobile-gc-sweep-objects` is thread-safe but not atomic with respect to allocation or GC, so gets confused if a GC occurs while it is sweeping segments that are affected by the GC or there is allocation in any of these segments. It is therefore rarely useful to sweep generation 0, and sweeping generation 1 is probably not useful either.

See also `sweep-all-objects`  
`sweep-gen-num-objects`  
“Mobile GC technical details” on page 154

| object-address | Function                              |
|----------------|---------------------------------------|
| Summary        | Returns the address of a Lisp object. |

|             |                                                                                                                                                                                                                                                                      |                |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| Package     | <code>system</code>                                                                                                                                                                                                                                                  |                |
| Signature   | <code>object-address object =&gt; address</code>                                                                                                                                                                                                                     |                |
| Arguments   | <code>object</code>                                                                                                                                                                                                                                                  | A Lisp object. |
| Values      | <code>address</code>                                                                                                                                                                                                                                                 | An integer.    |
| Description | The function <code>object-address</code> returns the address of the Lisp object <i>object</i> as an integer <i>address</i> . Note that the address of <i>object</i> may change during garbage collection so this integer should be used for debugging purposes only. |                |
| See also    | <a href="#"><code>immediatet</code></a><br><a href="#"><code>object-pointer</code></a><br><a href="#"><code>pointer-from-address</code></a>                                                                                                                          |                |

## **object-pointer** *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                |                |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| Summary     | Returns an integer specifying the representation of an object.                                                                                                                                                                                                                                                                                                                                                                                 |                |
| Package     | <code>system</code>                                                                                                                                                                                                                                                                                                                                                                                                                            |                |
| Signature   | <code>object-pointer object =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                |                |
| Arguments   | <code>object</code>                                                                                                                                                                                                                                                                                                                                                                                                                            | A Lisp object. |
| Values      | <code>result</code>                                                                                                                                                                                                                                                                                                                                                                                                                            | An integer.    |
| Description | The function <code>object-pointer</code> returns an integer specifying the actual representation of the object <i>object</i> . For most objects, that would be the pointer to it, which is its address (as returned by <code>object-address</code> ) plus some tag. Some objects are "immediate" (that is they do not use memory, and <code>immediatet</code> returns t) and for these <code>object-pointer</code> returns the actual address. |                |

The Garbage Collector can move objects, therefore the result of **object-pointer** is not permanent. It should be used only for debugging.

Notes      The result of **object-pointer** is what **cl:print-unreadable-object** uses for the object's "identity". It is normally what appears when using **cl:print-unreadable-object** with *identity t*.

Examples    

```
(let ((gf #'make-instance))
      (format t "~a pointer is ~x~%" gf
              (sys:object-pointer gf)))
```

See also    **immediatep**  
             **object-address**  
             **pointer-from-address**

## octet-ref

## base-char-ref

## Functions

Summary     Loads an octet from a simple vector and returns it as an integer or **base-char**.

Package     **system**

Signature    **octet-ref** **vector** **octet-index** => **iresult**  
**(setf octet-ref)** **int** **vector** **octet-index** => **int**

Signature    **base-char-ref** **vector** **octet-index** => **cresult**  
**(setf base-char-ref)** **char** **vector** **octet-index** => **char**

Arguments    **vector**      A **simple-base-string**, a **simple-bmp-string** or a simple *binary vector* meaning a vector of element type (**unsigned-byte n**) or (**signed-byte n**) for *n* = 8, 16, 32. In 64-bit LispWorks, *n* = 64 is also supported.

|             |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <i>octet-index</i> | A non-negative integer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|             | <i>int</i>         | An integer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|             | <i>char</i>        | A <b>base-char</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Values      | <i>iresult</i>     | An integer in the inclusive range [0, 255].                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|             | <i>cresult</i>     | A <b>base-char</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Description |                    | <p>The functions <b>octet-ref</b> and <b>load</b> an octet (8-bits element) from the simple vector <b>vector</b> at offset <i>octet-index</i>, and return it as an integer or <b>base-char</b>.</p> <p><b>vector</b> must be either a string with element type <b>base-char</b> or <b>bmp-char</b> or a binary vector (as defined above). <b>vector</b> cannot be displaced, adjustable or have a fill pointer, and it cannot be a string with element type <b>character</b>.</p> <p><i>octet-index</i> must be an integer, which is used as the count of octets (rather than array elements) to compute the actual offsets.</p> <p><b>octet-ref</b>, <b>base-char-ref</b> and their setters are intended to allow efficient access to <b>(unsigned-byte 8)</b> vectors and <b>simple-base-string</b> in the same code. For these types of vector they match what <b>aref</b> and <b>(setf aref)</b> do except that they always take and return the same value/result type, while <b>aref</b> and <b>(setf aref)</b> take and return a value of a type which depends on the type of the vector. <b>octet-ref</b> (and <b>base-char-ref</b>) are also more efficient than <b>aref</b>.</p> <p><b>octet-ref</b>, <b>base-char-ref</b> and their setters also work on simple binary vectors with element length other than 8 bits, and the results are consistent between themselves. However their results for such vectors do not match <b>aref</b>, because they will load and set either part of an element or multiple elements. Also the results of <b>octet-ref</b> (and <b>base-char-ref</b>) and the result of <b>aref</b> can differ between different platforms due to endianness.</p> |

Notes      `octet-ref`, `base-char-ref` and their setters cannot be used on a `simple-text-string`.

See also    “Optimized integer arithmetic and integer vector access” on page 472

## **open-pipe** *Function*

Summary    Runs an executable or shell command in a subshell.

Package    `system`

Signature    `open-pipe command &key direction element-type interrupt-off shell-type use-pty save-exit-status => stream`

Arguments    `command`      A string, a list of strings, a simple-vector of strings, or `nil`.

`direction`      `:input`, `:output`, `:io` or `:none`.

`element-type`    A type specifier.

`interrupt-off`   A boolean. Not implemented on Microsoft Windows.

`shell-type`     A shell type.

`use-pty`       A boolean.

`save-exit-status`   A boolean.

Values      `stream`      A pipe stream.

Description    On non-Windows platforms the behavior of `open-pipe` is analogous to that of `popen` in the UNIX library. It creates a pipe to/from a subprocess and returns a stream. The stream can be read from or written to as appropriate.

On Microsoft Windows `open-pipe` calls `CreateProcess` and `CreatePipe` and returns a bidirectional stream.

*command* is interpreted as by `call-system-showing-output`.

*direction* is a keyword for the stream direction. The default value is `:input`. Bidirectional (I/O) pipes may be created by passing `:io`. See the example below. *direction* can also be `:none`, which means no input and no output like `call-system`, but is useful when you want to use `pipe-exit-status` and `pipe-kill-process`. On Windows it is not possible to open a unidirectional pipe, so `:input` and `:output` both have the same effect as `:io`.

When `save-exit-status` is non-nil, the status of the child process that `open-pipe` creates is tracked, so `pipe-exit-status` and `pipe-kill-process` can be used reliably. The default value of `save-exit-status` is `nil`.

*element-type* specifies the type of the stream as with `open`. The default value is `base-char`. This argument is ignored on Microsoft Windows.

*interrupt-off*, if t, ensures that `Ctrl+C` (SIGINT) to the Lisp-Works image is ignored by the subprocess. This argument is not implemented on Microsoft Windows.

*shell-type* specifies the type of shell to run. On Unix-like systems the default value is `"/bin/sh"`. On Microsoft Windows the default value is `"cmd"`.

*use-pty* is useful on Unix-like systems if the sub-process behaves differently when running interactively and non-interactively. When *use-pty* is non-nil, the input and output of the sub-process are opened using PTY (Pseudo-pty). That means that the sub-process sees its input and output as if they come from an interactive terminal. The PTY also processes special characters such as Ctrl-C the same way that an ordinary TTY does.

*use-pty* is probably not useful on Microsoft Windows as there is no concept corresponding to the Unix behavior. If *use-pty* is non-nil then it uses the `CREATE_NEW_PROCESS_GROUP` flag

when creating the child, but it is not obvious when this might be useful.

*stream* supports mixed character and binary I/O in the same way as file streams constructed by `open`.

## Examples

### Example on Unix:

```
CL-USER 1 > (setf *ls* (sys:open-pipe "ls"))
Warning: Setting unbound variable *LS*
#<SYSTEM::PIPE-STREAM "ls">

CL-USER 2 > (loop while
                 (print (read-line *ls* nil nil)))

"hello"
"othello"
NIL
NIL

CL-USER 3 > (close *ls*)
T
```

The following example shows you how to use bidirectional pipes.

```
CL-USER 1 > (with-open-stream
                (s (sys:open-pipe "/bin/csh"
                                  :direction :io))
                (write-line "whereis ls" s)
                (force-output s)
                (read-line s))
"ls: /sbin/ls /usr/bin/ls /usr/share/man/man1.Z/ls.1"
NIL
```

### Example on Microsoft Windows

```

CL-USER 40 > (setf *ls* (sys:open-pipe "dir"))
#<WIN32::TWO-WAY-PIPE-STREAM 205F03F4>

CL-USER 41 > (loop while
                  (print (read-line *ls* nil nil)))

" Volume in drive Z is lispsrc"
" Volume Serial Number is 82E3-1342"
"""
" Directory of Z:\v42\delivery-tests"
"""
"20/02/02 11:57a      <DIR>          .
"20/02/02 11:57a      <DIR>          ..
"14/02/02 07:04p      6,815,772 othello.exe"
"14/02/02 07:07p      6,553,628 hello.exe"
"                         4 File(s)    13,369,400 bytes"
"                         3,974,103,040 bytes free"
NIL
NIL

CL-USER 42 > (close *ls*)
T

```

This last example illustrates the use of *save-exit-status*. This form runs LispWorks as a subprocess such that it quits immediately with exit status 1623:

```

(setq *sub*
      (sys:open-pipe
        (list (lisp-image-name)
              "-eval"
              "(quit :status 1623)"
              :save-exit-status t)))

```

This form then returns 1623:

```
(sys:pipe-exit-status *sub*)
```

#### See also

- [call-system](#)
- [call-system-showing-output](#)
- [pipe-exit-status](#)
- [pipe-kill-process](#)
- [pipe-close-connection](#)

| <b>open-url</b>     | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                   |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary             | Displays a HTML page in a web browser.                                                                                                                                                                                                                                                                                                                            |
| Package             | <code>system</code>                                                                                                                                                                                                                                                                                                                                               |
| Signature           | <code>open-url url</code>                                                                                                                                                                                                                                                                                                                                         |
| Arguments           | <code>url</code> A string.                                                                                                                                                                                                                                                                                                                                        |
| Description         | <p>The function <code>open-url</code> displays the page at the URL <code>url</code> in a web browser.</p> <p>Supported browsers are Netscape, Firefox, Mozilla, Opera on all platforms, Microsoft Internet Explorer on Microsoft Windows and Mac OS X, plus Safari on Mac OS X.</p> <p><code>open-url</code> is defined in the "<code>hqn-web</code>" module.</p> |
| Compatibility notes | If your code uses the unsupported function <code>hqn-web:browse</code> please change to use <code>open-url</code> in LispWorks 5.0 and later.                                                                                                                                                                                                                     |
| Examples            | <code>(sys:open-url "www.lispworks.com")</code>                                                                                                                                                                                                                                                                                                                   |
| See also            | <code>*browser-location*</code>                                                                                                                                                                                                                                                                                                                                   |

| <b>package-flagged-p</b> | <i>Function</i>                                                            |
|--------------------------|----------------------------------------------------------------------------|
| Summary                  | Queries whether a package is flagged.                                      |
| Package                  | <code>system</code>                                                        |
| Signature                | <code>package-flagged-p package flag =&gt; result</code>                   |
| Arguments                | <code>package</code> A package designator.<br><code>flag</code> A keyword. |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Values      | <i>result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | A boolean. |
| Description | The function <code>package-flagged-p</code> is the predicate for whether the package <i>package</i> is flagged with the keyword <i>flag</i> .<br><br>Current valid values for <i>flag</i> are:<br><br><code>:implementation</code><br>Packages that are part of the LispWorks implementation. You must not add definitions to them.<br><br><code>:documented</code> Packages that are fully documented (that is, all external symbols are documented), and all external symbols are intended for your use. |            |

|             |               | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     |               | Close the connection that a pipe-stream uses without closing the stream.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Package     |               | <code>system</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Signature   |               | <code>pipe-close-connection <i>stream</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Arguments   | <i>stream</i> | A pipe stream.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Description |               | The function <code>pipe-close-connection</code> closes the connection underlying <i>stream</i> without closing the stream itself. This means that you cannot communicate with the child process anymore, but <code>pipe-exit-status</code> can still return the exit-status of the child process after a call to <code>pipe-close-connection</code> . This differs from <code>close</code> , which prevents <code>pipe-exit-status</code> from working on Microsoft Windows. You should still call <code>close</code> on <i>stream</i> when you have finished using it. |

|          |                                                                                                                                                                                           |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | <code>pipe-close-connection</code> is useful when you need to send end-of-file to the child process, which causes the child process to exit, and then you want to obtain the exit status. |
| See also | <code>open-pipe</code><br><code>pipe-exit-status</code>                                                                                                                                   |

## pipe-exit-status *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Summary     | Returns the exit status of the child process that <code>open-pipe</code> created.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |
| Package     | <code>system</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |
| Signature   | <code>pipe-exit-status stream &amp;key wait =&gt; exit-status, signal-number</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |
| Arguments   | <code>stream</code> A pipe stream.<br><code>wait</code> A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |
| Values      | <code>exit-status</code> An integer, <code>nil</code> or the keyword <code>:closed</code> .<br><code>signal-number</code> An integer or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |
| Description | <p>The function <code>pipe-exit-status</code> returns the exit status of the child process that <code>open-pipe</code> created.</p> <p><code>stream</code> must be a pipe stream object which was returned by a call to <code>open-pipe</code> with <code>save-exit-status</code> non-<code>nil</code>.</p> <p>If <code>wait</code> is <code>t</code> then <code>pipe-exit-status</code> waits until the child process dies. If <code>wait</code> is <code>nil</code> then <code>pipe-exit-status</code> does not wait, and if the child process is still running it returns <code>nil</code>. The default value of <code>wait</code> is <code>t</code>.</p> <p>On Microsoft Windows, if <code>close</code> was called on the stream before the child process died, then <code>pipe-exit-status</code> returns <code>exit-status :closed</code>. On Unix-like systems it works</p> |  |

after `close` but for compatibility it should be called only before calling `close`. If you need to send an end-of-file to the child process but also want to read the exit status, use `pipe-close-connection` before calling `pipe-exit-status`, and call `close` afterwards.

If `exit-status` is not `nil` or `:closed`, it is an integer which is the exit status of the child process. See “Interpreting the exit status” on page 462 for the interpretation of the exit status and the signal number.

See also

`open-pipe`  
`call-system`  
`pipe-kill-process`  
`pipe-close-connection`  
“Interpreting the exit status” on page 462

|             |                                                                                                                                                                                                                                                                      | <i>Function</i> |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Summary     | Tries to kill the process of a pipe stream.                                                                                                                                                                                                                          |                 |
| Package     | <code>system</code>                                                                                                                                                                                                                                                  |                 |
| Signature   | <code>pipe-kill-process pipe-stream =&gt; result</code>                                                                                                                                                                                                              |                 |
| Arguments   | <code>pipe-stream</code>                                                                                                                                                                                                                                             | A pipe stream.  |
| Values      | <code>result</code>                                                                                                                                                                                                                                                  | A boolean.      |
| Description | The function <code>pipe-kill-process</code> tries to kill the process of a pipe stream.<br><br><code>pipe-stream</code> must be the result of <code>open-pipe</code> . <code>pipe-kill-process</code> tries to kill the process that <code>open-pipe</code> creates. |                 |

The return value `nil` means that the process has already died. In this case the process is guaranteed to have died.

The return value `t` means that the process was still alive when `pipe-kill-process` was called, and it tried to kill it.

On Microsoft Windows, it causes the process to exit, but there may be some delay until it actually exits, so the process may still be alive at the time `pipe-kill-process` returns.

On Unix it sends SIGTERM to the process, which normally would cause it to exit, but in principle the process may handle SIGTERM and continue to run.

#### Notes

1. When `open-pipe` is called with a string, it executes it using a shell (non-Windows) or cmd (Windows), so the process that `pipe-kill-process` will kill is the shell or cmd. When `open-pipe` is called with a list, it executes the process (first element of the list) directly, and `pipe-kill-process` kills this process (the different behavior is actually documented in `call-system`).
2. On Microsoft Windows, `pipe-kill-process` needs to be called before the stream is closed by `close`. On Unix-like systems it works after `close` too, but for compatibility `pipe-kill-process` should not be called after `close`.
3. On Unix-like systems, if `open-pipe` was called with `save-exit-status nil`, there is a possibility that the child process that `open-pipe` started died and another process started with the same Process ID, and then `pipe-kill-process` may wrongly kill the new process. When `open-pipe` is called with `save-exit-status non-nil`, the status of the child process is tracked properly, and `pipe-kill-process` is guaranteed to do the right thing. On Windows `pipe-kill-process` always does the right thing.
4. When `open-pipe` was called with a string as the command, the process killed is the shell (Unix) or cmd (Windows), which normally kills the child process too. On

Unix-like systems the shell may execute the child process directly (overwriting itself with the child without forking) in which case it will kill the child. If you want to guarantee killing of the actual child, pass the command to `open-pipe` as a list of a vector.

## See also

`open-pipe`  
`call-system`

**pointer-from-address** *Function*

Summary      Returns the object into which the given address is pointing.

Package      `system`

Signature      `pointer-from-address address => object`

Arguments      `address`      An integer giving the address of the object.

Values      `object`      The object pointed to by `address`.

Description      The function `pointer-from-address` returns the object into which the given integer `address` is pointing. Note that this address may not be pointing into this object after a garbage collection, unless the object is static and is still referenced by another Lisp variable or object.

Example

```

CL-USER 8 > (setq static-string
                      (make-array 3
                                 :element-type 'base-char
                                 :allocation :static))
Warning: Setting unbound variable STATIC-STRING
")?"
```

```

CL-USER 9 > (sys:object-address static-string)
537166552
```

```

CL-USER 10 > (sys:pointer-from-address *)
")?"
```

```

CL-USER 11 > (eq * static-string)
T
```

See also

- `object-address`
- `object-pointer`

|           |                                              | <i>Function</i>                                                                                                                        |
|-----------|----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| Summary   | Prints a Gesture Spec object as a keystroke. |                                                                                                                                        |
| Package   | <code>system</code>                          |                                                                                                                                        |
| Signature |                                              | <code>print-pretty-gesture-spec <i>gspec stream</i> &amp;key <i>force-meta-to-alt force-shift-for-upcase</i> =&gt; <i>gspec</i></code> |
| Arguments | <i>gspec</i>                                 | A Gesture Spec object.                                                                                                                 |
|           | <i>stream</i>                                | An output stream.                                                                                                                      |
|           | <i>force-meta-to-alt</i>                     | A boolean.                                                                                                                             |
|           | <i>force-shift-for-upcase</i>                |                                                                                                                                        |
|           |                                              | A boolean.                                                                                                                             |
| Values    | <i>gspec</i>                                 | The Gesture Spec object that was passed.                                                                                               |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The function <code>print-pretty-gesture-spec</code> prints the key-stroke represented by the Gesture Spec object <code>gspec</code> to the stream <code>stream</code>.</p> <p>If <code>force-meta-to-alt</code> is true, then <code>gesture-spec-meta-bit</code> is represented as <code>Alt</code> in the output; otherwise it is represented as <code>Meta</code>. <code>force-meta-to-alt</code> defaults to <code>nil</code>.</p> <p>If <code>force-shift-for-upcase</code> is true and <code>gspec</code> represents uppercase input such as <code>A</code>, then the <code>Shift</code> modifier is printed, indicating that <code>Shift</code> is pressed to obtain the <code>A</code> character. <code>force-shift-for-upcase</code> defaults to <code>t</code>.</p> <p>If <code>gspec</code> has a wild modifiers or data component (that is, <code>gesture-spec-modifiers</code> and/or <code>gesture-spec-data</code> return <code>nil</code>) then <code>&lt;Wild&gt;</code> appears in the output.</p> |
| See also    | <code>gesture-spec-data</code><br><code>gesture-spec-meta-bit</code><br><code>gesture-spec-modifiers</code><br><code>make-gesture-spec</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

## \*print-symbols-using-bars\* *Variable*

|               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary       | Controls how escaping is done when symbols are printed.                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Package       | <code>system</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Initial value | <code>nil</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Description   | <p>The variable <code>*print-symbols-using-bars*</code> controls how escaping is done when symbols are printed.</p> <p>When the value is true, printing symbols that must be escaped (for example, those with names containing the colon character <code>:</code>) is done using the bar character <code> </code> instead of the backslash character <code>\</code> in cases when the readtable case and <code>*print-case*</code> are both <code>:upcase</code> or both <code>:downcase</code>.</p> |

Example

```

CL-USER 1 > readable-case *readable*
:UPCASE

CL-USER 2 > (let ((sys:*print-symbols-using-bars* t)
                    (*print-case* :upcase))
                (print (intern "FOO:BAR"))
                (values))

| FOO:BAR |

CL-USER 3 > (let ((sys:*print-symbols-using-bars* t)
                    (*print-case* :downcase))
                (print (intern "FOO:BAR"))
                (values))

foo\:bar

```

## product-registry-path *Function*

|             |                                                                                                                                                                                                                                                                                        |                                            |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|
| Summary     | Gets or sets a registry path for use with your software.                                                                                                                                                                                                                               |                                            |
| Package     | <code>system</code>                                                                                                                                                                                                                                                                    |                                            |
| Signature   | <code>product-registry-path <i>product</i> =&gt; <i>path-string</i></code>                                                                                                                                                                                                             |                                            |
| Signature   | <code>(setf product-registry-path) <i>path</i> <i>product</i> =&gt; <i>path</i></code>                                                                                                                                                                                                 |                                            |
| Arguments   | <i>product</i>                                                                                                                                                                                                                                                                         | A Lisp object.                             |
| Values      | <i>path</i>                                                                                                                                                                                                                                                                            | The path as a string or a list of strings. |
|             | <i>path-string</i>                                                                                                                                                                                                                                                                     | The path as a string.                      |
| Description | <p>The function <code>product-registry-path</code> returns the registry subpath defined for the product denoted by <i>product</i>, as a string.</p> <p>The function <code>(setf product-registry-path)</code> sets the registry subpath for the product denoted by <i>product</i>.</p> |                                            |

If *path* is a string it can contain backslash \ or forward slash / as directory separators - these are translated internally to the separator appropriate for the system. Note that any backslash will need escaping (with another backslash) if you input the string value via the Lisp reader.

If *path* is a list of strings, then it is interpreted like the directory component of a pathname.

This registry subpath is used when reading and storing user preferences with `user-preference`.

Note that while *product* can be any Lisp object, values of *product* are compared by `eq`, so you should use keywords.

**Notes** To store CAPI window geometries under the registry path for your product, see the entry for `capi:top-level-interface-geometry-key`. in the *CAPI User Guide and Reference Manual*.

**Example**

```
(setf (sys:product-registry-path :deep-thought)
      (list "Deep Thought" "1.0"))
```

Then, on non-Windows systems:

```
(sys:product-registry-path :deep-thought)
=>
"Deep Thought/1.0"
```

And on Microsoft Windows:

```
(sys:product-registry-path :deep-thought)
=>
"Deep Thought\\1.0"
```

**See also** `copy-preferences-from-older-version`  
`user-preference`

## release-object-and-nullify Macro

Summary      64-bit LispWorks only: Explicitly release the memory of an object if possible.

Package      `system`

Signature      `release-object-and-nullify place => released-p`

Arguments      `place`      A generalized reference (see the Common Lisp definition).

Values      `released-p`      A boolean.

Description      The macro `release-object-and-nullify` checks if `place` contains a pointer to an object that can be explicitly released, and if it does then it frees the object and sets `place` to `nil`.

`place` must be the only reference to the object to be released, and no other thread can be still accessing the object. `release-object-and-nullify` releases the memory and stores `nil` in `place`, so there is no dangling pointer to the object.

The released memory is returned to the operating system for objects that are allocated in their own segment. Currently, these are objects larger than 1 MB in the Mobile GC, larger than 64 MB in the ordinary 64-bit GC. For other objects, the memory will eventually be reclaimed by the GC, except for permanent objects that are not in their own segment, which are never reclaimed.

`release-object-and-nullify` cannot be executed in interpreted code (because the interpreted code would keep pointers to the object). It must be compiled.

Notes      If the pointer in `place` is not the only reference, then you will be left with "dangling" pointers to a free memory, with unpredictable results.

`release-object-and-nullify` is mainly intended to be used with references to the large objects that are allocated in their own segment, where it can return the memory to the operating system, and hence reduce the memory usage substantially without waiting for a GC. In particular, it is the only way to release the memory of such objects that were made permanent in the Mobile GC. This is the main purpose of it.

Since `release-object-and-nullify` does not release the memory for objects that are not in their own segment, it is not very useful for such objects. However, it may have a useful effect when called on an object that contains pointers and is in a higher generation, because objects in lower generations that are kept alive because of pointers from this object can be GCed earlier, but in most cases it probably does not justify the effort. `release-object-and-nullify` can be called with a reference to a permanent object too, and if it is allocated in its own segment then the memory will also be released.

`release-object-and-nullify` releases only the object that is referenced by *place*, but not anything that this object points to, which means that you may not get the effect you expect for an object that is complex, such as a `hash-table`, a CLOS instance, a `pathname` or a non-simple array.

See also

`allocated-in-its-own-segment-p`  
`make-object-permanent`  
`make-permanent-simple-vector`  
“Mobile GC technical details” on page 154

| room-values | Function                                                |
|-------------|---------------------------------------------------------|
| Summary     | Returns information about the state of internal memory. |
| Package     | <code>system</code>                                     |

|             |                                                                                                                                                                                    |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signature   | <code>room-values =&gt; result</code>                                                                                                                                              |
| Values      | <code>result</code><br>A plist<br><code>(:total-size size<br/>:total-allocated allocated<br/>:total-free free)</code>                                                              |
| Description | <code>room-values</code> returns a plist containing information about the state of internal memory. This information is the same as would be printed by ( <code>room nil</code> ). |
| Notes       | In 64-bit LispWorks you can also use <code>count-gen-num-allocation</code> and <code>gen-num-segments-fragmentation-state</code> .                                                 |
| See also    | <code>count-gen-num-allocation</code><br><code>room</code><br>“Guidance for control of the memory management system” on page 130                                                   |

|                          | <i>Function</i>                                                                                                                                                                                                                                                         |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>run-shell-command</b> |                                                                                                                                                                                                                                                                         |
| Package                  | <code>system</code>                                                                                                                                                                                                                                                     |
| Summary                  | Allows executables and DOS or Unix shell commands to be called from Lisp code.                                                                                                                                                                                          |
| Signature                | <code>run-shell-command command &amp;key input output error-output<br/>separate-streams wait if-input-does-not-exist if-output-exists if-error-<br/>output-exists show-window environment element-type save-exit-<br/>status =&gt; result</code>                        |
| Signature                | <code>run-shell-command command &amp;key input output error-output<br/>separate-streams wait if-input-does-not-exist if-output-exists if-error-<br/>output-exists show-window environment element-type save-exit-<br/>status =&gt; stream, error-stream, process</code> |

|           |                                |                                                                                                                                                          |
|-----------|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arguments | <i>command</i>                 | A string, a list of strings, a simple-vector of strings, or <code>nil</code> .                                                                           |
|           | <i>input</i>                   | <code>nil</code> , <code>:stream</code> or a file designator. Default value <code>nil</code> .                                                           |
|           | <i>output</i>                  | <code>nil</code> , <code>:stream</code> or a file designator. Default value <code>nil</code> .                                                           |
|           | <i>error-output</i>            | <code>nil</code> , <code>:stream</code> , <code>:output</code> or a file designator. Default value <code>nil</code> .                                    |
|           | <i>separate-streams</i>        | A boolean. True value not currently supported.                                                                                                           |
|           | <i>wait</i>                    | A boolean, default value <code>t</code> .                                                                                                                |
|           | <i>if-input-does-not-exist</i> | <code>:error</code> , <code>:create</code> or <code>nil</code> . Default value <code>:error</code> .                                                     |
|           | <i>if-output-exists</i>        | <code>:error</code> , <code>:overwrite</code> , <code>:append</code> , <code>:supersede</code> or <code>nil</code> . Default value <code>:error</code> . |
|           | <i>if-error-output-exists</i>  | <code>:error</code> , <code>:overwrite</code> , <code>:append</code> , <code>:supersede</code> or <code>nil</code> . Default value <code>:error</code> . |
|           | <i>show-window</i>             | A boolean. True value not currently supported.                                                                                                           |
|           | <i>environment</i>             | An alist of strings naming environment variables and values. Default value <code>nil</code> .                                                            |
|           | <i>element-type</i>            | Default value <code>base-char</code> .                                                                                                                   |
|           | <i>save-exit-status</i>        | A boolean, default value <code>nil</code> .                                                                                                              |
| Values    | <i>result</i>                  | The exit status of the process running command, or a process ID                                                                                          |
|           | <i>stream</i>                  | A stream, or <code>nil</code> .                                                                                                                          |
|           | <i>error-stream</i>            | A stream, or <code>nil</code> .                                                                                                                          |

|                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>process</i> | A process ID.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Description    | <p>The function <code>run-shell-command</code> allows executables and DOS or Unix shell commands to be called from Lisp code with redirection of the stdout, stdin and stderr to Lisp streams. It creates a subprocess which executes the command <i>command</i>.</p> <p>The argument <i>command</i> is interpreted as by <code>call-system</code>. In the cases where a shell is run, the shell to use is determined by the environment variable <code>SHELL</code>, or defaults to <code>/bin/csh</code> or <code>/bin/sh</code> if that does not exist.</p> <p>If <i>wait</i> is true, then <code>run-shell-command</code> executes <i>command</i> and does not return until the process has exited. In this case none of <i>input</i>, <i>output</i> or <i>error-output</i> may have the value <code>:stream</code>, and the single value <i>result</i> is the exit status of the process that ran <i>command</i>.</p> <p>If <i>wait</i> and <i>save-exit-status</i> are <code>nil</code> and none of <i>input</i>, <i>output</i> or <i>error-output</i> have the value <code>:stream</code> then <code>run-shell-command</code> executes <i>command</i> and returns a single value <i>result</i> which is the process ID of the process running <i>command</i>.</p> <p>If <i>wait</i> is <code>nil</code> and either of <i>input</i> or <i>output</i> have the value <code>:stream</code> then <code>run-shell-command</code> executes <i>command</i> and returns three values: <i>stream</i> is a Lisp stream which acts as the stdout of the process if <i>output</i> is <code>:stream</code>, and is the stdin of the process if <i>input</i> is <code>:stream</code>. <i>error-stream</i> is determined by the argument <i>error-output</i> as described below. <i>process</i> is the process ID of the process.</p> <p>If <i>wait</i> and <i>save-exit-status</i> are <code>nil</code> and neither of <i>input</i> or <i>output</i> have the value <code>:stream</code> then the first return value, <i>stream</i>, is <code>nil</code>.</p> <p>If <i>wait</i> is <code>nil</code>, <i>save-exit-status</i> is true and neither of <i>input</i> or <i>output</i> have the value <code>:stream</code> then the first return value, <i>stream</i>, is a dummy stream that can only be used with <code>pipe-exit-status</code> (see <i>save-exit-status</i> below).</p> |

If *wait* is `nil` and *error-output* has the value `:stream` then `run-shell-command` executes *command* and returns three values. *stream* is determined by the arguments *input* and *output* as described above. *error-stream* is a Lisp stream which acts as the stderr of the process. *process* is the process ID of the process.

If *wait* is `nil` and *error-output* is not `:stream` then the second return value, *error-stream*, is `nil`. If *error-output* is `:output`, then stderr goes to the same place as stdout.

If *input* is a pathname or string, then `open` is called with `:if-does-not-exist if-input-does-not-exist`. The resulting *file-stream* acts as the stdin of the process.

If *output* is a pathname or string, then `open` is called with `:if-exists if-output-exists`. The resulting *file-stream* acts as the stdout of the process.

If *error-output* is a pathname or string, then `open` is called with `:if-exists if-error-output-exists`. The resulting *file-stream* acts as the stderr of the process.

This table describes the streams created, for each combination of stream arguments:

Table 49.1 The streams created by `run-shell-command`

| Arguments                                                                                                                        | <i>stream</i>                               | <i>error-stream</i>                 |
|----------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|-------------------------------------|
| <i>input</i> is <code>:stream</code><br><i>output</i> is <code>:stream</code><br><i>error-output</i> is <code>:stream</code>     | An I/O stream connected to stdin and stdout | An input stream connected to stderr |
| <i>input</i> is not <code>:stream</code><br><i>output</i> is <code>:stream</code><br><i>error-output</i> is <code>:stream</code> | An input stream connected to stdout         | An input stream connected to stderr |
| <i>input</i> is <code>:stream</code><br><i>output</i> is not <code>:stream</code><br><i>error-output</i> is <code>:stream</code> | An output stream connected to stdin         | An input stream connected to stderr |

Table 49.1 The streams created by `run-shell-command`

| Arguments                                                                                                                                                        | <i>stream</i>                                       | <i>error-stream</i>                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|-------------------------------------|
| <i>input</i> is not <code>:stream</code><br><i>output</i> is not <code>:stream</code><br><i>error-output</i> is <code>:stream</code>                             | <code>nil</code>                                    | An input stream connected to stderr |
| <i>input</i> is <code>:stream</code><br><i>output</i> is <code>:stream</code><br><i>error-output</i> is <code>:output</code>                                     | An I/O stream connected to stdin, stdout and stderr | <code>nil</code>                    |
| <i>input</i> is not <code>:stream</code><br><i>output</i> is <code>:stream</code><br><i>error-output</i> is <code>:output</code>                                 | An input stream connected to stdout and stderr      | <code>nil</code>                    |
| <i>input</i> is <code>:stream</code><br><i>output</i> is not <code>:stream</code><br><i>error-output</i> is <code>:output</code>                                 | An output stream connected to stdin                 | <code>nil</code>                    |
| <i>input</i> is not <code>:stream</code><br><i>output</i> is not <code>:stream</code><br><i>error-output</i> is <code>:output</code>                             | <code>nil</code>                                    | <code>nil</code>                    |
| <i>input</i> is <code>:stream</code><br><i>output</i> is <code>:stream</code><br><i>error-output</i> is not <code>:stream</code> OR <code>:output</code>         | An I/O stream connected to stdin and stdout         | <code>nil</code>                    |
| <i>input</i> is not <code>:stream</code><br><i>output</i> is <code>:stream</code><br><i>error-output</i> is not <code>:stream</code> OR <code>:output</code>     | An input stream connected to stdout                 | <code>nil</code>                    |
| <i>input</i> is <code>:stream</code><br><i>output</i> is not <code>:stream</code><br><i>error-output</i> is not <code>:stream</code> OR <code>:output</code>     | An output stream connected to stdin                 | <code>nil</code>                    |
| <i>input</i> is not <code>:stream</code><br><i>output</i> is not <code>:stream</code><br><i>error-output</i> is not <code>:stream</code> OR <code>:output</code> | <code>nil</code>                                    | <code>nil</code>                    |

If any of *input*, *output* or *error-output* are streams, then they must be `file-streams` or `socket-streams` capable of acting as the stdin, stdout or stderr of the process.

*environment* should be an alist of strings naming environment variables and their values. The process runs in an environment inherited from the Lisp process, augmented by *environment*.

If `save-exit-status` is true then the system stores the exit status of the process, so that it can be recovered by calling `pipe-exit-status` on *stream* or *error-stream* if either of these is a stream.

#### Example

```
(multiple-value-bind (out err pid)
    (sys:run-shell-command "sh -c 'echo foo >&2; echo
bar'"'
                           :wait nil
                           :output :stream
                           :error-output :stream)
    (with-open-stream (out out)
        (with-open-stream (err err)
            (values (read-line out) (read-line err)))))

=>
"bar", "foo"
```

#### See also

`call-system`  
`call-system-showing-output`  
`open-pipe`  
`pipe-exit-status`

## safe-locale-file-encoding

### Function

Summary      Provides a safe encoding which corresponds to the current code page on Microsoft Windows, and the locale on Unix.

Package      `system`

Signature      `safe-locale-file-encoding pathname ef-spec buffer length => new-ef-spec`

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | The function <code>safe-locale-file-encoding</code> is similar to <code>locale-file-encoding</code> except that it always returns a safe external format. That is, the external format does not signal error on writing characters not in the encoding.<br><br>On Microsoft Windows, <code>safe-locale-file-encoding</code> consults the ANSI code page. If the code page identifier <i>id</i> is in <code>win32:*latin-1-code-pages*</code> , it merges <i>ef-spec</i> with <code>:latin-1-safe</code> . This external format writes Latin-1 on output, using 63 (ASCII '?') to replace any non-Latin-1 characters that are written. If the code page identifier <i>id</i> is not in <code>win32:*latin-1-code-pages*</code> then <code>safe-locale-file-encoding</code> merges <i>ef-spec</i> with an encoding corresponding to the current code page that uses the code page's replacement code for characters that cannot be encoded.<br><br><code>safe-locale-file-encoding</code> merges <i>ef-spec</i> with <code>:latin-1-safe</code> on Unix. |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|          |                                                                                                                            |
|----------|----------------------------------------------------------------------------------------------------------------------------|
| See also | <code>*file-encoding-detection-algorithm*</code><br><code>*latin-1-code-pages*</code><br><code>locale-file-encoding</code> |
|----------|----------------------------------------------------------------------------------------------------------------------------|

| <b>set-approaching-memory-limit-callback</b> |                                                                                                                                                         | <i>Function</i>        |
|----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Summary                                      | Sets a callback that it is called when 32-bit LispWorks approaches its memory limit.                                                                    |                        |
| Package                                      | <code>system</code>                                                                                                                                     |                        |
| Signature                                    | <code>set-approaching-memory-limit-callback</code> <i>callback</i>                                                                                      |                        |
| Arguments                                    | <i>callback</i>                                                                                                                                         | A function designator. |
| Description                                  | The function <code>set-approaching-memory-limit-callback</code> sets a callback that it is called when 32-bit LispWorks approaches its limit of memory. |                        |

The function *callback* must take two arguments: the size of the image and the margin of growth:

`callback size margin`

Normally *callback* should do something to prevent further growth of the image, or at least minimize the damage if Lisp-Works crashes when it actually reaches its limit (for example by saving data to disk).

*callback* can prevent an error being signalled by calling `cl:continue`.

If there is no *callback* (the default) or *callback* returns, Lisp-Works signals an error.

|          |                                                                                                                                                                                          |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | <p><code>set-approaching-memory-limit-callback</code> is not relevant to 64-bit LispWorks.</p> <p><code>set-approaching-memory-limit-callback</code> does not return a useful value.</p> |
| See also | <p>“Approaching the memory limit” on page 142<br/> <code>approaching-memory-limit</code></p>                                                                                             |

|                                  | <i>Function</i>                                                                                                        |
|----------------------------------|------------------------------------------------------------------------------------------------------------------------|
| <b>set-automatic-gc-callback</b> |                                                                                                                        |
| Summary                          | Sets a function or functions to call after an automatic GC in 64-bit LispWorks.                                        |
| Package                          | <code>system</code>                                                                                                    |
| Signature                        | <code>set-automatic-gc-callback blocking-gen-num-func &amp;optional other-func =&gt; other-func</code>                 |
| Arguments                        | <p><i>blocking-gen-num-func</i></p> <p>A function designator for a function of two arguments, or <code>nil</code>.</p> |

|             |                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <i>other-func</i> | A function designator for a function of one argument, or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Values      | <i>other-func</i> | A function designator for a function of one argument, or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Description |                   | <p>The function <code>set-automatic-gc-callback</code> sets a function or functions to call after an automatic garbage collection (GC).</p> <p>If <i>blocking-gen-num-func</i> is a function designator it should take two arguments: the generation number and, if <i>do-gc</i> in the last call to <code>set-blocking-gen-num</code> was a number, the number of copied segments. It is called whenever the blocking generation is garbage collected automatically. If <i>blocking-gen-num-func</i> is <code>nil</code>, then this callback is switched off.</p> <p>If <i>other-func</i> is a function designator it should take one argument, the generation number that was garbage collected. It is called whenever an automatic GC occurred and <i>blocking-gen-num-func</i> was not called, either because the blocking generation was not garbage collected, or because <i>blocking-gen-num-func</i> was passed as <code>nil</code>. If <i>other-func</i> is <code>nil</code> (the default) then this callback is switched off.</p> <p>The calls occur after the GC has finished and there is no restriction on what they can do. If the call ends up allocating enough to trigger another automatic GC, they enter again recursively.</p> |
| Notes       |                   | <code>set-automatic-gc-callback</code> is implemented only in 64-bit LispWorks. It is not relevant to the Memory Management API in 32-bit implementations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| See also    |                   | <p><code>set-blocking-gen-num</code></p> <p>“Memory Management in 64-bit LispWorks” on page 146</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

|                             | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>set-blocking-gen-num</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Summary                     | Sets the blocking generation in 64-bit LispWorks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Package                     | <code>system</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Signature                   | <code>set-blocking-gen-num gen-num &amp;key do-gc max-size max-size-to-copy gc-threshold =&gt; old-blocking-gen-num, do-gc, max-size-to-copy, old-gc-threshold</code>                                                                                                                                                                                                                                                                                                                                                                                                      |
| Arguments                   | <p><i>gen-num</i> An integer between 0 and 7, inclusive.</p> <p><i>do-gc</i> One of <code>t</code>, <code>nil</code> and <code>:mark</code>, or a real number between 0 and 10, inclusive.</p> <p><i>max-size-to-copy</i> A positive real number, or <code>nil</code>.</p> <p><i>max-size</i> A synonym for <i>max-size-to-copy</i>.</p> <p><i>gc-threshold</i> An integer greater than 12800, or a real in the inclusive range [0 100], or <code>nil</code>.</p>                                                                                                          |
| Values                      | <p><i>old-blocking-gen-num</i> An integer between 0 and 7, inclusive.</p> <p><i>do-gc</i> One of <code>t</code>, <code>nil</code> and <code>:mark</code>, or a real number between 0 and 10, inclusive.</p> <p><i>max-size-to-copy</i> A positive real number.</p> <p><i>old-gc-threshold</i> A number.</p>                                                                                                                                                                                                                                                                |
| Description                 | <p>The function <code>set-blocking-gen-num</code> sets <i>gen-num</i> as the generation that blocks. That is, no object is automatically promoted out of generation <i>gen-num</i> to a higher generation.</p> <p>If <i>do-gc</i> is non-nil, then generation <i>gen-num</i> is automatically collected when needed, as defined by <i>gc-threshold</i> (see <code>set-gen-num-gc-threshold</code>).</p> <p>The actual value of <i>do-gc</i> specifies how to GC the blocking generation when required. The possible values of <i>do-gc</i> are interpreted as follows:</p> |

|                                         |                                                                                                                                                                                                                                                                                                                                                                             |
|-----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>t</code>                          | Use Copying GC.                                                                                                                                                                                                                                                                                                                                                             |
| <code>:mark</code>                      | Use Marking GC.                                                                                                                                                                                                                                                                                                                                                             |
| A number in the inclusive range [0, 10] | Use Marking GC with copying of fragmented segments. The value specifies the <i>fragmentation-threshold</i> (the same as the argument to <code>marking-gc</code> ). This is the ratio between the amount of free space that cannot be easily used and the amount of allocated space inside a segment. Only segments with fragmentation higher than the threshold are copied. |

The default value of *do-gc* is `t`.

*max-size-to-copy* is meaningful only if *do-gc* is a number. It specifies the maximum size in Gigabytes to try to copy. If the fragmented segments contain more data than this value, only some of them are copied in each GC.

If *gc-threshold* is non-nil, it is used to set the threshold for automatic GC using `set-gen-num-gc-threshold`.

The initial setup is as if this call has been made:

```
(sys:set-blocking-gen-num 3)
```

That is, the system will GC automatically according to the default *gc-threshold* using Copying GC.

Setting the blocking generation *gen-num* to a lower number is useful into two situations:

1. When you have an operation that allocates a significant amount of data, and almost of it goes when the operation finishes, it is useful to reduce the blocking *gen-num* during the operation. The macro `block-promotion` is a convenient way of doing that.

2. If you have a good idea of how your application behaves, it may be useful to block at a lower generation (2 or 1), and then periodically call `gc-generation` explicitly to promote long living objects to a higher generation. The advantage of doing this is that you can call `gc-generation` in places where you know there are not many short-lived objects alive.

Passing a `do-gc` value other than `t` is useful when the blocking generation can be large enough that copying it all may cause very serious paging. Passing `do-gc :mark` will stop the system from copying the blocking generation, but may cause fragmentation if a significant number of long-lived objects die after a while, and there are not explicit calls to `gc-generation` or `marking-gc`.

`set-blocking-gen-num` returns four values: the old blocking generation number, the old value of `do-gc`, the `max-size-to-copy`, and the old value of `gc-threshold`. It can be called with `gen-num nil` to query the values without changing any of them.

|       |                                                                                                                                                                                                                                |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes | <code>set-blocking-gen-num</code> is implemented only in 64-bit LispWorks. It does nothing in the Mobile GC and its return value is not meaningful. It is not relevant to the Memory Management API in 32-bit implementations. |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|          |                                                                                                                                                                                                                                                                  |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| See also | <a href="#">block-promotion</a><br><a href="#">gc-generation</a><br><a href="#">marking-gc</a><br><a href="#">set-automatic-gc-callback</a><br><a href="#">set-gen-num-gc-threshold</a><br>“Guidance for control of the memory management system”<br>on page 130 |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## **set-default-segment-size** *Function*

**Summary** Sets the default initial size of a segment in 64-bit LispWorks.

**Package** `system`

**Signature** `set-default-segment-size gen-num allocation-type size-in-mb  
=> segment-size`

**Arguments** `gen-num` An integer between 0 and 3, inclusive.

`allocation-type` One of :`cons`, :`symbol`, :`function`, :`non-pointer`, :`other`, :`mixed`, :`cons-static`, :`non-pointer-static`, :`mixed-static`, :`weak`, :`other-big`, and :`non-pointer-big`.

`size-in-mb` A number, or `nil`.

**Values** `segment-size` A number.

**Description** The function `set-default-segment-size` sets the default initial size of a segment for a specific generation and allocation type.

The default initial size is also used as the default size for enlargement of the segment.

`allocation-type` can be any of the allocation types. However, if `allocation-type` is :`other-big` or :`non-pointer-big`, this function has no effect.

If `size-in-mb` is a number, it specifies the size in megabytes. If `size-in-mb` is `nil` then `set-default-segment-size` returns the default initial segment size without altering it.

The returned value, `segment-size`, is the previous default initial segment size.

During automatic garbage collections (GCs) the system collects an ephemeral generation when any of its segments for

the main allocation types is full. Thus the size of the segments defines the frequency of GCs in these generations.

|          |                                                                                                                                                                                                                                                                                        |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | <code>set-default-segment-size</code> is implemented only in 64-bit LispWorks. It does nothing in the Mobile GC and its return value is not meaningful. It is not relevant to the Memory Management API in 32-bit implementations, where <code>enlarge-generation</code> is available. |
| See also | <code>avoid-gc</code><br><code>enlarge-generation</code><br><code>set-maximum-segment-size</code><br>“Memory Management in 64-bit LispWorks” on page 146                                                                                                                               |

## set-delay-promotion *Function*

|             |                                                                                                                                                                                                                                                                                                                  |                                        |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|
| Summary     | Delays promotion for a specified generation in 64-bit LispWorks.                                                                                                                                                                                                                                                 |                                        |
| Package     | <code>system</code>                                                                                                                                                                                                                                                                                              |                                        |
| Signature   | <code>set-delay-promotion gen-num on =&gt; on</code>                                                                                                                                                                                                                                                             |                                        |
| Arguments   | <code>gen-num</code>                                                                                                                                                                                                                                                                                             | An integer between 0 and 7, inclusive. |
|             | <code>on</code>                                                                                                                                                                                                                                                                                                  | A generalized boolean.                 |
| Values      | <code>on</code>                                                                                                                                                                                                                                                                                                  | A generalized boolean.                 |
| Description | The function <code>set-delay-promotion</code> delays promotion for generation <code>gen-num</code> , which means that objects are promoted to the next generation in the second garbage collection (GC) that they survive in generation <code>gen-num</code> . By default, objects are promoted in the first GC. |                                        |

It is not obvious under what circumstances delayed promotion is more useful than the default behavior. If you find this function useful, please let us know at Lisp Support.

|          |                                                                                                                                                                                                                                |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | <code>set-delay-promotion</code> is implemented only in 64-bit Lisp-Works. It does nothing in the Mobile GC and its return value is not meaningful. It is not relevant to the Memory Management API in 32-bit implementations. |
| See also | <code>set-blocking-gen-num</code>                                                                                                                                                                                              |

## **set-expected-allocation-in-generation-2-after-gc** *Function*

|             |                                                                                                                                                                                                                                                                           |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Mobile GC only: tells the GC what is the maximum amount that you expect to be allocated in generation 2 after a GC of generation 2.                                                                                                                                       |
| Package     | <code>system</code>                                                                                                                                                                                                                                                       |
| Signature   | <code>set-expected-allocation-in-generation-2-after-gc &amp;key<br/>expected-other-mbs expected-cons-mbs max-needed-other-mbs max-<br/>needed-cons-mbs =&gt; prev-expected-other-mbs prev-expected-cons-mbs<br/>prev-max-needed-other-mbs prev-max-needed-cons-mbs</code> |
| Arguments   | <code>expected-other-mbs, expected-cons-mbs, max-needed-other-mbs,<br/>max-needed-cons-mbs</code><br><br>Non-negative integers or <code>nil</code> .                                                                                                                      |
| Values      | <code>prev-expected-other-mbs, prev-expected-cons-mbs, prev-max-<br/>needed-other-mbs, prev-max-needed-cons-mbs</code><br><br>Non-negative integers.                                                                                                                      |
| Description | The function <code>set-expected-allocation-in-generation-2-after-gc</code> is intended to improve the behavior of the application, but it may also degrade the performance if not used appropriately. It sets internal values associated with each of                     |

the parameters *max-needed-other-mbs*, *max-needed-cons-mbs*, *expected-other-mbs* and *expected-cons-mbs*.

All parameters and return values are in megabytes. If any parameter is `nil` or is larger than the maximum, which is 65535, then the maximum is used for that parameter. *expected-other-mbs* defaults to its current internal value and *max-needed-other-mbs* defaults to the maximum of its current internal value and *expected-other-mbs* (see below). Likewise for *expected-cons-mbs* and *max-needed-cons-mbs*. LispWorks starts with all internal values set to the maximum.

The main purpose of `set-expected-allocation-in-generation-2-after-gc` is to tell the GC what you expect to be the maximum allocated megabytes in generation 2 after a GC of generation 2. That allows LispWorks to perform a better GC in situations where it does not have enough memory to copy all of generation 2. You set this separately for Other and `cons` objects, by supplying *expected-other-mbs* and *expected-cons-mbs*. Note that Other does not include Large and Static objects.

In situations where LispWorks cannot get enough memory from the operating system to copy all of generation 2, but can get the expected size that you have set, the GC is faster than it would have been if the expected size was not set (that is, set to the maximum), and more importantly, the memory usage after the GC will be smaller (sometimes much smaller). On the other hand, if the expected size is set too low in such a situation, then the GC is a little slower, and more importantly, the memory usage after the GC is larger than it would have been if the expected size was not set, until the next GC of generation 2 where the expectation is met. Thus for the expected size setting to be useful, it needs to be met (that is, the allocated size after GC must be less than the setting) in almost all GCs of generation 2. It probably needs to be met more than 90% in the GCs to be useful.

The function `get-maximum-allocated-in-generation-2-after-gc` is designed to allow you to find out what values to use. You exercise the application by trying to do anything that an end user may do, and then call `get-maximum-allocated-in-generation-2-after-gc` to see the maximums. Note that with normal settings, the points at which GC of generation 2 is invoked (and hence the amount alive after it) are not well defined. Therefore, you need to exercise the application more than once to find the correct numbers. Alternatively, if you block GC of generation 2 (by using `set-generation-2-gc-options`) and invoke the GC yourself, you can be more confident that you know the memory state at the time the GC is invoked. Alternatively, instead of calling `get-maximum-allocated-in-generation-2-after-gc` you can use the second and third return values of (`count-gen-num-allocation 2`), or the values that `room` reports for "Other 2" and "Cons 2". You can use `set-automatic-gc-callback` to set a function that will be called immediately after GC of generation 2.

In situations where LispWorks can get all the memory it needs to perform a GC of generation 2, the setting of `expected-other-mbs` and `expected-cons-mbs` has no effect.

`max-needed-other-mbs` and `max-needed-cons-mbs` set an upper bound on the amount of memory that LispWorks tries to get from the operating system for a GC of generation 2.

`set-expected-allocation-in-generation-2-after-gc` ensures that the settings of `max-needed-other-mbs` and `max-needed-cons-mbs` are always equal or larger than the setting of `expected-other-mbs` and `expected-cons-mbs` respectively, by enlarging the setting of `max-needed-other-mbs` or `max-needed-cons-mbs` when needed.

Smaller values of `max-needed-other-mbs` and `max-needed-cons-mbs` cause LispWorks to use less memory in situations where it could get more memory from the operating system than they specify. That means the memory peak that happens dur-

ing the GC will be smaller. That should not have much effect the performance of LispWorks itself, but when the operating system is close to running out of memory, that may prevent it from actually running out of memory while the GC is running. On the other hand, if the GC requires more than *max-needed-other-mbs* or *max-needed-cons-mbs*, it will try to get more memory during the GC operation, and if this fails it has larger effect on performance than failure to allocate during the initialization of the GC.

The return values are the settings before the call.

**set-expected-allocation-in-generation-2-after-gc** is thread-safe. It can be called repeatedly with different values.

#### Notes

**set-expected-allocation-in-generation-2-after-gc** is useful in the situation when you have a "generation leak", that is objects live long enough to be promoted from generation 1 to 2 but die soon afterwards, and you do not have much allocated in generation 2 otherwise. In this case, the size of the live objects after a call to GC of generation 2 would be small, which means that the GC will be fast because the timing of a GC that works as planned is dependent on the amount allocated after the GC.

However, the memory peak will still be dependent on the size of generation 2 before the GC, which may cause failure to get memory from the operating system, and hence result in a slower and much less effective GC. Setting the values reduces the chance of such a failure, and reduces the memory usage even in situation where LispWorks could get the memory. Therefore, as long as the settings are correct (that is, in the vast majority of GCs of generation 2, the amount allocated after the GC is less than the setting) it can improve the performance of LispWorks significantly.

#### See also

**get-maximum-allocated-in-generation-2-after-gc**  
**count-gen-num-allocation**

`room`

`set-automatic-gc-callback`

“Preventing/reducing GC of generation 2” on page 159

## **set-file-dates**

*Function*

Summary      Sets the modification and access times of a file.

Package      `system`

Signature      `set-file-dates file &key creation modification access`

Arguments      `file`      A pathname designator.

`creation`      A non-negative integer, or `nil`.

`modification`      A non-negative integer, or `nil`.

`access`      A non-negative integer, or `nil`.

Description      The function `set-file-dates` sets the modification and access times of the file `file` for each of modification and access that is non-nil.

On Microsoft Windows, if `creation` is non-nil, the creation time of the file is also set. `creation` is ignored on other platforms.

Each keyword argument is interpreted as a universal time representing the time to set, unless it is `nil` in which case the corresponding time for `file` is not changed. Each keyword argument has default value `nil`.

An error of type `file-error` is signaled on failure.

See also      `open`

| set-generation-2-gc-options | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary                     | Mobile GC only: Controls the automatic GC of generation 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Package                     | <code>system</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Signature                   | <code>set-generation-2-gc-options &amp;key <i>minimal-size-for-gc</i><br/> <i>allocation-increase-factor</i> =&gt; <i>prev-minimal-size-for-gc</i>, <i>prev-allocation-increase-factor</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Arguments                   | <p><i>minimal-size-for-gc</i> nil, t or a non-negative fixnum.</p> <p><i>allocation-increase-factor</i> nil or a real between 0 and 16 (exclusive).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Values                      | <p><i>prev-minimal-size-for-gc</i> Previous setting of <i>minimal-size-for-gc</i>.</p> <p><i>prev-allocation-increase-factor</i> Previous setting of <i>allocation-increase-factor</i>.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Description                 | <p>The function <code>set-generation-2-gc-options</code> sets internal variables that control when to automatically GC generation 2.</p> <p>For both arguments, the value nil (the default) causes no change to the corresponding internal variable.</p> <p><i>minimal-size-for-gc</i> is used to set the minimum allocated bytes in generation 2 that will trigger an automatic GC of generation 2. The special value t is interpreted as <code>most-positive-fixnum</code>, and effectively blocks any automatic GC of generation 2. Integers up to 10000 are interpreted as a size in megabytes, while integers above 10000 are interpreted as a size in bytes.</p> <p><i>allocation-increase-factor</i> controls how large an increase (since the last GC) in the allocated bytes in generation 2 will trigger another automatic GC of generation 2.</p> <p>After each GC of generation 2 (automatic or user invoked), LispWorks computes a value for <i>gen-2-gc-threshold</i> using the expression:</p> |

```
(max minimal-size-for-gc
      (* (1+ allocation-increase-factor)
          allocated-gen-2-bytes))
```

where *allocated-gen-2-bytes* is the allocated bytes in generation 2.

The next automatic GC of generation 2 will be triggered only when the allocated bytes in generation 2 exceeds *gen-2-gc-threshold* in the future.

`set-generation-2-gc-options` also sets *gen-2-gc-threshold* to *minimal-size-for-gc* if it is non-nil (*allocation-increase-factor* has no effect on this setting).

The initial values are 64 megabytes for *minimal-size-for-gc* and 0.5 for *allocation-increase-factor*.

**Notes** Setting a small threshold causes relatively frequent GCs of generation 2, which is acceptable if each GC is short enough that it does not bother the end user. That may be true if the total allocated (after a GC) in your application is only few 10's of megabytes. You should try to either time a GC of generation 2 by `(time (gc-generation 2))` on the slowest device to which you target your application, or alternatively try to use the application on such a device with the small threshold settings and see if you notice unacceptable delays.

A small threshold probably reduces the efficiency of the application a little, but has some advantages:

- It reduces the memory foot-print of your application.
- It reduces the chance that the application will run into a memory limitation when doing a GC. When the GC runs into such a limitation, it becomes much less efficient.
- It reduces the lifetime of objects in generation 0 and 1 that may stay alive because they are pointed to by objects in generation 2 that are actually dead but have not been GCed yet. As a result, in some circumstances frequent

GC of generation 2 may increase the efficiency of the application.

Therefore, if the delays are not long enough to be annoying then it is probably a good idea to have a low threshold.

By contrast, a large threshold causes less frequent GCs of generation 2, which normally causes it to grow more before a GC occurs. As long as LispWorks can get all the memory it needs to perform a copying GC, the time taken to do a GC correlates to the amount of memory that is still alive after (rather than before) the GC. Thus if generation 2 contains mainly "generation leak" objects (see "Preventing/reducing GC of generation 2" on page 159) that are removed by the GC, then each GC would take approximately the same time regardless of how frequently GC occurs. In that situation, doing a GC less frequently results in less time overall. However, if LispWorks fails to get memory from the operating system to do a copying GC, then the GC is done partially by a marking GC, which is slower and less effective. Thus you do not want to increase the threshold "too much". A copying GC needs to increase the memory size by approximately the current amount allocated, but it is difficult to predict how much memory the operating system is ready to give at any point, and it depends on the hardware and operating system. It is therefore difficult to say how much is "too much".

See also

**`set-promote-generation-1`**

"Preventing/reducing GC of generation 2" on page 159

### **set-gen-num-gc-threshold**

*Function*

Summary

Sets the additional allocation threshold that triggers a GC in the blocking generation in 64-bit LispWorks.

Package

**`system`**

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| Signature   | <code>set-gen-num-gc-threshold</code> <i>gen-num threshold</i> => <i>old-threshold</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                |
| Arguments   | <i>gen-num</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | An integer between 0 and 7, inclusive.                                                         |
|             | <i>threshold</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | An integer greater than 12800, or a real in the inclusive range [0 100], or <code>nil</code> . |
| Values      | <i>old-threshold</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | A number.                                                                                      |
| Description | <p>The function <code>set-gen-num-gc-threshold</code> sets the threshold for additional allocation that triggers a garbage collection (GC) in generation <i>gen-num</i> when this is the blocking generation (as set by <code>set-blocking-gen-num</code>). A GC is triggered when the allocation in generation <i>gen-num</i> grows more than <i>threshold</i> over the allocation after the last GC of this generation (or a GC of a higher generation).</p> <p>To set the threshold, <i>threshold</i> can be an integer greater than 12800, which is interpreted as the absolute value. Alternatively <i>threshold</i> can be a real number in the inclusive range [0 100], which is multiplied by the allocation since the previous GC to get the actual threshold to set.</p> <p>The default threshold for all generations is 1. That is, for all generations <i>gen-num</i>, when generation <i>gen-num</i> is the blocking generation and allocation in it has doubled since the previous GC, generation <i>gen-num</i> is collected automatically.</p> <p><code>set-gen-num-gc-threshold</code> can be called when the generation <i>gen-num</i> is not the blocking generation, and will set the value for that <i>gen-num</i>. Such a call will not take effect until the generation <i>gen-num</i> becomes the blocking generation, as set by a call to <code>set-blocking-gen-num</code> (with <code>:do-gc non-nil</code>).</p> <p>Increasing the threshold reduces the number of GC calls, but may increase the virtual memory usage.</p> |                                                                                                |

`set-gen-num-gc-threshold` returns the old threshold for the generation *gen-num*. It can be called with *threshold nil* to return the threshold value without changing it.

|          |                                                                                                                                                                                                                                    |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | <code>set-gen-num-gc-threshold</code> is implemented only in 64-bit LispWorks. It does nothing in the Mobile GC and its return value is not meaningful. It is not relevant to the Memory Management API in 32-bit implementations. |
| See also | <a href="#"><code>set-blocking-gen-num</code></a><br><a href="#">“Memory Management in 64-bit LispWorks” on page 146</a>                                                                                                           |

## set-maximum-memory *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                           |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| Summary     | Sets or removes a limit for the top of the Lisp heap in 32-bit LispWorks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                           |
| Package     | <code>system</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                           |
| Signature   | <code>set-maximum-memory address</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                           |
| Arguments   | <code>address</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | An integer address, or <code>nil</code> . |
| Description | <p><code>set-maximum-memory</code> sets or removes a limit for the maximum address that the Lisp heap can grow to. If <i>address</i> is an integer, this becomes the maximum address. If <i>address</i> is <code>nil</code>, any limit set by <code>set-maximum-memory</code> is removed.</p> <p>LispWorks sets the maximum memory on startup. In all cases the system is constrained by the size of the physical memory.</p> <p>When the maximum memory is reached (either that set by <code>set-maximum-memory</code> or the physical memory limit) the system will become unstable. Therefore this situation should be avoided. The benefit of having the maximum memory set is that a useful error is signaled if the limit is reached.</p> |                                           |

An application which is likely to grow to the maximum memory should test the amount of available memory using `memory-growth-margin` or `room-values` at suitable times, and take action to reclaim memory. Do not rely on handling the error signaled when the maximum memory is reached, since the system is already unstable at this point.

|          |                                                                                                                                                                                         |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | <code>set-maximum-memory</code> is implemented only in 32-bit Lisp-Works. It is not relevant to the Memory Management API in 64-bit implementations.                                    |
| See also | <code>check-fragmentation</code><br><code>mark-and-sweep</code><br><code>memory-growth-margin</code><br><code>room-values</code><br>“Memory Management in 32-bit LispWorks” on page 135 |

|           | <i>Function</i>                                                                                                                                                                                                                                                                                                    |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary   | Defines the maximum segment size for a generation and allocation type in 64-bit LispWorks.                                                                                                                                                                                                                         |
| Package   | <code>system</code>                                                                                                                                                                                                                                                                                                |
| Signature | <code>set-maximum-segment-size gen-num allocation-type size-in-mb</code>                                                                                                                                                                                                                                           |
| Arguments | <code>gen-num</code> An integer between 0 and 7, inclusive.<br><code>allocation-type</code> One of <code>:cons</code> , <code>:symbol</code> , <code>:function</code> , <code>:non-pointer</code> and <code>:other</code><br><code>size-in-mb</code> An integer between 1 and 256 inclusive, or <code>nil</code> . |
| Values    | <code>max-segment-size</code><br>A number.                                                                                                                                                                                                                                                                         |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The function <code>set-maximum-segment-size</code> sets the maximum segment size for a generation and allocation type in 64-bit LispWorks.</p> <p><i>allocation-type</i> can be any of the main allocation types described in “Segments and Allocation Types” on page 147.</p> <p><i>size-in-mb</i> is the size in megabytes.</p> <p>For the non-ephemeral generations (that is, the blocking generation and above), if the system needs more memory of some allocation type in some generation, its normal operation is to enlarge one of the existing segments in this generation of this allocation type. If it does not find a segment that it can enlarge, it allocates a new segment of the same allocation type in the same generation. Therefore the maximum segment size affects the number of segments that will be used.</p> <p>There is an overhead to using more segments, so normally having the largest segment size which the implementation allows (256MB) is the best. Reducing the size may be useful when using <code>marking-gc</code> with <i>what-to-copy</i> non-nil or <code>set-blocking-gen-num</code> with <i>do-gc</i> a number to prevent fragmentation in the blocking generation. In this situation, reducing the size of each segment makes it easier for the system to find segments to copy, even if the <i>max-size-to-copy</i> parameter is set to a low number to avoid using too much virtual memory.</p> <p>The returned value, <i>max-segment-size</i>, is the previous maximum segment size.</p> <p>If <i>size-in-mb</i> is a number, it specifies the size in megabytes. If <i>size-in-mb</i> is <code>nil</code> then <code>set-maximum-segment-size</code> returns the maximum segment size without altering it.</p> |
| Notes       | <p><code>set-maximum-segment-size</code> is implemented only in 64-bit LispWorks. It does nothing in the Mobile GC and its return value is not meaningful. It is not relevant to the Memory Management API in 32-bit implementations.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

See also **`marking-gc`**,  
**`set-blocking-gen-num`**,  
**`set-default-segment-size`**,  
“Memory Management in 64-bit LispWorks” on page 146

## **set-memory-check** *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                        |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Summary     | Sets a memory check in 64-bit LispWorks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                        |
| Package     | <b><code>system</code></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                        |
| Signature   | <b><code>set-memory-check size function</code></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                        |
| Arguments   | <b><code>size</code></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | An integer.            |
|             | <b><code>function</code></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | A function designator. |
| Description | <p>The function <b><code>set-memory-check</code></b> sets a memory check. <b><code>size</code></b> must be an integer. It specifies the total size in bytes of the mapped areas of Lisp at which the check is triggered. <b><code>function</code></b> is a function of no arguments.</p> <p>After each automatic garbage collection (GC) the system checks whether the mapped area (excluding stacks) is larger than <b><code>size</code></b>. If it is larger, <b><code>function</code></b> is called with no arguments.</p> <p>Inside the dynamic scope of the call, the check is disabled. There are no restrictions or special considerations on what the function <b><code>function</code></b> does.</p> <p>The current mapped area can be found by the <b><code>:total-size</code></b> value returned by <b><code>room-values</code></b>.</p> |                        |
| Notes       | <p><b><code>set-memory-check</code></b> is implemented only in 64-bit LispWorks. It is not relevant to the Memory Management API in 32-bit implementations.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                        |

See also      **set-memory-exhausted-callback**

## **set-memory-exhausted-callback** *Function*

Summary      Sets a callback that is called when memory is exhausted in 64-bit LispWorks.

Package      **system**

Signature      **set-memory-exhausted-callback** *function* &optional *where* => *callbacks*

Arguments      *function*      A function designator, the keyword :reset, or nil.

*where*      :first, :last or nil.

Values      *callbacks*      A list of function designators.

Description      The function **set-memory-exhausted-callback** adds a callback that is called when memory is exhausted. That is, when the system fails to map memory.

**Note:** **set-memory-check** is a more robust way to protect against memory exhaustion problems.

If *function* is a function designator then it should be a function with signature

*function gen-num size type-name static*

*function* is expected to report what the system was trying to allocate when it failed to map memory. Its arguments are:

*gen-num*      The number of the generation in which it was trying to allocate.

*size*      The size in bytes which it was trying to allocate.

*type-name* A string naming the allocation type it was trying to allocate.

*static* A boolean, true if it was trying to allocate a static object, and false otherwise.

*function* can also have the special value `:reset`, which resets the callback list to `nil`.

*function* can also be `nil`, which means do nothing but simply return the current list of callbacks.

*where* defines the position in the list that the callback *function* is placed. Its allowed values are:

`:first` *function* is placed first in the callbacks list.

`:last` *function* is placed last in the callbacks list.

`nil` *function* is removed from the callbacks list.

`set-memory-exhausted-callback` always first removes *function* from the callbacks list, and then adds it according to *where*. The default value of *where* is `:first`. Functions in the list are compared with `equalp`.

`set-memory-exhausted-callback` returns the callback list.

When a callback is called, Lisp already failed to map memory. This means that you must not rely on the callback to do real work. It should therefore attempt only a minimal amount of work such as clean-ups and generating debug information. It should not try to do real work.

After all the callbacks are called, the system signals an error of type `storage-exhausted`. The condition can be accessed using the accessors described for `storage-exhausted`.

Notes `set-memory-exhausted-callback` is implemented only in 64-bit LispWorks. It is not relevant to the Memory Management API in 32-bit implementations.

See also      **set-memory-check**  
**storage-exhausted**

## **set-promote-generation-1** *Function*

Summary      Mobile GC only: Set whether promotion occurs from generation 1 to 2.

Package      **system**

Signature      **set-promote-generation-1** *on* &optional *promote-all* => *prev-value*

Arguments      *on*                  A boolean.

*promote-all*        **nil**, **t** or **:full-gc**.

Values      *prev-value*         A boolean.

Description      The function **set-promote-generation-1** controls whether promotion can occur from generation 1 to 2. LispWorks starts with promotion on, so objects in generation 1 that survive a GC are promoted to generation 2. Calling **set-promote-generation-1** with *on nil* changes the behavior to leave those objects in generation 1.

**set-promote-generation-1** can be repeatedly called to switch promotion on or off. It affects all threads.

When *on* is **nil** and *promote-all* is non-**nil** then **set-promote-generation-1** promotes all currently live objects to generation 2, and then switches off promotion of generation 1. If *promote-all* is **t**, this promotion is done by a GC of generation 1. If *promote-all* is **:full-gc**, it is done by a GC of generation 2.

**set-promote-generation-1** returns the previous setting.

Notes      Blocking promotion of generation 1 prevents "generation leaks", that is promotion of objects to generation 2 that die

not long afterwards, but it causes growth of generation 1, which makes GC of generation 1 slower. As long as generation 1 is not too large, then that is not a problem, and blocking the potential leaks into generation 2 is useful. If generation 1 grows as a result of blocking promotion, GC of generation 1 starts to take noticeable time, and it is better not to block but to tune generation 2.

See also “Preventing/reducing GC of generation 2” on page 159

|             | <b>set-reserved-memory-policy</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <i>Function</i>              |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| Summary     | Mobile GC only: Tell LispWorks how much reserved memory to try to keep.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                              |
| Package     | <code>system</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                              |
| Signature   | <code>set-reserved-memory-policy fixed-size =&gt; policy</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                              |
| Arguments   | <code>fixed-size</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | A real or <code>nil</code> . |
| Values      | <code>policy</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <code>nil</code> or integer. |
| Description | The function <code>set-reserved-memory-policy</code> tells LispWorks how much reserved memory to keep.<br><br>If <code>fixed-size</code> is not <code>nil</code> , it tells LispWorks that it should keep this number of bytes of reserved memory. The reserved memory is held in segments of fixed size of 8 MB, the actual amount reserved is <code>fixed-size</code> rounded up to the nearest 8 MB. If <code>fixed-size</code> is <code>nil</code> , LispWorks uses the total size of generation 0 plus generation 1 after each GC to compute the size to keep.<br><br>LispWorks starts with the setting being <code>nil</code> .<br><br>Calling <code>set-reserved-memory-policy</code> does not change the current size of the reserved area. LispWorks only reduces the reserved area after a GC if it is too large. It only increases it, |                              |

up to the limit, when the GC has copied all objects from a segment.

`set-reserved-memory-policy` returns the current setting.

See also “Mobile GC technical details” on page 154

|                           | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |               |                        |                |                                  |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|------------------------|----------------|----------------------------------|
| <b>set-signal-handler</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |               |                        |                |                                  |
| Summary                   | Installs or removes a handler for a POSIX signal.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |               |                        |                |                                  |
|                           | <b>Note:</b> applicable only on non-Windows platforms.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |               |                        |                |                                  |
| Package                   | <code>system</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |               |                        |                |                                  |
| Signature                 | <code>set-signal-handler signum handler</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |               |                        |                |                                  |
| Arguments                 | <table border="0"> <tr> <td><i>signum</i></td><td>A POSIX signal number.</td></tr> <tr> <td><i>handler</i></td><td>A function or <code>nil</code>.</td></tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <i>signum</i> | A POSIX signal number. | <i>handler</i> | A function or <code>nil</code> . |
| <i>signum</i>             | A POSIX signal number.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |               |                        |                |                                  |
| <i>handler</i>            | A function or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |               |                        |                |                                  |
| Description               | <p><code>set-signal-handler</code> with a function <i>handler</i> configures LispWorks such that <i>handler</i> is called when the POSIX signal <i>signum</i> occurs.</p> <p>If <i>handler</i> is <code>nil</code>, any handler for <i>signum</i> is removed.</p> <p><i>handler</i> should be defined to take an <code>&amp;rest</code> argument, and ignore it. There are no restrictions on <i>handler</i> other than those applying to any asynchronous function call, and that it may be called in any thread. In particular there is no need to handle the signal immediately.</p> <p>The configuration established by <code>set-signal-handler</code> is not persistent over image saving (or application delivery), so it should be called each time the image (or application) is started.</p> |               |                        |                |                                  |

**Notes** The currently defined signal handlers are shown in the output of the bug report template which can be generated via the `:bug-form` listener command. For example, there is a `SIGINT` handler which calls `break`. You should consult Lisp Support before overwriting existing signal handlers.

LispWorks initially has no `SIGHUP` handler. `SIGHUP` will kill a LispWorks process which does not have a `SIGHUP` handler installed. When the LispWorks IDE starts up, a `SIGHUP` handler (which attempts to release locks in the environment) is installed. However if you need a `SIGHUP` handler in a server application, for example, you should install one using `set-signal-handler`.

**Example**

```
(defun my-hup-handler (&rest x)
  (declare (ignorable x))
  (cerror "Continue"
    "Got a HUP signal"))

(sys:set-signal-handler 1 'my-hup-handler)
```

Note that the LispWorks IDE overwrites a `SIGHUP` handler, so you would need to reinstall it after GUI startup.

## set-spare-keeping-policy

### *Function*

|                  |                                                                                    |                                          |
|------------------|------------------------------------------------------------------------------------|------------------------------------------|
| <b>Summary</b>   | Controls the behavior of the system when a segment is emptied in 64-bit LispWorks. |                                          |
| <b>Package</b>   | <code>system</code>                                                                |                                          |
| <b>Signature</b> | <code>set-spare-keeping-policy gen-num policy =&gt; old-policy</code>              |                                          |
| <b>Arguments</b> | <code>gen-num</code>                                                               | An integer in the inclusive range [0,7]. |
|                  | <code>policy</code>                                                                | A generalized boolean.                   |
| <b>Values</b>    | <code>old-policy</code>                                                            | A generalized boolean.                   |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The function <code>set-spare-keeping-policy</code> controls the behavior of the system when a segment is emptied in 64-bit LispWorks.</p> <p>If <i>policy</i> is non-nil, then when a segment in generation <i>gen-num</i> is emptied by copying all the objects out from it, it may be kept as a spare segment to be used in the future. This increases the use of virtual memory, but reduces the number of calls to <code>mmap</code> and <code>munmap</code>. It may be useful in applications that allocate at a very high rate.</p> <p>If timing an application reveals a lot (more than 5%) of time in the "System Time", and especially if this shows up in the GC times produced by <code>extended-time</code>, it may be useful to set the policy to non-nil in generation 1, 2 and maybe in generation 3.</p> <p>The default policy is <code>nil</code> for all generations, meaning that empty segments are discarded.</p> <p>The returned value <i>old-policy</i> is the previous policy for the generation <i>gen-num</i>.</p> |
| Notes       | <code>set-spare-keeping-policy</code> is implemented only in 64-bit LispWorks. It does nothing in the Mobile GC and its return value is not meaningful. It is not relevant to the Memory Management API in 32-bit implementations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| See also    | <code>extended-time</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

|           | <i>Function</i>                                           |
|-----------|-----------------------------------------------------------|
| Summary   | Mobile GC only: Sets splitting promotion of generation 1. |
| Package   | <code>system</code>                                       |
| Signature | <code>set-split-promotion on-p =&gt; prev-on-p</code>     |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |            |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Arguments   | <i>on-p</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | A boolean. |
| Values      | <i>prev-on-p</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | A boolean. |
| Description | <p>The function <code>set-split-promotion</code> switches split promotion of generation 1 on or off, depending of the value of <i>on-p</i>. Split promotion means that in a copying (the default) GC, objects in generation 1 that already survived a GC of generation 1 are promoted to generation 2, while objects that are new in generation 1 stay in generation 1. Non-split promotion means that all objects in generation 1 are promoted to generation 2.</p> <p>Split promotion makes it less likely that objects will reach generation 2 and then die (causing a "generation leak"), but means that the GC spends more time on long-lived objects in generation 1 that should be in generation 2. Since "generation leak" is the more serious problem, the default is on, and it is probably rarely useful to switch it off.</p> <p>A situation when it is useful to switch it off is when you have an "initialization" phase when you allocate mostly long-lived objects, and explicitly invoke a GC of generation 2 at the end of this phase. In this situation, you are not worried about generation leak, because all the leaked objects will be discarded when you invoke the GC of generation 2, so switching off split promotion during the phase may speed it up. However the effect is unlikely to be large, and you should time the initialization phase with and without split promotion to see which is faster.</p> |            |

`set-split-promotion` returns the previous setting.

See also “Mobile GC technical details” on page 154

|             | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |      |                                                                            |           |                                                                            |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------------------------------------------------------------|-----------|----------------------------------------------------------------------------|
| Summary     | Mobile GC only: set the default static segment size, and optionally the size of the initial segment.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |                                                                            |           |                                                                            |
| Package     | <code>system</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |      |                                                                            |           |                                                                            |
| Signature   | <code>set-static-segment-size size &amp;optional init-size =&gt; prev-size, prev-init-size</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |      |                                                                            |           |                                                                            |
| Arguments   | <table border="0"> <tr> <td style="vertical-align: top;">size</td><td>A positive integer in the range #x10000 to #x1000000 or <code>nil</code>.</td></tr> <tr> <td style="vertical-align: top;">init-size</td><td>A positive integer in the range #x10000 to #x1000000 or <code>nil</code>.</td></tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | size | A positive integer in the range #x10000 to #x1000000 or <code>nil</code> . | init-size | A positive integer in the range #x10000 to #x1000000 or <code>nil</code> . |
| size        | A positive integer in the range #x10000 to #x1000000 or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |      |                                                                            |           |                                                                            |
| init-size   | A positive integer in the range #x10000 to #x1000000 or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |      |                                                                            |           |                                                                            |
| Values      | <code>prev-size, prev-init-size</code><br>Integer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |      |                                                                            |           |                                                                            |
| Description | <p>The function <code>set-static-segment-size</code> sets the size of new static segments other than the initial one, and optionally the size of the initial one.</p> <p>Normally you should not use static objects, because it makes the GC less efficient. However, in some circumstances it may be the best solution. In this situation <code>set-static-segment-size</code> can be used to minimize the overhead.</p> <p>The overhead for the GC depends on the number of segments, so it is best to minimize the number of static segments by making them larger. On the other hand, if a segment is not full, it wastes memory. Hence the ideal solution would be the smallest single segment that is large enough to accommodate all static allocation. You can check the current number and sizes of static segments by looking at the output of <code>(room t)</code>.</p> <p>By default, LispWorks allocates a small segment on startup of size 64 kB (#x10000). It actually uses very little of it (a few hundred bytes, up to several kB if you have many processes), and if your application uses only a few kB that should be</p> |      |                                                                            |           |                                                                            |

enough. If there is further static allocation and the initial segment becomes full, then LispWorks allocates another segment of size 1 MB, and repeats this as needed.

`set-static-segment-size` controls these sizes. `size` controls the size of all the static segments except the one that is allocated on startup. `init-size` controls the size of the initial segment.

The initial segment is allocated before your code is called on startup, so to set the initial segment size you need to call `set-static-segment-size` before delivering the image. `set-static-segment-size` gives an error if `init-size` is non-nil and the Mobile GC is already running.

A `nil` value means do not change the value. Calling `set-static-segment-size` with `nil` is a way to get the current settings.

`set-static-segment-size` returns the previous settings.

See also “Mobile GC technical details” on page 154

|                           | <i>Function</i>                                                                                                                                                                                                                             |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>set-temp-directory</b> |                                                                                                                                                                                                                                             |
| Summary                   | Sets the default temp directory.                                                                                                                                                                                                            |
| Package                   | <code>system</code>                                                                                                                                                                                                                         |
| Signature                 | <code>set-temp-directory temp-dir</code>                                                                                                                                                                                                    |
| Arguments                 | <code>temp-dir</code> A pathname or <code>nil</code> .                                                                                                                                                                                      |
| Description               | The function <code>set-temp-directory</code> sets the default temp directory, that is the directory that <code>get-temp-directory</code> returns, and which is also used by <code>create-temp-file</code> and <code>open-temp-file</code> . |

*temp-dir* must be either a pathname of a suitable directory, or *nil*, which means use the default. The default is what the Operating System returns for a temp directory.

|          |                                                                                                                                                                                                                                                                                                                                                         |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | <code>set-temp-directory</code> affects the global setting, that is all threads, and it is not thread-safe. If you need to call it, do that during start up. When you want to use temp files not in the default temp directory, you should call <code>open-temp-file</code> or <code>create-temp-file</code> with a suitable <i>directory</i> argument. |
| See also | <code>open-temp-file</code><br><code>create-temp-file</code><br><code>get-temp-directory</code>                                                                                                                                                                                                                                                         |

## **setup-atomic-funcall** *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Sets up mutually atomic funcalls in SMP LispWorks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Package     | <code>system</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Signature   | <code>setup-atomic-funcall &amp;rest function-and-arguments</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Arguments   | <i>function-and-arguments</i> A list.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Description | <p>The function <code>setup-atomic-funcall</code> sets up a funcall which will be executed atomically with respect to any other calls which were also set up by <code>setup-atomic-funcall</code>.</p> <p>The call causes the execution of the form</p> <pre>(apply (car function-and-arguments)       (cdr function-and-arguments))</pre> <p>some time after the entry to <code>setup-atomic-funcall</code>. The call may happen before <code>setup-atomic-funcall</code> returns, and it is expected that normally this is what will happen. However, it may be delayed for an indefinite period, but normally this period is short (milliseconds). The execution occurs</p> |

atomically with respect to other calls that were set up by `setup-atomic-funcall`.

The call should be short, because otherwise it will delay all the other calls. If an error occurs during the call, the atomicity is no longer guaranteed.

`setup-atomic-funcall` is useful when a process needs to atomically tell another process to do something, but does not need to wait for it to finish.

`setup-atomic-funcall` causes less congestion than using a lock, and so is more efficient for locks that may cause congestion. `compare-and-swap` and `atomic-exchange` operations will be faster.

See also      `atomic-exchange`  
                  `compare-and-swap`

## **\*sg-default-size\*** *Variable*

Summary      Default initial size of a stack group.

Package      `system`

Initial value      In LispWorks (64-bit) for Solaris:

`20000`

In LispWorks (64-bit) on ARM64:

`18000`

In all other implementations:

`16000`

Description      The value of the variable `*sg-default-size*` is the initial size of a stack group, in 32 bit words (in 32-bit implementations) or in 64 bit words (in 64-bit implementations).

**\*sg-default-size\*** can be bound around a call to a process creation function. Note that setting the global value of this variable affects the size of all system processes too, so this is not recommended.

Example To create a process with a stack of 32000 words:

```
(let ((sys:*sg-default-size* 32000))
  (mp:process-run-function "Larger stack" '()
    #'(lambda ()
      (print (hcl:current-stack-length)))))
```

See also **current-stack-length**  
**\*stack-overflow-behaviour\***

## simple-int32-vector *Type*

|             |                                                                                                                                                                                                                                                                                                                    |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | A type for simple vectors of <b>int32</b> objects.                                                                                                                                                                                                                                                                 |
| Package     | <b>system</b>                                                                                                                                                                                                                                                                                                      |
| Signature   | <b>simple-int32-vector</b>                                                                                                                                                                                                                                                                                         |
| Description | The type <b>simple-int32-vector</b> provides simple vectors of <b>int32</b> objects and can be used to generate optimal 32-bit arithmetic code. Create a <b>simple-int32-vector</b> by calling <b>make-simple-int32-vector</b> .<br><br>See the section “Fast 32-bit arithmetic” on page 472 for more information. |
| See also    | <b>int32</b><br><b>int32-aref</b><br><b>make-simple-int32-vector</b><br><b>simple-int32-vector-length</b><br><b>simple-int32-vector-p</b>                                                                                                                                                                          |

## **simple-int32-vector-length** *Function*

|             |                                                                                      |                                |
|-------------|--------------------------------------------------------------------------------------|--------------------------------|
| Summary     | Return the length of a <b>simple-int32-vector</b> .                                  |                                |
| Package     | <b>system</b>                                                                        |                                |
| Signature   | <b>simple-int32-vector-length</b>                                                    | <i>vector</i> => <i>length</i> |
| Arguments   | <i>vector</i>                                                                        | A <b>simple-int32-vector</b> . |
| Values      | <i>length</i>                                                                        | A non-negative fixnum.         |
| Description | The function <b>simple-int32-vector-length</b> returns the length of <i>vector</i> . |                                |
| See also    | <b>make-simple-int32-vector</b><br><b>simple-int32-vector</b>                        |                                |

## **simple-int32-vector-p** *Function*

|             |                                                                                                                              |                                |
|-------------|------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| Summary     | A predicate for objects of type <b>simple-int32-vector</b> .                                                                 |                                |
| Package     | <b>system</b>                                                                                                                |                                |
| Signature   | <b>simple-int32-vector-p</b>                                                                                                 | <i>object</i> => <i>result</i> |
| Arguments   | <i>object</i>                                                                                                                | An object.                     |
| Values      | <i>result</i>                                                                                                                | A boolean.                     |
| Description | The function <b>simple-int32-vector-p</b> returns true if <i>object</i> is a <b>simple-int32-vector</b> and false otherwise. |                                |
| See also    | <b>make-simple-int32-vector</b><br><b>simple-int32-vector</b>                                                                |                                |

|             | <i>Type</i>                                                                                                                                                                                                                                                                                                                                |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | A type for simple vectors of <code>int64</code> objects.                                                                                                                                                                                                                                                                                   |
| Package     | <code>system</code>                                                                                                                                                                                                                                                                                                                        |
| Signature   | <code>simple-int64-vector</code>                                                                                                                                                                                                                                                                                                           |
| Description | The type <code>simple-int64-vector</code> provides simple vectors of <code>int64</code> objects and can be used to generate optimal 64-bit arithmetic code. Create a <code>simple-int64-vector</code> by calling <code>make-simple-int64-vector</code> .<br><br>See the section “Fast 64-bit arithmetic” on page 474 for more information. |
| See also    | <code>int64</code><br><code>int64-aref</code><br><code>make-simple-int64-vector</code><br><code>simple-int64-vector-length</code><br><code>simple-int64-vector-p</code>                                                                                                                                                                    |

|             | <i>Function</i>                                                                                  |
|-------------|--------------------------------------------------------------------------------------------------|
| Summary     | Return the length of a <code>simple-int64-vector</code> .                                        |
| Package     | <code>system</code>                                                                              |
| Signature   | <code>simple-int64-vector-length vector =&gt; length</code>                                      |
| Arguments   | <code>vector</code> A <code>simple-int64-vector</code> .                                         |
| Values      | <code>length</code> A non-negative fixnum.                                                       |
| Description | The function <code>simple-int64-vector-length</code> returns the length of <code>vector</code> . |

See also [make-simple-int64-vector](#)  
[simple-int64-vector](#)

## simple-int64-vector-p

## *Function*

**Summary** A predicate for objects of type `simple-int64-vector`.

## Package system

Signature simple-int64-vector-p *object* => *result*

|           |               |            |
|-----------|---------------|------------|
| Arguments | <i>object</i> | An object. |
|-----------|---------------|------------|

Values              *result*              A boolean.

Description The function `simple-int64-vector-p` returns true if *object* is a `simple-int64-vector` and false otherwise.

See also [make-simple-int64-vector](#)  
[simple-int64-vector](#)

## \*specific-valid-file-encodings\*

## Variable

**Summary** List of external formats to check for validity.

Package system

### Initial Value      nil

|             |                                                                                                                                                                                                                                                                                                             |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | The variable <code>*specific-valid-file-encodings*</code> is a list used by <code>specific-valid-file-encoding</code> , which tests each element of <code>*specific-valid-file-encodings*</code> to see if it is valid for the contents of buffer, bounded by length, and returns the first valid encoding. |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

See also      **specific-valid-file-encoding**  
                  **\*file-encoding-detection-algorithm\***

|                                     | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                    |                                                                                                       |                |                          |               |                                       |               |                                                            |
|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-------------------------------------------------------------------------------------------------------|----------------|--------------------------|---------------|---------------------------------------|---------------|------------------------------------------------------------|
| <b>specific-valid-file-encoding</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                    |                                                                                                       |                |                          |               |                                       |               |                                                            |
| Summary                             | Provides an encoding chosen from list of specific encodings if valid.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                    |                                                                                                       |                |                          |               |                                       |               |                                                            |
| Package                             | <b>system</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                    |                                                                                                       |                |                          |               |                                       |               |                                                            |
| Signature                           | <b>specific-valid-file-encoding pathname ef-spec buffer length<br/>=&gt; new-ef-spec</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                    |                                                                                                       |                |                          |               |                                       |               |                                                            |
| Arguments                           | <table border="0"> <tr> <td><i>pathname</i></td><td>Pathname identifying location of buffer.</td></tr> <tr> <td><i>ef-spec</i></td><td>An external format spec.</td></tr> <tr> <td><i>buffer</i></td><td>A buffer whose contents are examined.</td></tr> <tr> <td><i>length</i></td><td>Length (an integer) up to which buffer should be examined.</td></tr> </table>                                                                                                                                                                                      | <i>pathname</i>    | Pathname identifying location of buffer.                                                              | <i>ef-spec</i> | An external format spec. | <i>buffer</i> | A buffer whose contents are examined. | <i>length</i> | Length (an integer) up to which buffer should be examined. |
| <i>pathname</i>                     | Pathname identifying location of buffer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                    |                                                                                                       |                |                          |               |                                       |               |                                                            |
| <i>ef-spec</i>                      | An external format spec.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                    |                                                                                                       |                |                          |               |                                       |               |                                                            |
| <i>buffer</i>                       | A buffer whose contents are examined.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                    |                                                                                                       |                |                          |               |                                       |               |                                                            |
| <i>length</i>                       | Length (an integer) up to which buffer should be examined.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                    |                                                                                                       |                |                          |               |                                       |               |                                                            |
| Values                              | <table border="0"> <tr> <td><i>new-ef-spec</i></td><td>Default external format spec created by merging ef-spec with the encoding that was found to be valid.</td></tr> </table>                                                                                                                                                                                                                                                                                                                                                                            | <i>new-ef-spec</i> | Default external format spec created by merging ef-spec with the encoding that was found to be valid. |                |                          |               |                                       |               |                                                            |
| <i>new-ef-spec</i>                  | Default external format spec created by merging ef-spec with the encoding that was found to be valid.                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                    |                                                                                                       |                |                          |               |                                       |               |                                                            |
| Description                         | <p>The function <b>specific-valid-file-encoding</b> tests each element of <b>*specific-valid-file-encodings*</b> to see if it is valid for the contents of <i>buffer</i>, bounded by <i>length</i>. The first valid encoding is returned. For input files, <i>buffer</i> will contain the start of the file, so it is assumed that it contains a representative sample. For output files, <i>buffer</i> will have length 0, so the first element of <b>*specific-valid-file-encodings*</b> will always be returned.</p> <p><i>pathname</i> is ignored.</p> |                    |                                                                                                       |                |                          |               |                                       |               |                                                            |
| Notes                               | You need to set <b>*specific-valid-file-encodings*</b> for <b>specific-valid-file-encoding</b> to have any effect. The                                                                                                                                                                                                                                                                                                                                                                                                                                     |                    |                                                                                                       |                |                          |               |                                       |               |                                                            |

default value of `*specific-valid-file-encodings*` is `nil`, which causes `specific-valid-file-encoding` to return `ef-spec` unchanged.

See also      `*specific-valid-file-encodings*`  
                 `*file-encoding-detection-algorithm*`

## **`*stack-overflow-behaviour*`** *Variable*

|                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary             | Controls behavior when stack overflow is detected.                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Package             | <code>system</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Initial value       | <code>:error</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Description         | <p>The variable <code>*stack-overflow-behaviour*</code> controls behavior when stack overflow is detected.</p> <p>When <code>*stack-overflow-behaviour*</code> is set to <code>:error</code>, LispWorks signals an error.</p> <p>When it is set to <code>:warn</code>, LispWorks increases the stack size automatically to accommodate the overflow, but prints a warning message to signal that this has happened.</p> <p>When it is set to <code>nil</code>, LispWorks increases stack size silently.</p> |
| Notes               | Stack overflow is only detected when code was compiled with optimize qualities <code>safety &gt;= 1</code> or <code>interruptible &gt; 0</code> (see “Compiler control” on page 104l). Code compiled with <code>safety = 0</code> and <code>interruptible = 0</code> can cause an undetected stack overflow that will crash LispWorks.                                                                                                                                                                      |
| Compatibility notes | In LispWorks 4.4 and previous on Windows and Linux platforms, automatic stack extension is not implemented. This has been fixed in LispWorks 5.0 and later.                                                                                                                                                                                                                                                                                                                                                 |
| See also            | <code>*sg-default-size*</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

| <b>staticp</b> | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary        | Specifies whether a given object has been allocated in static memory.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Package        | <code>system</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Signature      | <code>staticp obj =&gt; bool</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Arguments      | <i>obj</i> An object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Values         | <i>bool</i> <code>t</code> if the object is allocated in static memory;<br><code>nil</code> otherwise.                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Description    | This predicate can be used on an object to find out whether it is allocated in static memory.<br><br>Foreign objects made by Lisp — for example in a Foreign Language Interface program — are made in static memory. The Lisp representations of these alien objects are not, however. Therefore <code>staticp</code> applied to an alien returns <code>nil</code> even though the alien instance itself is really allocated in static memory. To establish this, you can check the pointer to the alien instance within its Lisp representation (a structure). |

| <b>storage-exhausted</b> | <i>Class</i>                                                                                                                                                                        |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary                  | A condition class for failures to map memory.                                                                                                                                       |
| Superclasses             | <code>storage-condition</code>                                                                                                                                                      |
| Initargs                 | <code>:gen-num</code> The number of the generation in which the system was trying to allocate.<br><br><code>:size</code> The size in bytes which the system was trying to allocate. |

|             |                                                                                                                                                                                  |                                                                                            |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
|             | <b>:type</b>                                                                                                                                                                     | A string naming the allocation type the system was trying to allocate.                     |
|             | <b>:static</b>                                                                                                                                                                   | A boolean, true if the system was trying to allocate a static object, and false otherwise. |
| Accessors   | <b>storage-exhausted-gen-num</b><br><b>storage-exhausted-size</b><br><b>storage-exhausted-static</b><br><b>storage-exhausted-type</b>                                            |                                                                                            |
| Description | The class <b>storage-exhausted</b> is a condition class used for reporting failures to map memory.<br><br>Allocation types are as described in <b>set-maximum-segment-size</b> . |                                                                                            |
| See also    | <b>set-memory-exhausted-callback</b>                                                                                                                                             |                                                                                            |

| <b>sweep-gen-num-objects</b> |                 | <i>Function</i>                                                                                                              |
|------------------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------|
| Summary                      |                 | Applies a function to all the live objects in a generation in 64-bit LispWorks.                                              |
| Package                      |                 | <b>system</b>                                                                                                                |
| Signature                    |                 | <b>sweep-gen-num-objects</b> <i>gen-num function</i>                                                                         |
| Arguments                    | <i>gen-num</i>  | An integer in the inclusive range [0,7].                                                                                     |
|                              | <i>function</i> | A designator for a function of one argument, the object.                                                                     |
| Values                       |                 | <b>sweep-gen-num-objects</b> returns <b>nil</b> .                                                                            |
| Description                  |                 | The function <b>sweep-gen-num-objects</b> applies <i>function</i> to all the live objects in the generation <i>gen-num</i> . |

*function* should take one argument, the object. It can allocate, but if it allocates heavily the sweeping becomes unreliable. Small amounts of allocation will normally happen only in generation 0, and so will not affect sweeping of other generations.

|          |                                                                                                                                                                                                                                                   |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | <p><code>sweep-gen-num-objects</code> is not implemented in 32-bit Lisp-Works, where you can use <code>sweep-all-objects</code> instead.</p> <p><code>sweep-gen-num-objects</code> does not sweep <code>cons</code> objects in the Mobile GC.</p> |
| See also | <code>sweep-all-objects</code>                                                                                                                                                                                                                    |

|                         | <i>Function</i>                                                                                                                                                                                                                                                   |                   |                   |                     |                                                           |                         |                        |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------------|---------------------|-----------------------------------------------------------|-------------------------|------------------------|
| Summary                 | Accesses a typed aref vector efficiently.                                                                                                                                                                                                                         |                   |                   |                     |                                                           |                         |                        |
| Package                 | <code>system</code>                                                                                                                                                                                                                                               |                   |                   |                     |                                                           |                         |                        |
| Signature               | $\text{typed-aref } \text{type } \text{vector } \text{byte-index} \Rightarrow \text{value}$ $(\text{setf typed-aref}) \text{ value type vector byte-index} \Rightarrow \text{value}$                                                                              |                   |                   |                     |                                                           |                         |                        |
| Arguments               | <table> <tr> <td><code>type</code></td><td>A type specifier.</td></tr> <tr> <td><code>vector</code></td><td>A vector created by <code>make-typed-aref-vector</code>.</td></tr> <tr> <td><code>byte-index</code></td><td>A non-negative fixnum.</td></tr> </table> | <code>type</code> | A type specifier. | <code>vector</code> | A vector created by <code>make-typed-aref-vector</code> . | <code>byte-index</code> | A non-negative fixnum. |
| <code>type</code>       | A type specifier.                                                                                                                                                                                                                                                 |                   |                   |                     |                                                           |                         |                        |
| <code>vector</code>     | A vector created by <code>make-typed-aref-vector</code> .                                                                                                                                                                                                         |                   |                   |                     |                                                           |                         |                        |
| <code>byte-index</code> | A non-negative fixnum.                                                                                                                                                                                                                                            |                   |                   |                     |                                                           |                         |                        |
| Values                  | <code>value</code> An object of type <code>type</code> .                                                                                                                                                                                                          |                   |                   |                     |                                                           |                         |                        |
| Description             | <p>The function <code>typed-aref</code> allows efficient access to a typed aref vector.</p> <p>The following values of <code>type</code> are accepted:</p> <ul style="list-style-type: none"> <li>• <code>double-float</code></li> </ul>                          |                   |                   |                     |                                                           |                         |                        |

- `float`
- `single-float`
- `sys:int32`
- `(unsigned-byte 32)`
- `(signed-byte 32)`
- `(unsigned-byte 16)`
- `(signed-byte 16)`
- `(unsigned-byte 8)`
- `(signed-byte 8)`

Additionally in 64-bit LispWorks only, the following values of type are also accepted:

- `sys:int64`
- `(unsigned-byte 64)`
- `(signed-byte 64)`

`vector` must be an object returned by `make-typed-aref-vector`.

`byte-index` specifies the index in 8-bit bytes from the start of the data in the vector. It must be a non-negative fixnum which is less than the `byte-length` argument passed to `make-typed-aref-vector`.

`typed-aref` and `(setf typed-aref)` will be inlined to code which is as efficient as possible when compiled with `(optimize (safety 0))` and a constant type. As usual, you need to add `(optimize (float 0))` to remove boxing for the float types.

## Notes

Efficient access to foreign arrays is also available. See `fli:foreign-typed-aref` in the *LispWorks Foreign Language Interface User Guide and Reference Manual*

|          |                                                                                                                                                                                   |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Example  | <pre>(defun double-float-typed-aref-incf (x y z)   (declare (optimize (float 0) (safety 0)))   (incf (sys:typed-aref 'double-float x y)         (the double-float z)))   x)</pre> |
| See also | <b>make-typed-aref-vector</b><br>“Optimized integer arithmetic and integer vector access” on page 472                                                                             |

## wait-for-input-streams *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                            |                                                          |  |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|--|
| Summary     | Waits for input on a list of socket streams, returning those that are ready.                                                                                                                                                                                                                                                                                                               |                                                          |  |
| Package     | <b>system</b>                                                                                                                                                                                                                                                                                                                                                                              |                                                          |  |
| Signature   | <b>wait-for-input-streams</b> <i>streams</i> &key <b>wait-function</b> <b>wait-reason</b> <b>timeout</b> => <i>result</i>                                                                                                                                                                                                                                                                  |                                                          |  |
| Arguments   | <b>streams</b>                                                                                                                                                                                                                                                                                                                                                                             | A list, each member of which is a <b>socket-stream</b> . |  |
|             | <b>wait-function</b>                                                                                                                                                                                                                                                                                                                                                                       | A function of no arguments.                              |  |
|             | <b>wait-reason</b>                                                                                                                                                                                                                                                                                                                                                                         | A string.                                                |  |
|             | <b>timeout</b>                                                                                                                                                                                                                                                                                                                                                                             | A real number or <b>nil</b> .                            |  |
| Values      | <b>result</b>                                                                                                                                                                                                                                                                                                                                                                              | A list of <b>socket-streams</b> or <b>nil</b> .          |  |
| Description | The function <b>wait-for-input-streams</b> waits for any of the streams in the argument <i>streams</i> to be ready for input. “Ready for input” typically means that some input is available from the stream, but can also mean that the peer closed the connection or there is an attempt to connect to the socket. Note that this function first checks the buffer for buffered streams. |                                                          |  |

When any of the streams is ready for input, `wait-for-input-streams` returns a list of all the streams that are ready, in the same order that they appear in `streams`.

If `timeout` is non-nil it must be a real number, specifying a timeout in seconds. If `timeout` seconds pass and none of the streams is ready, `wait-for-input-streams` returns `nil`.

If `timeout` is 0, `wait-for-input-streams` returns all of the streams that are ready immediately, without waiting at all. That is, it behaves like `listen` on many streams.

If `wait-function` is supplied, it is called periodically with no arguments, and if it returns non-nil then `wait-for-input-streams` returns `nil`. Note that, like the `wait-function` of `process-wait`, `wait-function` is called often and on other threads, so need to be an inexpensive call and independent of dynamic context.

If `wait-reason` is supplied it is used as the `wait-reason` for the Lisp process that calls `wait-for-input-streams` while it is waiting.

Notes      `wait-for-input-streams` may return the list `streams` that was passed to it as is, if all the streams are ready.

See also    `wait-for-input-streams-returning-first`

## `wait-for-input-streams-returning-first` *Function*

Summary    Waits for input on a list of socket streams, returning the first stream that is ready.

Package    `system`

Signature    `wait-for-input-streams-returning-first streams &key wait-function wait-reason timeout => result`

|             |                                                                                                                                                                                                                    |                                                                |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|
| Arguments   | <i>streams</i>                                                                                                                                                                                                     | A list, each member of which is a <code>socket-stream</code> . |
|             | <i>wait-function</i>                                                                                                                                                                                               | A function of no arguments.                                    |
|             | <i>wait-reason</i>                                                                                                                                                                                                 | A string.                                                      |
|             | <i>timeout</i>                                                                                                                                                                                                     | A real number or <code>nil</code> .                            |
| Values      | <i>result</i>                                                                                                                                                                                                      | A <code>socket-stream</code> or <code>nil</code> .             |
| Description | The function <code>wait-for-input-streams-returning-first</code> behaves just like <code>wait-for-input-streams</code> except that it returns the first stream in the list <i>streams</i> that is ready for input. |                                                                |
| See also    | <code>wait-for-input-streams</code>                                                                                                                                                                                |                                                                |

## with-modification-change *Macro*

|             |                                                                                                                                                                                                                                                                                                        |                                                               |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| Summary     | Provides a way to check whether there was any "modification" during execution of a body of code.                                                                                                                                                                                                       |                                                               |
| Package     | <code>system</code>                                                                                                                                                                                                                                                                                    |                                                               |
| Signature   | <code>with-modification-change <i>modification-place</i> &amp;body <i>body</i></code>                                                                                                                                                                                                                  |                                                               |
| Arguments   | <i>modification-place</i>                                                                                                                                                                                                                                                                              | A place as defined in Common Lisp which can receive a fixnum. |
|             | <i>body</i>                                                                                                                                                                                                                                                                                            | Lisp code                                                     |
| Description | The macro <code>with-modification-change</code> , together with the macro <code>with-modification-check-macro</code> , provides a way for a body of code to execute and check whether there was any "modification" during this execution, where modification is execution of some other piece of code. |                                                               |

See “Aids for implementing modification checks” on page 300 for the full description and an example.

Notes *modification-place* does not need to be one of the places defined for low level atomic operations.

See also `with-modification-check-macro`

## **with-modification-check-macro** *Macro*

Summary Provides a way to check whether there was any "modification" during execution of a body of code.

Package `system`

Signature `with-modification-check-macro macro-name modification-place &body body`

Arguments *modification-place*A place as defined in Common Lisp which can receive a fixnum.

Description The macro `with-modification-check-macro`, together with the macro `with-modification-change`, provides a way for a body of code to execute and check whether there was any "modification" during this execution, where modification is execution of some other piece of code.

`with-modification-check-macro` defines a lexical macro (by macrolet) with the name *macro-name* which takes no arguments, and is used to check whether there was any change since entering the body.

*modification-place* must be initialized to a fixnum. It must not be modified by any code except `with-modification-change`.

See “Aids for implementing modification checks” on page 300 for the full description and an example.

Notes      *modification-place* does not need to be one of the places defined for low level atomic operations.

See also    **`with-modification-change`**

## **`with-other-threads-disabled`** *Macro*

Summary     A debugging macro which executes code with all other threads temporarily disabled.

Package     **`system`**

Signature    **`with-other-threads-disabled &body body => results`**

Arguments    *body*                Code.

Values        *results*              The results of evaluating *body*.

Description    The macro **`with-other-threads-disabled`** disables all the other threads (that is, the `mp:process` objects), executes *body* and then enables the other threads. Thus it guarantees "single-thread execution" for the forms in *body*.

The point at which each of the other threads is stopped is not well-defined. It is always a GC safe point, but it can be inside manipulating some data structure or while holding a `lock`. As a result, if the code in *body* accesses a data structure or tries to lock a lock, it may see an inconsistent structure or get an error about calling `process-wait` when scheduling not is allowed.

As a result, **`with-other-threads-disabled`** is safe only if the code in *body* does not do anything that accesses trees of pointers and expects them to be in a consistent state and does not use locks. Any other code may, rarely but not never, get some unexpected error.

**`with-other-threads-disabled`** is useful for:

- the most accurate timing possible of specific operations
- running `sweep-all-objects` reliably
- "freezing" the program when something unexpected occurs and you want to debug it in the terminal.

Notes      `with-other-threads-disabled` cannot be guaranteed to be 100% safe in all cases, and therefore must not be used in end-user applications. It is useful for debugging purposes.  
The LispWorks IDE relies on multithreading and will not work while the code in *body* executes.

See also    `sweep-all-objects`  
              `time`



# 50

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## Miscellaneous WIN32 symbols

This chapter describes miscellaneous symbols available in the `WIN32` package.

The `WIN32` package also includes “The Windows registry API”, “The DDE client interface” and “The DDE server interface”. These are documented in separate chapters in this manual.

**Note:** the `WIN32` package is not a supported implementation of the Win32 API. You should not use symbols in the `WIN32` package unless they are documented in this manual. Instead, define your own interfaces to Windows functions as you need - see the *LispWorks Foreign Language Interface User Guide and Reference Manual* for details.

**Note:** This chapter applies only to LispWorks for Windows, and not the UNIX, Linux, x86/x64 Solaris, FreeBSD, AIX or Mac OS X platforms.

| canonicalize-sid-string | <i>Function</i>                                              |
|-------------------------|--------------------------------------------------------------|
| Summary                 | Returns the canonical format of a SID specifier string.      |
| Package                 | <code>win32</code>                                           |
| Signature               | <code>canonicalize-sid-string sid-string =&gt; result</code> |

|             |                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arguments   | <i>sid-string</i> | A string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Values      | <i>result</i>     | A string or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Description |                   | The function <code>canonicalize-sid-string</code> returns the canonical format of the SID specified by <i>sid-string</i> . If the string is already canonical (in the S-1.. format) it returns a string which is equal to it. When the string is an alias, it returns the canonical form. The aliases are documented in the MSDN in the page titled "SID strings" (search for <code>SDQL_ANONYMOUS</code> ).<br><br><code>canonicalize-sid-string</code> returns <code>nil</code> for an unrecognized SID. |
| See also    |                   | <code>wait-for-connection</code><br><code>security-description-string-for-open-named-pipe</code>                                                                                                                                                                                                                                                                                                                                                                                                           |

| <b>connect-to-named-pipe</b> |                  | <i>Function</i>                                                                       |
|------------------------------|------------------|---------------------------------------------------------------------------------------|
| Summary                      |                  | Opens a stream connection to a named pipe.                                            |
| Package                      |                  | <code>win32</code>                                                                    |
| Signature                    |                  | <code>connect-to-named-pipe name &amp;key host errorp direction</code>                |
| Arguments                    | <i>name</i>      | A string.                                                                             |
|                              | <i>host</i>      | A string or <code>nil</code> .                                                        |
|                              | <i>errorp</i>    | A boolean.                                                                            |
|                              | <i>direction</i> | One of the keywords <code>:io</code> , <code>:input</code> and <code>:output</code> . |
| Values                       | <i>stream</i>    | A stream or <code>nil</code> .                                                        |
|                              | <i>keyword</i>   | A keyword or <code>nil</code> .                                                       |
|                              | <i>condition</i> | An error condition or <code>nil</code> .                                              |

Description     The function `connect-to-named-pipe` opens a connection to a named pipe and returns a stream connected to it that can be used like any other stream.

*name* is the pipe name. It can contain any character except #\\ (according to the MSDN). For successful connection another process must have already created a pipe with that name, with the right input/output direction and permissions for the caller of `connect-to-named-pipe`, and tried to connect to it but has not succeeded yet. In LispWorks this is done by `open-named-pipe-stream`. The Windows function is `ConnectNamedPipe`.

*host*, if non-nil, specifies a host on which the named pipe was created. `host nil` means the current machine.

*direction* specifies the direction of input/output. It needs be allowed by the pipe (in inverse, that is if `connect-to-named-pipe` gets direction `:input` then the pipe must have been opened for output, for example by calling `open-named-pipe-stream` with *direction* `:output` or `:io`). The default value of *direction* is `:io`.

*errorp* specifies what to do in case of failure. If it is non-nil (the default), an error is signaled. If it is `nil`, then `connect-to-named-pipe` returns *stream nil*, *keyword* is a descriptive keyword, and *condition* is an error condition. *keyword* can be one of:

**:does-not-exist**

There is no named pipe with this name.

**:all-in-use**

There is at least one named pipe with this name, but all are already connected.

**:access-denied**

There is already a named pipe with this name, but it denies access. That may be either because the permissions of the named

pipe do not allow the connection, or because other security features of the host system block the connection.

**:error** An unknown error.

On success `connect-to-named-pipe` returns a stream and the other two returned values are both `nil`.

See also [open-named-pipe-stream](#)

## dismiss-splash-screen *Function*

Summary Makes a startup screen disappear.

Package `win32`

Signature `dismiss-splash-screen &optional forcep`

Arguments `forcep` A generalized boolean.

Description The function `dismiss-splash-screen` makes a startup screen (as specified via the `:startup-bitmap-file` delivery keyword) disappear.

If `forcep` is `nil` then the startup screen is displayed for a minimum of 5 seconds before disappearing. If `forcep` is true then the startup screen disappears when `dismiss-splash-screen` is called. The default value of `forcep` is `nil`.

If `dismiss-splash-screen` is not called, the startup screen appears for 30 seconds.

**Note:** the user can dismiss the startup screen by clicking on it.

For more information about specifying a startup screen in your application, see the entry for `:startup-bitmap-file` in the *LispWorks Delivery User Guide*.

|                                        | <i>Macro</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>impersonating-named-pipe-client</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Summary                                | Executes code while impersonating the client of the named pipe.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Package                                | <code>win32</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Signature                              | <code>impersonating-named-pipe-client (named-pipe-stream &amp;key fail-form fail-no-read-form) &amp;body body</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Arguments                              | <p><i>named-pipe-stream</i> A named pipe stream.</p> <p><i>fail-form</i> A Lisp form.</p> <p><i>fail-no-read-form</i> A Lisp form.</p> <p><i>body</i> Lisp forms.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Description                            | <p>The macro <code>impersonating-named-pipe-client</code> executes the code of <i>body</i> while impersonating the client of the named pipe.</p> <p><i>named-pipe-stream</i> must be the result of <code>open-named-pipe-stream</code>.</p> <p>For the impersonation to work, some input must have already been read from the pipe. If impersonation is used on a named pipe from which nothing was read, it calls <code>error</code> unless <i>fail-no-read-form</i> is supplied, in which case it executes this form. For all other kinds of failure <i>fail-form</i> is executed.</p> <p>Apart from mechanism used to find the user to impersonate, <code>impersonating-named-pipe-client</code> behaves identically to <code>impersonating-user</code>. See <code>impersonating-user</code> for further details.</p> |
| Notes                                  | The limitation that some input must have been read is an undocumented restriction in the underlying Microsoft Windows functions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| See also                               | <code>impersonating-user</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Macro |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Summary     | Executes code while impersonating the user.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |       |
| Package     | <code>win32</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |       |
| Signature   | <code>impersonating-user (<i>user-name</i> <i>password</i> &amp;key <i>domain</i> <i>logon-type</i> <i>fail-form</i>) &amp;body <i>body</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |       |
| Arguments   | <p><i>user-name</i>      A string, or <code>t</code>.</p> <p><i>password</i>      A string.</p> <p><i>domain</i>      A string or <code>nil</code>.</p> <p><i>logon-type</i>      <code>nil</code> or one of the keywords <code>:interactive</code>,<br/> <code>:batch</code>, <code>:network</code>, <code>:network-cleartext</code>,<br/> <code>:service</code> and <code>:new-credentials</code>.</p> <p><i>fail-form</i>      A Lisp form.</p> <p><i>body</i>      Lisp forms.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |       |
| Description | <p>The macro <code>impersonating-user</code> executes the code of <i>body</i> while impersonating a specified user.</p> <p><i>user-name</i> and <i>password</i> specify login credentials. In general, these are strings but the symbol <code>t</code> as <i>user-name</i> is treated specially to mean the user that is currently interacting with the console of the computer (<i>password</i> is ignored in this case).</p> <p><i>domain</i>, if non-<code>nil</code>, must be a string specifying the domain or server where the account database to find the user is held. It can be <code>".</code> meaning the local database. <i>domain nil</i> means use the default domain or server, as defined by Windows.</p> <p>The <i>logon-type</i> keywords are mapped to the <code>LOGON32_LOGON_*</code> constants which are documented in the MSDN entry for <code>LogonUser</code>. The default value <code>nil</code> of <i>logon-type</i> is treated as an alias for <code>:interactive</code>.</p> |       |

*body* is evaluated only if the impersonation is successful. If the impersonation is not successful for any reason, *body* is not executed, and instead *fail-form* is evaluated.

On success, `impersonating-user` returns the result of the last form of *body*. On failure, it returns the result of *fail-form*.

|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | <p>Impersonation means that, in operations where the user identity makes a difference, the user identity is the impersonated user rather than the user running the process. For example, when opening a file the system uses the credentials of the impersonated user to check the access control list of the file. When creating a file, the impersonated user is also used as the owner and creator of the file.</p> <p>The process that tries to impersonate must have special privilege to do that. Processes do not normally have these privileges. The processes that do are those that run with system credentials, for example services. Impersonation is used by these processes to perform specific operations with the credentials of some user rather than the system user.</p> <p>Impersonation can also be used when a service process wants to start a process to interact with the user. In that situation, the new process must run as the user. To do that, you start process inside the scope of <code>impersonating-user</code>, for example by calling <code>call-system</code> or <code>open-pipe</code>. Normally you will want to run as the user that is currently logged on the console (see the special <i>user-name</i> value <code>t</code> above).</p> |
| See also | <code>impersonating-named-pipe-client</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

|         | <b>known-sid-integer-to-sid-string</b>              | <i>Function</i> |
|---------|-----------------------------------------------------|-----------------|
| Summary | Returns the sid string for a known SID type integer |                 |
| Package | <code>win32</code>                                  |                 |

|             |                                                                                                                                                                                                                                                                                                                                                                     |                                |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| Signature   | <code>known-sid-integer-to-sid-string integer =&gt; sid-string</code>                                                                                                                                                                                                                                                                                               |                                |
| Arguments   | <code>integer</code>                                                                                                                                                                                                                                                                                                                                                | An integer.                    |
| Values      | <code>sid-string</code>                                                                                                                                                                                                                                                                                                                                             | A string or <code>nil</code> . |
| Description | <p>The function <code>known-sid-integer-to-sid-string</code> returns the SID string for <code>integer</code>, which needs to be one of the known integers, which are documented in the MSDN in the entry for <code>WELL_KNOWN_SID_TYPE Enumeration</code>.</p> <p><code>known-sid-integer-to-sid-string</code> returns <code>nil</code> for an unknown integer.</p> |                                |
| See also    | <code>wait-for-connection</code><br><code>security-description-string-for-open-named-pipe</code>                                                                                                                                                                                                                                                                    |                                |

|                             |                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>*latin-1-code-pages*</b> | <i>Variable</i>                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Summary                     | Windows Code Pages for which Latin-1 encoded files are used.                                                                                                                                                                                                                                                                                                                                                                              |
| Package                     | <code>win32</code>                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Initial value               | <code>(1252 28591)</code>                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Description                 | <p>The value of <code>*latin-1-code-pages*</code> is a list of integers, which must be Windows code page identifiers. When the current Code Page is on this list, the default file encoding detection algorithm will cause <code>(:latin-1 :encoding-error-action 63)</code> to be used for file I/O. Files will be written as Latin-1 with '?' replacing any non-Latin-1 character. This is faster than converting to the code page.</p> |

If `safe-locale-file-encoding` is used for file encoding detection, then the `:latin-1-safe` external format will be used.

|          |                                                                                                                                                                                                                                                     |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Notes    | The LispWorks editor binds <code>*latin-1-code-pages*</code> to <code>nil</code> when reading and writing files, in order to ensure that code page characters outside of Latin-1 are handled regardless of the configuration of <code>open</code> . |
| See also | <code>*file-encoding-detection-algorithm*</code>                                                                                                                                                                                                    |

## **long-namestring** *Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                       |                                |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| Summary     | Returns the long form of a namestring.                                                                                                                                                                                                                                                                                                                                                                |                                |
| Package     | <code>win32</code>                                                                                                                                                                                                                                                                                                                                                                                    |                                |
| Signature   | <code>long-namestring pathname =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                    |                                |
| Arguments   | <code>pathname</code>                                                                                                                                                                                                                                                                                                                                                                                 | A pathname designator.         |
| Values      | <code>result</code>                                                                                                                                                                                                                                                                                                                                                                                   | A string or <code>nil</code> . |
| Description | <p>The function <code>long-namestring</code> first obtains the full namestring as if by <code>c1:namestring</code>, and then converts this namestring to the long form (in the Microsoft Windows meaning of "Long" paths).</p> <p>If the translation succeeds then <code>result</code> is a string in the Long form.</p> <p>The translation may fail, in which case <code>nil</code> is returned.</p> |                                |
| See also    | <code>short-namestring</code>                                                                                                                                                                                                                                                                                                                                                                         |                                |

**\*multibyte-code-page-ef\*** *Variable*

|             |                                                                                                                                                                                                                                                                                   |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Holds the external format corresponding to the current Windows multi-byte code page.                                                                                                                                                                                              |
| Package     | <code>win32</code>                                                                                                                                                                                                                                                                |
| Description | This variable holds the external format corresponding to the current Windows multi-byte code page. It is automatically initialized to the right value, when the image is started. If you change the code page (using <code>_setmbcp</code> ), you need to set this variable, too. |
| See also    | <code>locale-file-encoding</code>                                                                                                                                                                                                                                                 |

**named-pipe-stream-name** *Function*

|             |                                                                                                                                                                                                                                                                                                           |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Returns the name of a named pipe stream.                                                                                                                                                                                                                                                                  |
| Package     | <code>win32</code>                                                                                                                                                                                                                                                                                        |
| Signature   | <code>named-pipe-stream-name stream =&gt; name</code>                                                                                                                                                                                                                                                     |
| Arguments   | <code>stream</code> A named pipe stream.                                                                                                                                                                                                                                                                  |
| Values      | <code>name</code> A string.                                                                                                                                                                                                                                                                               |
| Description | The function <code>named-pipe-stream-name</code> returns the name of a named pipe stream.<br><br><code>stream</code> must be the result of a call to <code>open-named-pipe-stream</code> .<br><code>name</code> is the name of the stream, that is, the argument to <code>open-named-pipe-stream</code> . |
| See also    | <code>wait-for-connection</code>                                                                                                                                                                                                                                                                          |

| <b>open-named-pipe-stream</b> | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |               |                                |                   |            |                     |                                          |                   |                                                                 |                    |                                |                |                                     |                      |                                                   |                  |                                                                        |                         |            |               |                                     |
|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------------------------------|-------------------|------------|---------------------|------------------------------------------|-------------------|-----------------------------------------------------------------|--------------------|--------------------------------|----------------|-------------------------------------|----------------------|---------------------------------------------------|------------------|------------------------------------------------------------------------|-------------------------|------------|---------------|-------------------------------------|
| Summary                       | Creates a stream that writes and read through a named pipe.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |               |                                |                   |            |                     |                                          |                   |                                                                 |                    |                                |                |                                     |                      |                                                   |                  |                                                                        |                         |            |               |                                     |
| Package                       | <code>win32</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |                                |                   |            |                     |                                          |                   |                                                                 |                    |                                |                |                                     |                      |                                                   |                  |                                                                        |                         |            |               |                                     |
| Signature                     | <code>open-named-pipe-stream name &amp;key errorp allow-remote max-number wait-reason timeout wait-function direction inherit-access-p access =&gt; stream, connectedp, condition</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |               |                                |                   |            |                     |                                          |                   |                                                                 |                    |                                |                |                                     |                      |                                                   |                  |                                                                        |                         |            |               |                                     |
| Arguments                     | <table><tr><td><i>name</i></td><td>A string identifying the pipe.</td></tr><tr><td><i>errorp</i></td><td>A boolean.</td></tr><tr><td><i>allow-remote</i></td><td>A boolean.</td></tr><tr><td><i>max-number</i></td><td>An integer in the inclusive range [1,254] or <code>nil</code>.</td></tr><tr><td><i>wait-reason</i></td><td>A string or <code>nil</code>.</td></tr><tr><td><i>timeout</i></td><td>A real number or <code>nil</code>.</td></tr><tr><td><i>wait-function</i></td><td>A function of no arguments, or <code>nil</code>.</td></tr><tr><td><i>direction</i></td><td>One of <code>:io</code>, <code>:input</code>, <code>:output</code>.</td></tr><tr><td><i>inherit-access-p</i></td><td>A boolean.</td></tr><tr><td><i>access</i></td><td>A list, keyword, integer or string.</td></tr></table> | <i>name</i>   | A string identifying the pipe. | <i>errorp</i>     | A boolean. | <i>allow-remote</i> | A boolean.                               | <i>max-number</i> | An integer in the inclusive range [1,254] or <code>nil</code> . | <i>wait-reason</i> | A string or <code>nil</code> . | <i>timeout</i> | A real number or <code>nil</code> . | <i>wait-function</i> | A function of no arguments, or <code>nil</code> . | <i>direction</i> | One of <code>:io</code> , <code>:input</code> , <code>:output</code> . | <i>inherit-access-p</i> | A boolean. | <i>access</i> | A list, keyword, integer or string. |
| <i>name</i>                   | A string identifying the pipe.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |               |                                |                   |            |                     |                                          |                   |                                                                 |                    |                                |                |                                     |                      |                                                   |                  |                                                                        |                         |            |               |                                     |
| <i>errorp</i>                 | A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |               |                                |                   |            |                     |                                          |                   |                                                                 |                    |                                |                |                                     |                      |                                                   |                  |                                                                        |                         |            |               |                                     |
| <i>allow-remote</i>           | A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |               |                                |                   |            |                     |                                          |                   |                                                                 |                    |                                |                |                                     |                      |                                                   |                  |                                                                        |                         |            |               |                                     |
| <i>max-number</i>             | An integer in the inclusive range [1,254] or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |               |                                |                   |            |                     |                                          |                   |                                                                 |                    |                                |                |                                     |                      |                                                   |                  |                                                                        |                         |            |               |                                     |
| <i>wait-reason</i>            | A string or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |               |                                |                   |            |                     |                                          |                   |                                                                 |                    |                                |                |                                     |                      |                                                   |                  |                                                                        |                         |            |               |                                     |
| <i>timeout</i>                | A real number or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |               |                                |                   |            |                     |                                          |                   |                                                                 |                    |                                |                |                                     |                      |                                                   |                  |                                                                        |                         |            |               |                                     |
| <i>wait-function</i>          | A function of no arguments, or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |               |                                |                   |            |                     |                                          |                   |                                                                 |                    |                                |                |                                     |                      |                                                   |                  |                                                                        |                         |            |               |                                     |
| <i>direction</i>              | One of <code>:io</code> , <code>:input</code> , <code>:output</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |               |                                |                   |            |                     |                                          |                   |                                                                 |                    |                                |                |                                     |                      |                                                   |                  |                                                                        |                         |            |               |                                     |
| <i>inherit-access-p</i>       | A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |               |                                |                   |            |                     |                                          |                   |                                                                 |                    |                                |                |                                     |                      |                                                   |                  |                                                                        |                         |            |               |                                     |
| <i>access</i>                 | A list, keyword, integer or string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |               |                                |                   |            |                     |                                          |                   |                                                                 |                    |                                |                |                                     |                      |                                                   |                  |                                                                        |                         |            |               |                                     |
| Values                        | <table><tr><td><i>stream</i></td><td>A stream or <code>nil</code>.</td></tr><tr><td><i>connectedp</i></td><td>A boolean.</td></tr><tr><td><i>condition</i></td><td>An error condition or <code>nil</code>.</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <i>stream</i> | A stream or <code>nil</code> . | <i>connectedp</i> | A boolean. | <i>condition</i>    | An error condition or <code>nil</code> . |                   |                                                                 |                    |                                |                |                                     |                      |                                                   |                  |                                                                        |                         |            |               |                                     |
| <i>stream</i>                 | A stream or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |               |                                |                   |            |                     |                                          |                   |                                                                 |                    |                                |                |                                     |                      |                                                   |                  |                                                                        |                         |            |               |                                     |
| <i>connectedp</i>             | A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |               |                                |                   |            |                     |                                          |                   |                                                                 |                    |                                |                |                                     |                      |                                                   |                  |                                                                        |                         |            |               |                                     |
| <i>condition</i>              | An error condition or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |               |                                |                   |            |                     |                                          |                   |                                                                 |                    |                                |                |                                     |                      |                                                   |                  |                                                                        |                         |            |               |                                     |
| Description                   | The function <code>open-named-pipe-stream</code> creates a stream that communicates via a named pipe, and then tries to establish a connection. For a connection to be established, another process (which can be a Lisp process in the same image, or another process altogether) must connect to it. In LispWorks this is done by <code>connect-to-named-pipe</code> , other software                                                                                                                                                                                                                                                                                                                                                                                                                          |               |                                |                   |            |                     |                                          |                   |                                                                 |                    |                                |                |                                     |                      |                                                   |                  |                                                                        |                         |            |               |                                     |

does by the underlying Windows function `ConnectNamedPipe`.

`open-named-pipe-stream` returns three values. `stream` is a stream on success, and `nil` if there is an error and `errorp` is `nil`. If `open-named-pipe-stream` returns a stream and `connectedp` is non-`nil`, the stream is connected and is ready for input/output operations like a normal stream. `condition` is an error condition if an error occurred and `errorp` is `nil`, otherwise it is `nil`.

When `open-named-pipe-stream` returns a stream and `connectedp` is `nil` (which can happen when `timeout` is non-`nil` or `wait-function` returns `t`), the stream is valid but is not ready for I/O and gives an error for any reading or writing calls. In this case the function `wait-for-connection` must be used to establish the connection, and once it returns non-`nil` the stream is ready for input/output operations.

Note that that if you stop using a stream before it is connected, it still must be closed (by `cl:close`) to get rid of the named pipe.

The creation has two steps:

1. Creating the named pipe. This is controlled by `name`, `max-number`, `direction`, `access`, `inherit-access-p`, `allow-remote` and `errorp`.
2. Waiting for connection. This is controlled by `timeout`, `wait-reason`, and `wait-function`.

`name` is the pipe name. It can contain any character except `#\\` (according to the MSDN). `open-named-pipe-stream` prepends to it the pipe prefix `\.\.\pipe\`. It needs to be highly unique, because on the same machine it is visible to all processes.

`direction` specifies the direction of I/O with the conventional meaning (as in Common Lisp file streams). The default value of `direction` is `:io`. All simultaneous opened pipes with the same name on the same machine must be opened with the

same value of *direction*. If different *direction* values are used, it causes `open-named-pipe-stream` to give an error.

*max-number* specifies the maximum number of simultaneously existing pipes with the same name on the local machine. By default it is unlimited. All simultaneous pipes with the same name on the same machine must have the same *max-number*, though currently this is not enforced.

*access* specifies access permission, which controls who can connect to the pipe. If it is `nil`, the permissions of the current thread are inherited and used (`inherit-access-p` is ignored in this case), and if *access* is `:world` the pipe is created with no restrictions. Otherwise *access* has to be a keyword, a list, an integer or a string, and it is passed to `security-description-string-for-open-named-pipe`. See the entry for `security-description-string-for-open-named-pipe` for details. The result of `security-description-string-for-open-named-pipe`, potentially with the inherited access appended, is passed to the Windows function `ConvertStringSecurityDescriptorToSecurityDescriptor` to generate the descriptor that is used when creating the pipe.

*inherit-access-p* controls whether the permissions of the current thread are inherited when *access* is not `nil` or `:world` or a string. When it is not `nil`, the permissions of the current thread are appended to what is specified by *access* (which means that the specification in *access* takes precedence). The default value of *inherit-access-p* is `t`.

*allow-remote* controls whether the pipe can be connected from another machine. The default value of *allow-remote* is `nil`.

*errorp* controls what happens when there is a failure because of one of these possibilities:

1. `security-description-string-for-open-named-pipe` returns `nil` because `access` contains unknown entities (for example a user name that does not exist on the local machine)
2. Converting the string that `security-description-string-for-open-named-pipe` returned to a security descriptor failed. That can happen if `access` is a string in bad format or a list containing strings in bad format.
3. `open-named-pipe-stream` failed for some other reason, for example it reached the limit on the number of the pipes with this name, or tried to open it with a different `direction` from the previous call.

When there has been a failure, if `errorp` is non-`nil` an error is signaled, and if `errorp` is `nil` then `open-named-pipe-stream` returns `stream nil` and `connectedp nil` with the error condition returned as the third value `condition`. The default value of `errorp` is `t`.

Once the pipe has been successfully created, `open-named-pipe-stream` uses `wait-for-connection` to establish the connection, passing `timeout`, `wait-reason` and `wait-function`, and returns the stream as first value, the result of `wait-for-connection` as the second value, and `nil` as the third value. See the description of `wait-for-connection` for details.

To connect to the other side of the pipe from Lisp, use `connect-to-named-pipe`. The Microsoft Windows function is `ConnectNamedPipe`.

See also

`wait-for-connection`  
`security-description-string-for-open-named-pipe`  
`named-pipe-stream-name`  
`connect-to-named-pipe`  
`impersonating-named-pipe-client`

| record-message-in-windows-event-log | Function                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                   |            |                      |                              |                          |           |                              |                               |                     |                                               |                       |             |                       |             |                       |                                                        |                   |                               |
|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|------------|----------------------|------------------------------|--------------------------|-----------|------------------------------|-------------------------------|---------------------|-----------------------------------------------|-----------------------|-------------|-----------------------|-------------|-----------------------|--------------------------------------------------------|-------------------|-------------------------------|
| Summary                             | Records a message in the Windows event log.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                   |            |                      |                              |                          |           |                              |                               |                     |                                               |                       |             |                       |             |                       |                                                        |                   |                               |
| Package                             | <code>win32</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                   |            |                      |                              |                          |           |                              |                               |                     |                                               |                       |             |                       |             |                       |                                                        |                   |                               |
| Signature                           | <code>record-message-in-windows-event-log type message &amp;key source-name unc-server-name handle category event-id user-sid data</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                   |            |                      |                              |                          |           |                              |                               |                     |                                               |                       |             |                       |             |                       |                                                        |                   |                               |
| Arguments                           | <table><tr><td><code>type</code></td><td>A keyword.</td></tr><tr><td><code>message</code></td><td>A string or list of strings.</td></tr><tr><td><code>source-name</code></td><td>A string.</td></tr><tr><td><code>unc-server-name</code></td><td><code>nil</code> or a string.</td></tr><tr><td><code>handle</code></td><td><code>nil</code> or an open event log handle.</td></tr><tr><td><code>category</code></td><td>An integer.</td></tr><tr><td><code>event-id</code></td><td>An integer.</td></tr><tr><td><code>user-sid</code></td><td><code>nil</code> or a foreign pointer to a SID object.</td></tr><tr><td><code>data</code></td><td><code>nil</code> or a string.</td></tr></table>                                                                                                                                                                                                                       | <code>type</code> | A keyword. | <code>message</code> | A string or list of strings. | <code>source-name</code> | A string. | <code>unc-server-name</code> | <code>nil</code> or a string. | <code>handle</code> | <code>nil</code> or an open event log handle. | <code>category</code> | An integer. | <code>event-id</code> | An integer. | <code>user-sid</code> | <code>nil</code> or a foreign pointer to a SID object. | <code>data</code> | <code>nil</code> or a string. |
| <code>type</code>                   | A keyword.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                   |            |                      |                              |                          |           |                              |                               |                     |                                               |                       |             |                       |             |                       |                                                        |                   |                               |
| <code>message</code>                | A string or list of strings.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                   |            |                      |                              |                          |           |                              |                               |                     |                                               |                       |             |                       |             |                       |                                                        |                   |                               |
| <code>source-name</code>            | A string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                   |            |                      |                              |                          |           |                              |                               |                     |                                               |                       |             |                       |             |                       |                                                        |                   |                               |
| <code>unc-server-name</code>        | <code>nil</code> or a string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                   |            |                      |                              |                          |           |                              |                               |                     |                                               |                       |             |                       |             |                       |                                                        |                   |                               |
| <code>handle</code>                 | <code>nil</code> or an open event log handle.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                   |            |                      |                              |                          |           |                              |                               |                     |                                               |                       |             |                       |             |                       |                                                        |                   |                               |
| <code>category</code>               | An integer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                   |            |                      |                              |                          |           |                              |                               |                     |                                               |                       |             |                       |             |                       |                                                        |                   |                               |
| <code>event-id</code>               | An integer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                   |            |                      |                              |                          |           |                              |                               |                     |                                               |                       |             |                       |             |                       |                                                        |                   |                               |
| <code>user-sid</code>               | <code>nil</code> or a foreign pointer to a SID object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                   |            |                      |                              |                          |           |                              |                               |                     |                                               |                       |             |                       |             |                       |                                                        |                   |                               |
| <code>data</code>                   | <code>nil</code> or a string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                   |            |                      |                              |                          |           |                              |                               |                     |                                               |                       |             |                       |             |                       |                                                        |                   |                               |
| Description                         | <p>The function <code>record-message-in-windows-event-log</code> records a message <code>message</code> in the Windows event log.</p> <p><code>type</code> must be one of the keywords <code>:success</code>, <code>:error</code>, <code>:warning</code>, <code>:information</code>, <code>:audit-success</code> or <code>:audit-failure</code>, corresponding to the types of Window event log entry.</p> <p><code>message</code> is used as the string (or list of strings) recorded with the event.</p> <p>If <code>handle</code> is <code>nil</code>, <code>source-name</code> is used as the name of the event source for recording events. If <code>source-name</code> is <code>nil</code> then the name of the Lisp executable is used.</p> <p>If <code>handle</code> is <code>nil</code> and <code>unc-server-name</code> is non-nil, then it specifies the UNC name of a server which records the events.</p> |                   |            |                      |                              |                          |           |                              |                               |                     |                                               |                       |             |                       |             |                       |                                                        |                   |                               |

If *handle* is non-nil, then it must be an open event log handle, such as created by `with-windows-event-log-event-source`. If *handle* is nil, then *source-name* is used to open an event log handle for the duration of the call to `record-message-in-windows-event-log`.

*category* and *event-id* are recorded in the event log. They are only useful if you create and register an event source provider DLL in Windows (see MSDN documentation for "Reporting Events").

If *user-sid* is non-nil, then it is used to record the user that logged the event.

If *data* is non-nil, then it is recorded as extra data associated with the event.

See also [with-windows-event-log-event-source](#)

## security-description-string-for-open-named-pipe *Function*

|           |                                                                                                             |                                                          |
|-----------|-------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|
| Summary   | Interprets an access specification and generates a Security Descriptor String.                              |                                                          |
| Package   | <code>win32</code>                                                                                          |                                                          |
| Signature | <code>security-description-string-for-open-named-pipe access-spec =&gt; result, fail-type, fail-item</code> |                                                          |
| Arguments | <i>access-spec</i>                                                                                          | A keyword, an integer, a string or a list.               |
| Values    | <i>result</i>                                                                                               | A string or nil.                                         |
|           | <i>fail-type</i>                                                                                            | Undefined, or a string.                                  |
|           | <i>fail-item</i>                                                                                            | Undefined, or a keyword, an integer, a string or a list. |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The function <code>security-description-string-for-open-named-pipe</code> interprets <code>access-spec</code> and generates from it a Security Descriptor String as defined by Windows. See the MSDN for documentation of "Security Descriptor String Format".</p> <p><code>security-description-string-for-open-named-pipe</code> has quite limited capabilities, and the string that it generates contains only the DACL part of the descriptor.</p> <p>If <code>access-spec</code> is a keyword, then its symbol name specifies a SID (Security Identifier). This SID gets read/write permission. The SID can be either standard representation (which looks like "<code>s-1-...</code>") or one of the aliases. The aliases are documented in the MSDN in the page titled "SID strings" (search for <code>SDDL_ANONYMOUS</code>). In general they have two letters, for example <code>:AU</code> means authenticated users. The common standard strings are documented in the MSDN page titled "Well-known SIDs" (search for <code>SECURITY_WORLD_RID</code>). For example, <code>:s-1-15-11</code> means authentication users. Any standard strings is acceptable, not only the documented ones, provided that it specifies a valid SID. For example, you can find the SID of a user by <code>user-name-to-sid-string</code>, intern it in the keyword package and use this (but it is better to pass a list (<code>:user</code>) as described below).</p> <p>If <code>access-spec</code> is an integer, it must be one of the integers in the <code>WELL_KNOWN_SID_TYPE Enumeration</code> as documented in the MSDN. For example, 17 means authenticated users. The corresponding SID gets read/write permission.</p> <p>If <code>access-spec</code> is a string, it is returned as-is. In this case it is the responsibility of the programmer to ensure that the string is valid. Note that if this string is used in <code>open-named-pipe-stream</code>, <code>open-named-pipe-stream</code> does not inherit the access even if <code>inherit-access-p</code> is non-nil.</p> <p>If <code>access-spec</code> is a list, then each element in the list must be one of:</p> |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A string                                                                       | The string must be a correct ACE (Access Control Entry) string, as described in the MSDN (search for "ACE strings"). The string must contain the opening and closing brackets, and can contain more than one ACE.<br><code>security-description-string-for-open-named-pipe</code> does not check the syntax in the string, and if the ACE is wrong the result string would be invalid.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| A keyword                                                                      | This is interpreted as when <code>access-spec</code> is a keyword, and the corresponding SID gets read/write permission.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| An integer                                                                     | This is interpreted as when <code>access-spec</code> is an integer, and the corresponding SID gets read/write permission.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| A list of the form ( <i>keyword</i> <i>SID-spec</i> &rest <i>permissions</i> ) | The first element <i>keyword</i> specifies how to interpret the <i>SID-spec</i> . The possible keywords are <code>:user</code> , when <i>SID-spec</i> must be a string and should name a user on the local machine, and <code>:sid</code> , when <i>SID-spec</i> must be a keyword, an integer or a string specifying the SID. Integers and keywords are interpreted as above, and strings are interpreted in the same way as keywords. If <i>permissions</i> are not supplied, they default to ( <code>:read :write</code> ). When they are supplied, they are keywords specifying permission. Currently supported keywords are (i) one of <code>:read</code> or <code>:disallow-read</code> (ii) one of <code>:write</code> or <code>:disallow-write</code> , specifying the obvious meaning. It is an error if a keyword is repeated or if an incompatible pair is passed.<br><br><code>security-description-string-for-open-named-pipe</code> returns 3 values. When successful, result is the string and the |

other return values are undefined. When it fails, which can be because it is given an unrecognized SID specifier, *result* is **nil**, *fail-type* is a short string giving the type of the item that fails, and *fail-item* is the item in the list that fails when *access-spec* is a list.

Notes

1. When the argument is syntactically incorrect, **security-description-string-for-open-named-pipe** signals an error. It fails and returns **nil** only when a SID specifier of an acceptable type does not specify a SID.
2. Except when given a string which is returned as-is, **security-description-string-for-open-named-pipe** works by generating an ACE (Access Control Entry) string for each SID giving it the read and write permission, except in the case when either **:disallow-write** or **:disallow-read** is used, when it generates an ACE string denying permission. All the ACEs are then concatenated and "**D:**" is prepended, thus generating a Security Descriptor String containing only the DACL.
3. Experimentally, you can connect to a named pipe only if you have both read and write permission, even when opening it for only read or only write. Thus when this function is used from **open-named-pipe-stream**, the keywords **:disallow-read** etc are not very useful. They are useful only when you want to deny access for a specific SID, by using **:disallow-read** and **:disallow-write**.
4. The order of the items in the list is significant: earlier items override later items.
5. Disallowing permission, for example by using **:disallow-read**, is not the same as not allowing it, because in the latter case a later ACE can give the SID the permission. Disallowing prevents later ACEs from giving permission.

6. Using a string or ACE strings in the list allows the user to generate a more elaborate string than `security-description-string-for-open-named-pipe` knows how to generate. In this case the returned string may be invalid. When this happens from `open-named-pipe-stream`, `open-named-pipe-stream` will get a failure and signal or return an error according to `errorp`.

Examples Any of these gives permissions to all authenticated users:

```
:AU
17
'(:AU)
'(17)
'((:SID :AU))
'((:SID "AU"))
'((:SID 17))
```

Also, all of the above with `AU` replaced by `s-1-15-11` will give permission to all authenticated users.

This gives permissions to all authorized users except the user "`exclude`":

```
'((:use "exclude" :DISALLOW-READ :DISALLOW-WRITE)
:AU)
```

See also `canonicalize-sid-string`  
`named-pipe-stream-name`  
`open-named-pipe-stream`  
`sid-string-to-user-name`  
`user-name-to-sid-string`

## set-application-themed *Function*

Summary Controls whether LispWorks should be themed.

Package `win32`

Signature `set-application-themed on/off`

*This chapter applies only to LispWorks for Windows*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                        |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Arguments   | <i>on/off</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | A generalized boolean. |
| Description | The function <code>set-application-themed</code> controls whether a LispWorks application should be themed.<br><br>On supported versions of Microsoft Windows, LispWorks is "themed", that is it uses the current theme of the desktop. You can switch this off by calling<br><br><code>(win32:set-application-themed nil)</code><br><br>On systems older than Windows XP (no longer supported), or when the application does not have Common Controls 6, this call has no effect.<br><br><code>set-application-themed</code> affects only windows that are created after it was called. Normally, it should be called before any window is created, so all LispWorks windows will appear with the same theme. However, <code>set-application-themed</code> can be called multiple times in the same run. |                        |

|             |                 | <i>Function</i>                                                                                                                                                                                                             |
|-------------|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     |                 | Returns the short form of a namestring.                                                                                                                                                                                     |
| Package     |                 | <code>win32</code>                                                                                                                                                                                                          |
| Signature   |                 | <code>short-namestring pathname =&gt; result</code>                                                                                                                                                                         |
| Arguments   | <i>pathname</i> | A pathname designator.                                                                                                                                                                                                      |
| Values      | <i>result</i>   | A string or <code>nil</code> .                                                                                                                                                                                              |
| Description |                 | The function <code>short-namestring</code> first obtains the full namestring as if by <code>cl:namestring</code> , and then converts this namestring to the short form (in the Microsoft Windows meaning of "Short" paths). |

If the translation succeeds then *result* is a string in the short form.

The translation may fail, in which case `nil` is returned.

See also      `long-namestring`

## **sid-string-to-user-name** *Function*

Summary      Takes a standard SID (Security Identifier) string and locates the user.

Package      `win32`

Signature      `sid-string-to-user-name sid-string => result`

Arguments      `sid-string`      A string.

Values      `result`      A string or `nil`.

Description      The function `sid-string-to-user-name` takes a standard SID (Security Identifier) string and tries to locate the user. It returns `nil` if *sid-string* is not the SID of a user.

See also      `wait-for-connection`  
`security-description-string-for-open-named-pipe`

## **str**

## **Ipcstr**

## **Ipstr**

*FLI type descriptors*

Summary      Types converting to ANSI strings.

Package      `win32`

|             |                                                                                                                                                                                                                                                                                                                                                                                |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Signature   | <code>str &amp;key length</code><br><code>lpcstr &amp;key max-length</code><br><code>lpstr &amp;key max-length</code>                                                                                                                                                                                                                                                          |
| Description | <code>str</code> is an ANSI string.<br><code>lpcstr</code> is a reference-pass pointer to an ANSI string.<br><code>lpstr</code> is a reference (in/out) pointer to an ANSI string.<br>These types are ANSI only. Use these if you do not need the power of Unicode. Take care to interface to ANSI functions named like <code>FooBarA</code> , with the <code>A</code> suffix. |
| See also    | <code>tstr</code>                                                                                                                                                                                                                                                                                                                                                              |

## **tstr**

## **lpctstr**

## **lptstr**

*FLI type descriptors*

|             |                                                                                                                                                                                                            |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Types which automatically switch between ANSI and Unicode strings.                                                                                                                                         |
| Package     | <code>win32</code>                                                                                                                                                                                         |
| Signature   | <code>tstr &amp;key length</code><br><code>lpctstr &amp;key max-length</code><br><code>lptstr &amp;key max-length</code>                                                                                   |
| Description | <code>tstr</code> is an ANSI/Unicode string.<br><code>lpctstr</code> is a reference-pass pointer to ANSI/Unicode string.<br><code>lptstr</code> is a reference (in/out) pointer to an ANSI/Unicode string. |

Each of these three types automatically switch between ANSI and Unicode, which makes them ideal for use with the `:dbcS` encoding option in `fli:define-foreign-function`.

**Example** This calls `GetDriveTypeA` on Windows ME, and `GetDriveTypeW` on supported versions of Windows.

The argument is passed as ANSI or Unicode respectively:

```
(fli:define-foreign-function (%get-drive-type
  "GetDriveType" :dbcS)
    ((lpRootPathName W:LPCTSTR))
    :result-type (:unsigned :int))

(defconstant +drive-types+
  #(:unknown :none :removable :fixed :remote :cdrom
  :ramdisk))

(defun get-drive-information (drive)
  (the drive-type (svref +drive-types+ (%get-drive-type
  drive))))
```

**wstr**

**lpcwstr**

**lpwstr**

*FLI type descriptors*

**Summary** Types converting to Unicode strings.

**Package** `win32`

**Signature** `wstr &key length`

`lpcwstr &key max-length`

`lpwstr &key max-length`

**Description** `wstr` is a Unicode string.

`lpcwstr` is a reference-pass pointer to a Unicode string.

`lpwstr` is a reference (in/out) pointer to a Unicode string.

These three types are Unicode only.

See also      **tstr**

## **user-name-to-sid-string**                          *Function*

Summary      Returns a standard SID (Security Identifier) associated with the user.

Package      **win32**

Signature      **user-name-to-sid-string user-name => sid-string**

Arguments      **user-name**      A string.

Values      **sid-string**      A string or **nil**.

Description      The function **user-name-to-sid-string** returns a standard SID (Security Identifier) associated with the user **user-name** on the current machine. It returns **nil** if it failed to find the user.

See also      **wait-for-connection**  
                 **security-description-string-for-open-named-pipe**

## **wait-for-connection**                          *Generic Function*

Summary      Waits to establish a connection for a stream.

Package      **win32**

Signature      **wait-for-connection stream &key timeout wait-reason wait-function => connectedp**

Arguments      **stream**      A named pipe stream.

|             |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <i>timeout</i>       | A non-negative real number, or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|             | <i>wait-reason</i>   | A string, or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|             | <i>wait-function</i> | A function designator, or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Values      | <i>connectedp</i>    | A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Description |                      | <p>The function <code>wait-for-connection</code> waits until it succeeds to establish a connection for the stream <i>stream</i>, or <i>timeout</i> seconds passed or <i>wait-function</i> returns non-nil, and returns a value indicating whether the connection is established successfully.</p> <p><i>stream</i> must be a stream of the right type. Currently the only supported stream is a named pipe stream (the result of <code>open-named-pipe-stream</code>).</p> <p><i>timeout</i> can be <code>nil</code> or a real number specifying the time in seconds before <code>wait-for-connection</code> returns without establishing a connection.</p> <p><i>wait-reason</i>, if non-nil, needs to be a string specifying the wait reason. It has the same semantics as the <i>wait-reason</i> argument of <code>process-wait</code>.</p> <p><i>wait-function</i>, if non-nil, must be a function of no arguments. If it returns non-nil, <code>wait-for-connection</code> returns <code>nil</code>.</p> <p><code>wait-for-connection</code> can be repeatedly called on the same stream. If the stream has already established a connection, it returns true immediately.</p> |
| Notes       |                      | <p><i>wait-function</i> has the same limitations as the <i>wait-function</i> of <code>process-wait</code>.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| See also    |                      | <code>open-named-pipe-stream</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

| with-windows-event-log-event-source |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Macro |
|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Summary                             | Provides an open event log handle for a body of code.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |
| Package                             | <code>win32</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |       |
| Signature                           | <code>with-windows-event-log-event-source (<i>handle source-name</i><br/>  <i>&amp;optional unc-server-name</i>) &amp;body <i>body</i> =&gt; <i>values</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |       |
| Arguments                           | <i>handle</i> A symbol.<br><br><i>source-name</i> <code>nil</code> or a string.<br><br><i>unc-server-name</i> <code>nil</code> or a string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |       |
| Values                              | <i>values</i> The values returned by <i>body</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |       |
| Description                         | The macro <code>with-windows-event-log-event-source</code> provides an open event log handle for a body of code.<br><br>The macro <code>with-windows-event-log-event-source</code> binds <i>handle</i> to an open event log handle, evaluates the forms of <i>body</i> and closes <i>handle</i> . The values of the last form in <i>body</i> are returned.<br><br><i>source-name</i> is used as the name of the event source for recording events. If <i>source-name</i> is <code>nil</code> then the name of the Lisp executable is used.<br><br>If <i>unc-server-name</i> is non- <code>nil</code> , then it specifies the UNC name of a server which records the events. |       |
| See also                            | <code>record-message-in-windows-event-log</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |       |



# 51

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## The Windows registry API

This chapter describes the Microsoft Windows registry API, which is available in the `WIN32` package

The `WIN32` package also includes “Miscellaneous WIN32 symbols”, “The DDE client interface” and “The DDE server interface”. These are documented in separate chapters in this manual.

**Note:** the `WIN32` package is not a supported implementation of the Win32 API. You should not use symbols in the `WIN32` package unless they are documented in this manual. Instead, define your own interfaces to Windows functions as you need - see the *LispWorks Foreign Language Interface User Guide and Reference Manual* for details.

**Note:** this chapter applies only to LispWorks for Windows, and not the UNIX, Linux, x86/x64 Solaris, FreeBSD, AIX or Mac OS X platforms.

| <b>close-registry-key</b> | <i>Function</i>                          |
|---------------------------|------------------------------------------|
| Summary                   | Closes a handle to an open registry key. |
| Package                   | <code>win32</code>                       |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                |                                             |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|
| Signature   | <code>close-registry-key handle &amp;key errorp =&gt; successp, error-code</code>                                                                                                                                                                                                                                                                                                                                              |                                             |
| Arguments   | <code>handle</code>                                                                                                                                                                                                                                                                                                                                                                                                            | A handle to an open registry key.           |
| Values      | <code>successp</code>                                                                                                                                                                                                                                                                                                                                                                                                          | A boolean.                                  |
|             | <code>error-code</code>                                                                                                                                                                                                                                                                                                                                                                                                        | An integer error code or <code>nil</code> . |
| Description | <p>The function <code>close-registry-key</code> closes <code>handle</code>, which should be an open registry key handle.</p> <p>The return value on success is <code>t</code>.</p> <p>If an error occurs and <code>errorp</code> is true then an error is signaled. Otherwise, the return values are <code>nil</code> and the Windows <code>error-code</code>. The default value of <code>errorp</code> is <code>t</code>.</p> |                                             |
| See also    | <a href="#">create-registry-key</a><br><a href="#">open-registry-key</a>                                                                                                                                                                                                                                                                                                                                                       |                                             |

## collect-registry-subkeys *Function*

|           |                                                                                                                           |                                             |
|-----------|---------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|
| Summary   | Returns names of the subkeys of a registry key.                                                                           |                                             |
| Package   | <code>win32</code>                                                                                                        |                                             |
| Signature | <code>collect-registry-subkeys subkey &amp;key root max-name-size max-names errorp value-function =&gt; subsubkeys</code> |                                             |
| Arguments | <code>subkey</code>                                                                                                       | A string specifying the name of the key.    |
|           | <code>root</code>                                                                                                         | A keyword or handle.                        |
|           | <code>max-name-size</code>                                                                                                | An integer.                                 |
|           | <code>max-names</code>                                                                                                    | An integer.                                 |
|           | <code>errorp</code>                                                                                                       | A boolean.                                  |
|           | <code>value-function</code>                                                                                               | A function designator or <code>nil</code> . |

|             |                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Values      | <code>subsubkeys</code> | A list.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Description |                         | <p>The function <code>collect-registry-subkeys</code> returns a list of names which are subsubkeys of <i>subkey</i> under the key <i>root</i>. <i>subkey</i> and <i>root</i> are interpreted as described for <code>create-registry-key</code>. The default value of <i>root</i> is <code>:user</code>.</p> <p><i>max-name-size</i> specifies the maximum length of the returned name. If the name is longer than this, an error is signaled. The default value of <i>max-name-size</i> is 256.</p> <p><i>max-names</i> specifies the maximum number of names returned. Names after this number are ignored. The default value of <i>max-names</i> is <code>most-positive-fixnum</code>.</p> <p>If <i>value-function</i> is non-nil, it should be a function with signature</p> <pre><code>value-function handle subsubkey-name =&gt; name, collectp</code></pre> <p><i>value-function</i> is funcalled for each subsubkey with the handle of <i>subkey</i> and the name of the subsubkey. If <i>collectp</i> is non-nil then <i>name</i> is collected into the list <i>subsubkeys</i> to return from <code>collect-registry-subkeys</code>. Otherwise it is ignored.</p> <p>If <i>value-function</i> is <code>nil</code>, then the returned <i>subsubkeys</i> is a list of strings naming all (subject to <i>max-names</i>) of the subsubkeys. The default value of <i>value-function</i> is <code>nil</code>.</p> <p>If an error occurs opening <i>subkey</i> and <i>errorp</i> is true then an error is signaled. Otherwise, <i>subsubkeys</i> is returned as <code>nil</code> if <i>subkey</i> could not be opened. The default value of <i>errorp</i> is <code>t</code>.</p> |
| See also    |                         | <code>collect-registry-values</code><br><code>create-registry-key</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

## **collect-registry-values** *Function*

|         |                                       |
|---------|---------------------------------------|
| Summary | Returns the values of a registry key. |
|---------|---------------------------------------|

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                          |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| Package     | <code>win32</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                          |
| Signature   | <code>collect-registry-values subkey &amp;key root max-name-size max-buffer-size expected-type errorp value-function =&gt; values-alist</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                          |
| Arguments   | <code>subkey</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | A string specifying the name of the key. |
|             | <code>root</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | A keyword or handle.                     |
|             | <code>max-name-size</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | An integer.                              |
|             | <code>max-buffer-size</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | An integer.                              |
|             | <code>expected-type</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | A keyword or <code>t</code> .            |
|             | <code>errorp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | A boolean.                               |
|             | <code>value-function</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | A function or symbol.                    |
| Values      | <code>values-alist</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | An alist.                                |
| Description | <p>The function <code>collect-registry-values</code> returns an alist of all of the values of <code>subkey</code> under the key <code>root</code>. <code>subkey</code> and <code>root</code> are interpreted as described for <code>create-registry-key</code>. The default value of <code>root</code> is <code>:user</code>. <code>max-name-size</code> specifies the maximum length of the returned name. If the name is longer than this, an error is signaled. The default value of <code>max-name-size</code> is 256. <code>max-buffer-size</code> specifies the maximum length in bytes of the data. If the data is longer than this, an error is signaled. The default value of <code>max-buffer-size</code> is 1024. If <code>value-function</code> is <code>nil</code>, the returned <code>values-alist</code> is an association list containing pairs <code>(name . data)</code> consisting of the names and data of the values of <code>subkey</code>. <code>expected-type</code> controls how certain types are converted to Lisp objects as described for <code>enum-registry-value</code>. The default value of <code>expected-type</code> is <code>t</code>. If <code>value-function</code> is non-nil, it should be a function with signature</p> |                                          |

```
value-function handle subsubkey-name-and-value => name-and-value,  
collectp
```

*value-function* is funcalled for each subsubkey with the handle of *subkey* and a cons of the name and value of the subsubkey. If *collectp* is non-nil then *name-and-value* is collected into the alist *values-alist* to return from **collect-registry-values**. Otherwise *name-and-value* is ignored.

If an error occurs and *errorp* is true, then an error is signaled. Otherwise, *values-alist* is returned as nil if *subkey* could not be opened at all or contains nil for the data of any particular pair that cannot be read. The default value of *errorp* is t.

See also      **collect-registry-subkeys**  
                 **create-registry-key**  
                 **enum-registry-value**

|           |                            | <i>Function</i>                                                                                                                                                                         |
|-----------|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           | <b>create-registry-key</b> |                                                                                                                                                                                         |
| Summary   |                            | Creates a new registry key.                                                                                                                                                             |
| Package   |                            | <b>win32</b>                                                                                                                                                                            |
| Signature |                            | <b>create-registry-key</b> <i>subkey</i> & <i>key</i> <i>class</i> <i>root</i> <i>access</i> <i>volatile</i><br><i>errorp</i> => <i>handle</i> , <i>disposition</i> , <i>error-code</i> |
| Arguments | <i>subkey</i>              | A string specifying the name of the key.                                                                                                                                                |
|           | <i>class</i>               | A string.                                                                                                                                                                               |
|           | <i>root</i>                | A keyword or handle.                                                                                                                                                                    |
|           | <i>access</i>              | A keyword or an integer.                                                                                                                                                                |
|           | <i>volatile</i>            | A generalized boolean.                                                                                                                                                                  |
|           | <i>errorp</i>              | A generalized boolean.                                                                                                                                                                  |
| Values    | <i>handle</i>              | The handle of the new key.                                                                                                                                                              |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                        |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
|             | <i>disposition</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | A keyword, either <code>:created-new-key</code> or <code>:opened-existing-key</code> . |
|             | <i>error-code</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | An integer error code or <code>nil</code> .                                            |
| Description | <p>The function <code>create-registry-key</code> creates a new registry key named <i>subkey</i> under the parent key <i>root</i>. If the key already exists, it is opened and returned.</p> <p><i>subkey</i> is a string specifying a path from a root. Each component of the path is separated by a backslash. Use <code>" "</code> to denote the null path (that is, the root).</p> <p><i>class</i> can be used to specify the class of the key if it is created. <i>root</i> should be a handle to an open registry key (for example a key returned by <code>create-registry-key</code> or <code>open-registry-key</code> or one of the keywords <code>:classes</code>, <code>:user</code>, <code>:local-machine</code> and <code>:users</code> which represent the standard top level roots in the registry. The default value of <i>root</i> is <code>:user</code>.</p> <p>If <i>access</i> is <code>:read</code>, then the key is created with <code>KEY_READ</code> permissions. If <i>access</i> is <code>:write</code>, then the key is created with <code>KEY_WRITE</code> permissions. If <i>access</i> is an integer, then the value <i>access</i> specifies the desired Win32 access rights. The default value of <i>access</i> is <code>:read</code>.</p> <p>The return values on success are the handle of the new key and a keyword <code>:created-new-key</code> or <code>:opened-existing-key</code> indicating whether a new key was created or opened.</p> <p>When <i>volatile</i> is true, the key is created with <code>REG_OPTION_VOLATILE</code>. <i>volatile</i> defaurs to false.</p> <p>If an error occurs and <i>errorp</i> is true then an error is signaled. Otherwise, the return values are <code>nil</code>, <code>nil</code> and the Windows <i>error-code</i>. The default value of <i>errorp</i> is <code>t</code>.</p> |                                                                                        |
| See also    | <code>delete-registry-key</code><br><code>open-registry-key</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                        |

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <i>Function</i>                             |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|
| <b>delete-registry-key</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                             |
| Summary                    | Deletes a registry key.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                             |
| Package                    | <code>win32</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                             |
| Signature                  | <code>delete-registry-key subkey &amp;key root errorp =&gt; successp, error-code</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                             |
| Arguments                  | <code>subkey</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | A string specifying the name of the key.    |
|                            | <code>root</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | A keyword or handle.                        |
|                            | <code>errorp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | A generalized boolean.                      |
| Values                     | <code>successp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | A boolean.                                  |
|                            | <code>error-code</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | An integer error code or <code>nil</code> . |
| Description                | The function <code>delete-registry-key</code> deletes the registry key named <code>subkey</code> under the parent key <code>root</code> .<br><br><code>subkey</code> and <code>root</code> are interpreted as described for <code>create-registry-key</code> . The default value of <code>root</code> is <code>:user</code> .<br><br>The value <code>t</code> is returned if the key is deleted successfully.<br><br>If an error occurs and <code>errorp</code> is true then an error is signaled. Otherwise, the return values are <code>nil</code> and the Windows <code>error-code</code> . The default value of <code>errorp</code> is <code>t</code> . |                                             |
| See also                   | <code>create-registry-key</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                             |

|                            |                                          | <i>Function</i> |
|----------------------------|------------------------------------------|-----------------|
| <b>enum-registry-value</b> |                                          |                 |
| Summary                    | Enumerates the values of a registry key. |                 |
| Package                    | <code>win32</code>                       |                 |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                             |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|
| Signature   | <code>enum-registry-value <i>subkey index &amp;key root max-name-size max-buffer-size expected-type errorp =&gt; name, data-type, data, error-code</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                             |
| Arguments   | <i>subkey</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | A string specifying the name of the key.    |
|             | <i>index</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | An integer.                                 |
|             | <i>root</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | A keyword or handle.                        |
|             | <i>max-name-size</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | An integer.                                 |
|             | <i>max-buffer-size</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | An integer.                                 |
|             | <i>expected-type</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | A keyword or <code>t</code> .               |
|             | <i>errorp</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | A boolean.                                  |
| Values      | <i>name</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | A string.                                   |
|             | <i>data-type</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A keyword.                                  |
|             | <i>data</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | A lisp object.                              |
|             | <i>error-code</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | An integer error code or <code>nil</code> . |
| Description | <p>The function <code>enum-registry-value</code> allows the values of subkey under the key <i>root</i> to be enumerated.</p> <p><i>subkey</i> and <i>root</i> are interpreted as described for <code>create-registry-key</code>. The default value of <i>root</i> is <code>:user</code>.</p> <p><i>index</i> specifies which value to return, with 0 being the first item.</p> <p><i>max-name-size</i> specifies the maximum length of the returned name. If the name is longer than this, an error is signaled. The default value of <i>max-name-size</i> is 256.</p> <p><i>max-buffer-size</i> specifies the maximum length in bytes of the value. The value is longer than this, an error is signaled. The default value of <i>max-buffer-size</i> is 1024.</p> <p>If the value exists (that is, <i>index</i> is not too large), then the return values are the name, data type and data associated with the value in the registry. The argument <i>expected-type</i> con-</p> |                                             |

trols how certain data types are converted to Lisp objects as follows:

Table 51.1 Conversion of registry values to Lisp objects

| <i>data-type</i>                    | <i>expected-type</i>      | Description of converted data                         |
|-------------------------------------|---------------------------|-------------------------------------------------------|
| <code>:string</code>                | <code>:lisp-object</code> | String made with <code>read-from-string</code>        |
| <code>:string</code>                | Not supplied              | String, exactly as in the registry                    |
| <code>:environment-string</code>    | <code>:string</code>      | String, exactly as in the registry                    |
| <code>:environment-string</code>    | Not supplied              | String, environment variables expanded                |
| <code>:integer</code>               | Not supplied              | Integer                                               |
| <code>:little-endian-integer</code> | Not supplied              | Integer                                               |
| <code>:binary</code>                | Not supplied              | A newly allocated foreign object                      |
| <code>:binary</code>                | <code>:lisp-object</code> | Vector, element type ( <code>unsigned-byte 8</code> ) |

The default value of *expected-type* is `t`.

If an error occurs and `errorp` is true, then an error is signaled. Otherwise, the return values are `nil`, `nil`, `nil` and the Windows `error-code`. The default value of `errorp` is `t`.

See also

`create-registry-key`

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <i>Function</i> |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
|             | <b>open-registry-key</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                 |
| Summary     | Opens a registry key.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |
| Package     | <code>win32</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |
| Signature   | <code>open-registry-key subkey &amp;key root access errorp =&gt; handle, error-code</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                 |
| Arguments   | <code>subkey</code> A string specifying the name of the key.<br><code>root</code> A keyword or handle.<br><code>access</code> An integer or keyword.<br><code>errorp</code> A generalized boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 |
| Values      | <code>handle</code> The handle of the key.<br><code>error-code</code> An integer error code or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                 |
| Description | <p>The function <code>open-registry-key</code> opens a registry key named <code>subkey</code> under the parent key <code>root</code>.</p> <p><code>subkey</code> and <code>root</code> are interpreted as described for <code>create-registry-key</code>. If <code>subkey</code> is an empty string, then the <code>root</code> key is returned. The default value of <code>root</code> is <code>:user</code>.</p> <p>If <code>access</code> is <code>:read</code>, then it opens the key with <code>KEY_READ</code> permissions. If <code>access</code> is <code>:write</code>, then it opens the key with <code>KEY_WRITE</code> permissions. If <code>access</code> is an integer, then the value <code>access</code> specifies the desired Win32 access rights. If <code>access</code> is omitted and <code>root</code> is <code>:user</code>, then <code>open-registry-key</code> uses <code>KEY_ALL_ACCESS</code>. Otherwise it uses <code>KEY_READ</code>.</p> <p>The return value on success is the <code>handle</code> of the opened key.</p> <p>If an error occurs and <code>errorp</code> is true, then an error is signaled. Otherwise, the return values are <code>nil</code> and the Windows <code>error-code</code>. The default value of <code>errorp</code> is <code>t</code>.</p> |                 |
| See also    | <code>create-registry-key</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                 |

| query-registry-key-info | Function                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary                 | Returns information about an open registry key handle.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Package                 | <code>win32</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Signature               | <code>query-registry-key-info key =&gt; info, error-code</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Arguments               | <code>key</code> A handle.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Values                  | <code>info</code> A property list.<br><code>error-code</code> An integer error code or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Description             | The function <code>query-registry-key-info</code> returns a plist of information about the open registry key handle <code>key</code> . The elements of the plist <code>info</code> are:<br><br><code>:class</code> A string naming the class of the key, if any.<br><code>:subkeys-count</code> An integer giving the number of subkeys.<br><code>:subkey-max-len</code><br>An integer giving the length of the longest subkey name.<br><code>:class-name-max-len</code><br>An integer giving the length of the longest class name.<br><code>:values-count</code> An integer giving the number of values.<br><code>:value-max-len</code> An integer giving the length of the longest value name.<br><code>:max-data-len</code> An integer giving the length of the longest value data.<br><code>:security-len</code> An integer giving the length of the security descriptor. |

|                            | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                                          |                       |                                            |                         |                                             |                            |                               |                     |            |
|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------------------------------------------|-----------------------|--------------------------------------------|-------------------------|---------------------------------------------|----------------------------|-------------------------------|---------------------|------------|
| Summary                    | Returns a value stored in the registry.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                     |                                          |                       |                                            |                         |                                             |                            |                               |                     |            |
| Package                    | <code>win32</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |                                          |                       |                                            |                         |                                             |                            |                               |                     |            |
| Signature                  | <code>query-registry-value subkey name &amp;key root expected-type<br/>errorp =&gt; data, successp, error-code</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     |                                          |                       |                                            |                         |                                             |                            |                               |                     |            |
| Arguments                  | <table> <tr> <td><code>subkey</code></td><td>A string specifying the name of the key.</td></tr> <tr> <td><code>name</code></td><td>A string specifying the name of the value.</td></tr> <tr> <td><code>root</code></td><td>A keyword or handle.</td></tr> <tr> <td><code>expected-type</code></td><td>A keyword or <code>t</code>.</td></tr> <tr> <td><code>errorp</code></td><td>A boolean.</td></tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <code>subkey</code> | A string specifying the name of the key. | <code>name</code>     | A string specifying the name of the value. | <code>root</code>       | A keyword or handle.                        | <code>expected-type</code> | A keyword or <code>t</code> . | <code>errorp</code> | A boolean. |
| <code>subkey</code>        | A string specifying the name of the key.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                     |                                          |                       |                                            |                         |                                             |                            |                               |                     |            |
| <code>name</code>          | A string specifying the name of the value.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                     |                                          |                       |                                            |                         |                                             |                            |                               |                     |            |
| <code>root</code>          | A keyword or handle.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     |                                          |                       |                                            |                         |                                             |                            |                               |                     |            |
| <code>expected-type</code> | A keyword or <code>t</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                     |                                          |                       |                                            |                         |                                             |                            |                               |                     |            |
| <code>errorp</code>        | A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                     |                                          |                       |                                            |                         |                                             |                            |                               |                     |            |
| Values                     | <table> <tr> <td><code>data</code></td><td>A Lisp object.</td></tr> <tr> <td><code>successp</code></td><td>A boolean.</td></tr> <tr> <td><code>error-code</code></td><td>An integer error code or <code>nil</code>.</td></tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <code>data</code>   | A Lisp object.                           | <code>successp</code> | A boolean.                                 | <code>error-code</code> | An integer error code or <code>nil</code> . |                            |                               |                     |            |
| <code>data</code>          | A Lisp object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     |                                          |                       |                                            |                         |                                             |                            |                               |                     |            |
| <code>successp</code>      | A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                     |                                          |                       |                                            |                         |                                             |                            |                               |                     |            |
| <code>error-code</code>    | An integer error code or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                     |                                          |                       |                                            |                         |                                             |                            |                               |                     |            |
| Description                | <p>The function <code>query-registry-value</code> returns the value associated with <code>name</code> in <code>subkey</code> under the key <code>root</code>. <code>subkey</code> and <code>root</code> are interpreted as described for <code>create-registry-key</code>. If <code>subkey</code> is an empty string, then the <code>root</code> key is returned. The default value of <code>root</code> is <code>:user</code>.</p> <p>If the value exists, then the return values are the data and true. <code>expected-type</code> controls how certain types are converted to the Lisp object <code>data</code> as described for <code>enum-registry-value</code>. The default value of <code>expected-type</code> is <code>t</code>.</p> <p>If an error occurs and <code>errorp</code> is true then an error is signaled. Otherwise, the return values are <code>nil</code>, <code>nil</code> and the Windows <code>error-code</code>. The default value of <code>errorp</code> is <code>t</code>.</p> |                     |                                          |                       |                                            |                         |                                             |                            |                               |                     |            |
| See also                   | <code>create-registry-key</code><br><code>enum-registry-value</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     |                                          |                       |                                            |                         |                                             |                            |                               |                     |            |

| <b>registry-key-exists-p</b> | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |                                          |                   |                      |                     |                        |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------------------------------------------|-------------------|----------------------|---------------------|------------------------|
| Summary                      | The predicate for whether a registry key can be opened.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                     |                                          |                   |                      |                     |                        |
| Package                      | <code>win32</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     |                                          |                   |                      |                     |                        |
| Signature                    | <code>registry-key-exists-p subkey &amp;key root access =&gt; existsP</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                                          |                   |                      |                     |                        |
| Arguments                    | <table><tr><td><code>subkey</code></td><td>A string specifying the name of the key.</td></tr><tr><td><code>root</code></td><td>A keyword or handle.</td></tr><tr><td><code>access</code></td><td>An integer or keyword.</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <code>subkey</code> | A string specifying the name of the key. | <code>root</code> | A keyword or handle. | <code>access</code> | An integer or keyword. |
| <code>subkey</code>          | A string specifying the name of the key.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                     |                                          |                   |                      |                     |                        |
| <code>root</code>            | A keyword or handle.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                     |                                          |                   |                      |                     |                        |
| <code>access</code>          | An integer or keyword.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     |                                          |                   |                      |                     |                        |
| Values                       | <code>existsP</code> A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |                                          |                   |                      |                     |                        |
| Description                  | <p>The function <code>registry-key-exists-p</code> checks whether the registry key named <code>subkey</code> can be opened under the parent key <code>root</code> with the supplied <code>access</code> permissions.</p> <p><code>subkey</code> and <code>root</code> are interpreted as described for <code>create-registry-key</code>. The default value of <code>root</code> is <code>:user</code>.</p> <p>If <code>access</code> is <code>:read</code>, then it opens the key with <code>KEY_READ</code> permissions. If <code>access</code> is <code>:write</code>, then it opens the key with <code>KEY_WRITE</code> permissions. If <code>access</code> is an integer, then the value <code>access</code> specifies the desired Win32 access rights. If <code>access</code> is omitted and <code>root</code> is <code>:user</code>, then <code>registry-key-exists-p</code> uses <code>KEY_ALL_ACCESS</code>. Otherwise it uses <code>KEY_READ</code>.</p> <p><code>registry-key-exists-p</code> closes the key before returning, but the return value is <code>t</code> if the key could actually be opened and <code>nil</code> otherwise.</p> |                     |                                          |                   |                      |                     |                        |
| See also                     | <code>create-registry-key</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                     |                                          |                   |                      |                     |                        |

| <b>registry-value</b> | <i>Accessor</i>                       |
|-----------------------|---------------------------------------|
| Summary               | Gets or sets a value in the registry. |

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                     |                                          |                       |                                            |                         |                                             |                            |                               |                     |            |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------------------------------------------|-----------------------|--------------------------------------------|-------------------------|---------------------------------------------|----------------------------|-------------------------------|---------------------|------------|
| Package                    | <code>win32</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                     |                                          |                       |                                            |                         |                                             |                            |                               |                     |            |
| Signature                  | <pre><code>registry-value subkey name &amp;key root expected-type errorp =&gt; data, successp, error-code</code></pre><br><pre><code>(setf registry-value) value subkey name &amp;key root expected- type errorp =&gt; value</code></pre>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     |                                          |                       |                                            |                         |                                             |                            |                               |                     |            |
| Arguments                  | <table> <tr> <td><code>subkey</code></td><td>A string specifying the name of the key.</td></tr> <tr> <td><code>name</code></td><td>A string specifying the name of the value.</td></tr> <tr> <td><code>root</code></td><td>A keyword or handle.</td></tr> <tr> <td><code>expected-type</code></td><td>A keyword or <code>t</code>.</td></tr> <tr> <td><code>errorp</code></td><td>A boolean.</td></tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <code>subkey</code> | A string specifying the name of the key. | <code>name</code>     | A string specifying the name of the value. | <code>root</code>       | A keyword or handle.                        | <code>expected-type</code> | A keyword or <code>t</code> . | <code>errorp</code> | A boolean. |
| <code>subkey</code>        | A string specifying the name of the key.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                     |                                          |                       |                                            |                         |                                             |                            |                               |                     |            |
| <code>name</code>          | A string specifying the name of the value.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     |                                          |                       |                                            |                         |                                             |                            |                               |                     |            |
| <code>root</code>          | A keyword or handle.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                                          |                       |                                            |                         |                                             |                            |                               |                     |            |
| <code>expected-type</code> | A keyword or <code>t</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                     |                                          |                       |                                            |                         |                                             |                            |                               |                     |            |
| <code>errorp</code>        | A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     |                                          |                       |                                            |                         |                                             |                            |                               |                     |            |
| Values                     | <table> <tr> <td><code>data</code></td><td>A Lisp object.</td></tr> <tr> <td><code>successp</code></td><td>A boolean.</td></tr> <tr> <td><code>error-code</code></td><td>An integer error code or <code>nil</code>.</td></tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <code>data</code>   | A Lisp object.                           | <code>successp</code> | A boolean.                                 | <code>error-code</code> | An integer error code or <code>nil</code> . |                            |                               |                     |            |
| <code>data</code>          | A Lisp object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     |                                          |                       |                                            |                         |                                             |                            |                               |                     |            |
| <code>successp</code>      | A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     |                                          |                       |                                            |                         |                                             |                            |                               |                     |            |
| <code>error-code</code>    | An integer error code or <code>nil</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                     |                                          |                       |                                            |                         |                                             |                            |                               |                     |            |
| Description                | <p>The function <code>registry-value</code> returns the value associated with <code>name</code> in <code>subkey</code> under the key <code>root</code>.</p> <p><code>subkey</code> and <code>root</code> are interpreted as described for <code>create-registry-key</code>. The default value of <code>root</code> is <code>:user</code>.</p> <p>If the value exists, then the return values are the data and true. <code>expected-type</code> controls how certain types are converted to Lisp objects as described for <code>enum-registry-value</code>. The default value of <code>expected-type</code> is <code>t</code>.</p> <p>If an error occurs and <code>errorp</code> is true then an error is signaled. Otherwise, the return values are <code>nil</code>, <code>nil</code> and the Windows <code>error-code</code>. The default value of <code>errorp</code> is <code>t</code>.</p> <p>The function <code>(setf registry-value)</code> sets the value associated with <code>name</code> in <code>subkey</code> under the key <code>root</code>, creating the subkey if necessary. The default value of <code>root</code> is <code>:user</code>.</p> |                     |                                          |                       |                                            |                         |                                             |                            |                               |                     |            |
| See also                   | <code>set-registry-value</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                     |                                          |                       |                                            |                         |                                             |                            |                               |                     |            |

| set-registry-value |                                                                                                                                                                                                                                                                                                                                                                                                                      | Function                                    |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|
| Summary            | Stores a value in the registry.                                                                                                                                                                                                                                                                                                                                                                                      |                                             |
| Package            | <code>win32</code>                                                                                                                                                                                                                                                                                                                                                                                                   |                                             |
| Signature          | <code>set-registry-value data subkey name &amp;key root expected-type<br/>errorp =&gt; error-code</code>                                                                                                                                                                                                                                                                                                             |                                             |
| Arguments          | <code>data</code>                                                                                                                                                                                                                                                                                                                                                                                                    | A Lisp object.                              |
|                    | <code>subkey</code>                                                                                                                                                                                                                                                                                                                                                                                                  | A string specifying the name of the key.    |
|                    | <code>name</code>                                                                                                                                                                                                                                                                                                                                                                                                    | A string specifying the name of the value.  |
|                    | <code>root</code>                                                                                                                                                                                                                                                                                                                                                                                                    | A keyword or handle.                        |
|                    | <code>expected-type</code>                                                                                                                                                                                                                                                                                                                                                                                           | A keyword or t.                             |
|                    | <code>errorp</code>                                                                                                                                                                                                                                                                                                                                                                                                  | A boolean.                                  |
| Values             | <code>error-code</code>                                                                                                                                                                                                                                                                                                                                                                                              | An integer error code or <code>nil</code> . |
| Description        | <p>The function <code>set-registry-value</code> sets the value associated with <i>name</i> in <i>subkey</i> under the key <i>root</i>.<br/><i>subkey</i> and <i>root</i> are interpreted as described for <code>create-registry-key</code>. The default value of <i>root</i> is <code>:user</code>.</p> <p>The stored value is derived from <i>data</i>, converted according to <i>expected-type</i> as follows:</p> |                                             |

Table 51.2 Conversion of Lisp objects to registry values

| Lisp data  | <i>expected-type</i>      | Registry type                                                             |
|------------|---------------------------|---------------------------------------------------------------------------|
| A string   | <code>:string</code>      | <code>REG_SZ</code> exactly as in <i>data</i>                             |
| Lisp value | <code>:lisp-object</code> | <code>REG_SZ</code> made with <code>prin1-to-string</code> of <i>data</i> |

Table 51.2 Conversion of Lisp objects to registry values

| Lisp data         | <i>expected-type</i>  | Registry type                                                          |
|-------------------|-----------------------|------------------------------------------------------------------------|
| An integer        | <code>:integer</code> | <code>REG_DWORD</code> containing <i>data</i>                          |
| A foreign pointer | <code>:binary</code>  | <code>REG_BINARY</code> containing bytes of one element at the pointer |
| An array          | <code>:binary</code>  | <code>REG_BINARY</code> containing bytes from the array                |

The default value of *expected-type* is `t`.

If an error occurs and *errorp* is true then an error is signaled.  
The default value of *errorp* is `t`.

See also      [create-registry-key](#)  
[registry-value](#)

## with-registry-key *Macro*

Summary      Runs code with an open registry key handle.

Package      `win32`

Signature      `with-registry-key (handle subkey &key root access errorp) &body body => values`

|           |                     |                                          |
|-----------|---------------------|------------------------------------------|
| Arguments | <code>handle</code> | A variable name.                         |
|           | <code>subkey</code> | A string specifying the name of the key. |
|           | <code>root</code>   | A keyword or handle.                     |
|           | <code>access</code> | An integer or keyword.                   |

|             |               |                                                                                                                                                                                                                                                                                                                   |
|-------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <i>errorp</i> | A boolean.                                                                                                                                                                                                                                                                                                        |
| Values      | <i>values</i> | The values returned by <i>body</i> .                                                                                                                                                                                                                                                                              |
| Description |               | The macro <b>with-registry-key</b> evaluates <i>body</i> with the variable <i>handle</i> bound to the registry key handle opened as if by calling<br><br><code>(open-registry-key <i>subkey</i> :root <i>root</i><br/>                  :access <i>access</i><br/>                  :errorp <i>errorp</i>)</code> |
|             |               | <i>subkey</i> and <i>root</i> are interpreted as described for <b>create-registry-key</b> .<br><br>If <i>errorp</i> is <code>nil</code> and <i>subkey</i> cannot be opened then <i>body</i> is not evaluated.                                                                                                     |

See also      [create-registry-key](#)



# 52

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## The DDE client interface

This chapter describes the Dynamic Data Exchange (DDE) client interface which is available in the `WIN32` package. You should use this chapter in conjunction with Chapter 22, “Dynamic Data Exchange”.

The `WIN32` package also includes “Miscellaneous WIN32 symbols”, “The Windows registry API” and “The DDE server interface”. These are documented in separate chapters in this manual.

**Note:** the `WIN32` package is not a supported implementation of the Win32 API. You should not use symbols in the `WIN32` package unless they are documented in this manual. Instead, define your own interfaces to Windows functions as you need - see the *LispWorks Foreign Language Interface User Guide and Reference Manual* for details.

**Note:** this chapter applies only to LispWorks for Windows, and not the UNIX, Linux, x86/x64 Solaris, FreeBSD, AIX or Mac OS X platforms.

| <code>dde-advise-start</code> | <i>Function</i>                                                     |
|-------------------------------|---------------------------------------------------------------------|
| Summary                       | Sets up an advise loop on a specified data item for a conversation. |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                               |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| Package     | <code>win32</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                               |
| Signature   | <code>dde-advise-start conversation item &amp;key key function format<br/>datap type errorp =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                               |
| Arguments   | <i>conversation</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | A conversation object.        |
|             | <i>item</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A string or symbol.           |
|             | <i>key</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | An object.                    |
|             | <i>function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | A function name.              |
|             | <i>format</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | A clipboard format specifier. |
|             | <i>datap</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | A boolean.                    |
|             | <i>type</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A keyword.                    |
|             | <i>errorp</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | A boolean.                    |
| Values      | <i>result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | A boolean.                    |
| Description | <p>The function <code>dde-advise-start</code> sets up an advise loop for the data item specified by <i>item</i> on the specified <i>conversation</i>.</p> <p>See “Advise loops” on page 324 for information about DDE advise loops.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                               |
|             | <p>The argument <i>format</i> should be one of the following:</p> <ul style="list-style-type: none"> <li>• A DDE format specifier, consisting of either a standard clipboard format or a registered clipboard format.</li> <li>• A string containing either the name of a standard clipboard format (without the <code>CF_</code> prefix), or the name of a registered clipboard format.</li> <li>• A symbol, in which case its print name is taken to specify the clipboard format.</li> <li>• The keyword <code>:text</code> – the default value of <i>format</i>. The keyword <code>:text</code> is treated specially. If supported by the server it uses the <code>CF_UNICODETEXT</code> clipboard format, otherwise it used the <code>CF_TEXT</code> format.</li> </ul> |                               |

The argument *type* specifies how the response data should be converted to a Lisp object. For text formats, the default value indicates that a Lisp string should be created. The value `:string-list` may be specified to indicate that the return value should be taken as a tab-separated list of strings; in this case the Lisp return value is a list of strings. The default conversation class only supports text formats, unless *type* is specified as `:foreign`, which can be used with any clipboard format. It returns a `clipboard-item` structure, containing a foreign pointer to the data, the data length, and the format identifier.

If *datap* is `t` (the default value), a hot link is established, where the new data is supplied whenever it changes. If *datap* is `nil`, a warm link is established, where the data is not passed, and must be explicitly requested using `dde-request`.

The argument *key* is used to identify this link. If specified as `nil` (the default value), it defaults to the conversation. Multiple links are permitted on a conversation with the same *item* and *format* values, as long as their *key* values differ.

If the link is established, the return value *result* is `t`. If the link could not be established, the behavior depends on the value of *errorp*. If *errorp* is `t` (the default value), LispWorks signals an error. If it is `nil`, the function returns `nil` to indicate failure.

If the link is established, the function *function* is called whenever the data changes. If *function* is `nil` (the default value), then the generic function `dde-client-advise-data` will be called.

The function specified by *function* should have a lambda list similar to the following:

```
key item data &key conversation &allow-other-keys
```

The arguments *key* and *item* identify the link. The argument *data* contains the new data for hot links; for warm links it is `nil`.

See also      **dde-advise-start\***  
**dde-advise-stop**  
**dde-client-advise-data**

## **dde-advise-start\*** *Function*

Summary      Sets up an advise loop for a specified data item for an automatically managed conversation.

Package      **win32**

Signature      **dde-advise-start\* service topic item &key key function format datap type errorp connect-error-p new-conversation-p => result**

Arguments      *service*      A string or symbol.

*topic*      A string or symbol.

*item*      A string or symbol.

*key*      An object.

*function*      A function name.

*format*      A clipboard format specifier.

*datap*      A boolean.

*type*      A keyword.

*errorp*      A boolean.

*connect-error-p*      A boolean.

*new-conversation-p*

                  A boolean.

Values      *result*      A boolean.

Description      The function **dde-advise-start\*** is similar to the **dde-advise-start**, and sets up an advise loop for the data item

specified by *item* on a conversation recognizing the *service/topic* pair.

See **dde-advise-start** for information on DDE advise loops and the *format*, *type*, and *datap* arguments.

The argument *key* is used to identify this link. If specified as **nil** (the default value), it defaults to the conversation. Multiple links are permitted on a conversation with the same *item* and *format* values, as long as their *key* values differ.

If the link is established, the return value *result* is **t**. If the link could not be established, the behavior depends on the value of *errorp*. If *errorp* is **t** (the default value), LispWorks signals an error. If it is **nil**, the function returns **nil** to indicate failure.

If the link is established, the function *function* will be called whenever the data changes. If *function* is **nil** (the default value), the generic function **dde-client-advise-data** will be called.

The function specified by *function* should have a lambda list similar to the following:

**key item data &key conversation &allow-other-keys**

The arguments *key* and *item* identify the link. The argument *data* contains the new data for hot links; for warm links it is **nil**.

See also

**dde-advise-start**  
**dde-advise-stop**  
**dde-advise-stop\***  
**dde-client-advise-data**

| <b>dde-advise-stop</b> | <i>Function</i> |
|------------------------|-----------------|
|------------------------|-----------------|

Summary

Removes a link from a conversation specified by a given item and key.

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                               |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| Package     | <code>win32</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                               |
| Signature   | <code>dde-advise-stop conversation item &amp;key key format errorp<br/>disconnectp no-advise-ok =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                               |
| Arguments   | <i>conversation</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | A conversation object.        |
|             | <i>item</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A string or symbol.           |
|             | <i>key</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | An object.                    |
|             | <i>format</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | A clipboard format specifier. |
|             | <i>errorp</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | A boolean.                    |
|             | <i>disconnectp</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | A boolean.                    |
|             | <i>no-advise-ok</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | A boolean.                    |
| Values      | <i>result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | A boolean.                    |
| Description | <p>The function <code>dde-advise-stop</code> removes a particular link from <i>conversation</i> specified by <i>item</i>, <i>format</i> and <i>key</i>. If <i>key</i> is the last key for the <i>item/format</i> pair, the advise loop for the pair is terminated.</p> <p>See “Advise loops” on page 324 for information about DDE advise loops.</p> <p>If <i>disconnectp</i> is <code>t</code>, and the last advise loop for the conversation is terminated, the conversation is disconnected.</p> <p>Attempting to remove a link that does not exist raises an error, unless <i>no-advise-ok</i> is <code>t</code>.</p> <p>If this function succeeds, it returns <code>t</code>. If it fails, the behavior depends on the value of <i>errorp</i>. If <i>errorp</i> is <code>t</code> (the default value), LispWorks signals an error. If <i>errorp</i> is <code>nil</code>, the function returns <code>nil</code> to indicate failure.</p> |                               |
| See also    | <a href="#"><code>dde-advise-start</code></a><br><a href="#"><code>dde-advise-start*</code></a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                               |

```
dde-advise-stop*
dde-client-advise-data
```

|                         | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                |                     |              |                     |             |                     |            |            |               |                               |               |            |                    |            |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---------------------|--------------|---------------------|-------------|---------------------|------------|------------|---------------|-------------------------------|---------------|------------|--------------------|------------|
| <b>dde-advise-stop*</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                |                     |              |                     |             |                     |            |            |               |                               |               |            |                    |            |
| Summary                 | Removes a link from an automatically managed conversation specified by a given item and key.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                |                     |              |                     |             |                     |            |            |               |                               |               |            |                    |            |
| Package                 | <code>win32</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                |                     |              |                     |             |                     |            |            |               |                               |               |            |                    |            |
| Signature               | <code>dde-advise-stop* service topic item &amp;key key format errorp disconnectp =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                |                     |              |                     |             |                     |            |            |               |                               |               |            |                    |            |
| Arguments               | <table><tr><td><i>service</i></td><td>A string or symbol.</td></tr><tr><td><i>topic</i></td><td>A string or symbol.</td></tr><tr><td><i>item</i></td><td>A string or symbol.</td></tr><tr><td><i>key</i></td><td>An object.</td></tr><tr><td><i>format</i></td><td>A clipboard format specifier.</td></tr><tr><td><i>errorp</i></td><td>A boolean.</td></tr><tr><td><i>disconnectp</i></td><td>A boolean.</td></tr></table>                                                                                                                                                                                                 | <i>service</i> | A string or symbol. | <i>topic</i> | A string or symbol. | <i>item</i> | A string or symbol. | <i>key</i> | An object. | <i>format</i> | A clipboard format specifier. | <i>errorp</i> | A boolean. | <i>disconnectp</i> | A boolean. |
| <i>service</i>          | A string or symbol.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                |                     |              |                     |             |                     |            |            |               |                               |               |            |                    |            |
| <i>topic</i>            | A string or symbol.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                |                     |              |                     |             |                     |            |            |               |                               |               |            |                    |            |
| <i>item</i>             | A string or symbol.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                |                     |              |                     |             |                     |            |            |               |                               |               |            |                    |            |
| <i>key</i>              | An object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                |                     |              |                     |             |                     |            |            |               |                               |               |            |                    |            |
| <i>format</i>           | A clipboard format specifier.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |                     |              |                     |             |                     |            |            |               |                               |               |            |                    |            |
| <i>errorp</i>           | A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                |                     |              |                     |             |                     |            |            |               |                               |               |            |                    |            |
| <i>disconnectp</i>      | A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                |                     |              |                     |             |                     |            |            |               |                               |               |            |                    |            |
| Values                  | <table><tr><td><i>result</i></td><td>A boolean.</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <i>result</i>  | A boolean.          |              |                     |             |                     |            |            |               |                               |               |            |                    |            |
| <i>result</i>           | A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                |                     |              |                     |             |                     |            |            |               |                               |               |            |                    |            |
| Description             | <p>The function <code>dde-advise-stop*</code> is similar to the function <code>dde-advise-stop</code>, and removes a particular link from a conversation specified by the <i>service/topic</i> pair indicated by <i>item</i>, <i>format</i> and <i>key</i>. If <i>key</i> is the last key for the <i>item/format</i> pair, the advise loop for the pair is terminated.</p> <p>See “Advise loops” on page 324 for information about DDE advise loops.</p> <p>If <i>disconnectp</i> is <code>t</code> (the default value), and the last advise loop for the conversation is terminated, the conversation is disconnected.</p> |                |                     |              |                     |             |                     |            |            |               |                               |               |            |                    |            |

If this function succeeds, it returns `t`. If it fails, the behavior depends on the value of `errorp`. If `errorp` is `t` (the default value), LispWorks signals an error. If `errorp` is `nil`, the function returns `nil` to indicate failure.

## See also

`dde-advise-start`  
`dde-advise-start*`  
`dde-advise-stop`

**dde-client-advise-data***Generic Function*

## Summary

Called when data changes in an advise loop.

## Package

`win32`

## Signature

`dde-client-advise-data key item data &key &allow-other-keys`

## Arguments

`key` An object.

`item` A string or symbol.

`data` A string.

## Values

None.

## Description

The generic function `dde-client-advise-data` is the default function called when an advise loop informs a client that the data monitored by the loop has changed. By default it does nothing, but it may be specialized on the object used as the key in `dde-advise-start` or `dde-advise-start*`, or on a client conversation class if the default `key` is used.

See “Advise loops” on page 324 for information about DDE advise loops.

## See also

`dde-advise-start`  
`dde-advise-stop`

| <b>dde-connect</b> | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                |                     |              |                     |              |                                                 |               |            |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---------------------|--------------|---------------------|--------------|-------------------------------------------------|---------------|------------|
| Summary            | Attempts to create a conversation with a specified DDE server.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                |                     |              |                     |              |                                                 |               |            |
| Package            | <code>win32</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                |                     |              |                     |              |                                                 |               |            |
| Signature          | <code>dde-connect service topic &amp;key class errorp =&gt; object</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                |                     |              |                     |              |                                                 |               |            |
| Arguments          | <table><tr><td><i>service</i></td><td>A symbol or string.</td></tr><tr><td><i>topic</i></td><td>A symbol or string.</td></tr><tr><td><i>class</i></td><td>The class of the conversation object to create.</td></tr><tr><td><i>errorp</i></td><td>A boolean.</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <i>service</i> | A symbol or string. | <i>topic</i> | A symbol or string. | <i>class</i> | The class of the conversation object to create. | <i>errorp</i> | A boolean. |
| <i>service</i>     | A symbol or string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                |                     |              |                     |              |                                                 |               |            |
| <i>topic</i>       | A symbol or string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                |                     |              |                     |              |                                                 |               |            |
| <i>class</i>       | The class of the conversation object to create.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                |                     |              |                     |              |                                                 |               |            |
| <i>errorp</i>      | A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                |                     |              |                     |              |                                                 |               |            |
| Values             | <i>object</i><br>A conversation object.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                |                     |              |                     |              |                                                 |               |            |
| Description        | <p>The function <code>dde-connect</code> attempts to create a conversation with a DDE server. If <code>server</code> names a client service registered with <code>define-dde-client</code>, the registered service name is used as the DDE service name. If <code>server</code> is any other symbol, the print name of the symbol is used as the DDE service name. If <code>server</code> is a string, that string is used as the DDE service name.</p> <p>The <code>topic</code> argument specifies the DDE topic name to be used in the conversation. If it is a symbol, the symbol's print name is used. If it is a string, the string is used.</p> <p>The <code>class</code> argument specifies the class of the conversation object to create. It must be a subclass of <code>dde-client-conversation</code>, or <code>nil</code>. If it is <code>nil</code> (the default value), then a conversation of class <code>dde-client-conversation</code> is created, unless <code>server</code> names a client service registered with <code>define-dde-client</code>, in which case the registered class (if any) is used.</p> <p>On executing successfully, this function returns a conversation object. If unsuccessful, the behavior depends on the</p> |                |                     |              |                     |              |                                                 |               |            |

value of *errorp*. If *errorp* is `t` (the default value), then an error is raised. If *errorp* is false, the function returns `nil`.

Note that conversation objects may only be used within the thread in which they were created.

See also      **dde-disconnect**

## **dde-disconnect** *Function*

Summary      Disconnects a conversation object.

Package      `win32`

Signature      **dde-disconnect** *conversation* => *result*

Arguments      *conversation*      A conversation object.

Values      *result*      *A boolean.*

Description      The function **dde-disconnect** disconnects the conversation object. The conversation may no longer be used. If the conversation disconnects successfully, `t` is returned.

See also      **dde-connect**

## **dde-execute** *Function*

Summary      An alternative syntax for **dde-execute-command**.

Package      `win32`

Signature      **dde-execute** *conversation command &rest {args}\* => result*

Arguments      *conversation*      A conversation object.

|             |                |                                                                                                                                                                                                                                                                                                                                                            |
|-------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | <i>command</i> | A string or symbol.                                                                                                                                                                                                                                                                                                                                        |
|             | <i>args</i>    | An argument.                                                                                                                                                                                                                                                                                                                                               |
| Values      | <i>result</i>  | A boolean.                                                                                                                                                                                                                                                                                                                                                 |
| Description |                | The function <code>dde-execute</code> provides an alternative syntax for <code>dde-execute-command</code> . Unlike <code>dde-execute-command</code> , <code>dde-execute</code> takes the arguments for <i>command</i> as a sequence of <i>args</i> following <code>&amp;rest</code> , and does not have an argument for specifying how to handle an error. |
| See also    |                | <code>dde-execute*</code><br><code>dde-execute-command*</code><br><code>dde-execute-string</code>                                                                                                                                                                                                                                                          |

## **dde-execute\*** *Function*

|             |                                                                                                                                                                                                                                |                     |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| Summary     | An alternative syntax for <code>dde-execute-command*</code> .                                                                                                                                                                  |                     |
| Package     | <code>win32</code>                                                                                                                                                                                                             |                     |
| Signature   | <code>dde-execute* service topic command &amp;rest {args}* =&gt; result</code>                                                                                                                                                 |                     |
| Arguments   | <i>service</i>                                                                                                                                                                                                                 | A string or symbol. |
|             | <i>topic</i>                                                                                                                                                                                                                   | A string symbol.    |
|             | <i>command</i>                                                                                                                                                                                                                 | A string or symbol. |
|             | <i>args</i>                                                                                                                                                                                                                    | An argument.        |
| Values      | <i>result</i>                                                                                                                                                                                                                  | A boolean.          |
| Description | The function <code>dde-execute*</code> provides an alternative syntax for <code>dde-execute-command*</code> . Unlike <code>dde-execute-command*</code> , <code>dde-execute*</code> takes the arguments for <i>command</i> as a |                     |

sequence of `args` following `&rest`, and does not have any arguments for specifying how to handle errors.

## See also

`dde-execute`  
`dde-execute-command`  
`dde-execute-string`

## dde-execute-command *Function*

Summary     Sends a command string to a specified conversation.

Package     `win32`

Signature     `dde-execute-command conversation command arg-list &key errorp => result`

Arguments     `conversation`     A conversation object.

`command`     A string or symbol.

`arg-list`     A list of strings, integers, and floats.

`errorp`     A boolean.

Values        `result`     A boolean.

Description     The function `dde-execute-command` sends a command string to the conversation specified by `conversation`. The command string consists of `command` and `arg-list`, which are combined using the appropriate argument-marshalling conventions. By default, the syntax is

```
[command(arg1,arg2,...)]
```

On success, this function returns a result of `t`. On failure, the behavior depends on the value of the `errorp` argument. If `errorp` is `t` (the default value), LispWorks signals an error. If it is `nil`, the function returns `nil` to indicate failure.

See also

**dde-execute**  
**dde-execute-string**

**dde-execute-command\*** *Function*

Summary     Sends a command string to a specified service on a given topic.

Package     **win32**

Signature     **dde-execute-command\* service topic command arg-list &key  
errorp connect-error-p new-conversation-p => result**

Arguments     *service*     A string or symbol.

*topic*     A string or symbol.

*command*     A string or symbol.

*arg-list*     A list of strings, integers, and floats.

*errorp*     A boolean.

*connect-error-p*     A boolean.

*new-conversation-p*

              A boolean.

Values     *result*     A boolean.

Description     The function **dde-execute-command\*** is similar to **dde-execute-command**, and sends a command string to the server specified by *service* on a topic given by *topic*. The command string consists of *command* and *arg-list*, which are combined using the appropriate argument-marshalling conventions. By default, the syntax is

`[command(arg1,arg2,...)]`

If *server* names a client service registered with `define-dde-client`, the registered service name is used as the DDE service name. If *server* is any other symbol, the print name of the symbol is used as the DDE service name. If *server* is a string, that string is used as the DDE service name.

The *topic* argument specifies the DDE topic name to be used in the conversation. If it is a symbol, the symbol's print name is used. If it is a string, the string is used.

If necessary, the function `dde-execute-command*` creates a conversation for the duration of the transaction, but if a suitable conversation already exists, the transaction is executed over that conversation. Hence, if several transactions will be made with the same service and *topic*, placing them inside a `with-dde-conversation` prevents a new conversation being established for each transaction.

If *new-conversation-p* is set to `t` a new conversation is always established for the transaction. This new conversation is always automatically disconnected when the transaction is completed.

If *connect-error-p* is `t` (the default value) and a conversation cannot be established, then LispWorks signals an error. If it is `nil`, `dde-execute-command*` returns `nil` if a conversation cannot be established. This allows the caller to distinguish between the cases when the server is not running, and when the server is running but the transaction fails.

Upon success, this function returns a result of `t`. On failure, the behavior depends on the value of the *errorp* argument. If *errorp* is `t` (the default value), LispWorks signals an error. If it is `nil`, the function returns `nil` to indicate failure.

See also

`dde-execute`  
`dde-execute-string`  
`dde-execute-command`

|                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <i>Function</i>        |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| <b>dde-execute-string</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                        |
| Summary                   | Issues an execute transaction consisting of a specified string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                        |
| Package                   | <code>win32</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                        |
| Signature                 | <code>dde-execute-string conversation command &amp;key errorp =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                        |
| Arguments                 | <i>conversation</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | A conversation object. |
|                           | <i>command</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | A string or symbol.    |
|                           | <i>errorp</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | A boolean.             |
| Values                    | <i>result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | A boolean.             |
| Description               | The function <code>dde-execute-string</code> issues an execute transaction consisting of the string <i>command</i> . This string should be an appropriately formatted as described in “Execute transactions” on page 323. No processing of the string is performed.<br><br>On success, this function returns <code>t</code> . On failure, the behavior depends on the value of the <i>errorp</i> argument. If <i>errorp</i> is <code>t</code> (the default value), LispWorks signals an error. If it is <code>nil</code> , the function returns <code>nil</code> to indicate failure. |                        |
| See also                  | <code>dde-execute</code><br><code>dde-execute-command</code><br><code>dde-execute-string*</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                        |

|                            |                                                                                                          | <i>Function</i> |
|----------------------------|----------------------------------------------------------------------------------------------------------|-----------------|
| <b>dde-execute-string*</b> |                                                                                                          |                 |
| Summary                    | Issues an execute transaction consisting of a specified string on an automatically managed conversation. |                 |
| Package                    | <code>win32</code>                                                                                       |                 |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| Signature   | <code>dde-execute-string* service topic command &amp;key errorp<br/>connect-error-p new-conversation-p =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     |
| Arguments   | <code>service</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | A symbol or string. |
|             | <code>topic</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | A symbol or string. |
|             | <code>command</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | A string or symbol. |
|             | <code>errorp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | A boolean.          |
|             | <code>connect-error-p</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | A boolean.          |
|             | <br><code>new-conversation-p</code><br>A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                     |
| Values      | <code>result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | A boolean.          |
| Description | <p>The function <code>dde-execute-string*</code> is similar to <code>dde-execute-string</code>, in that it issues an execute transaction consisting of the string <code>command</code>. However, the conversation across which <code>command</code> is issued is managed automatically. No processing of the string is performed.</p> <p>If <code>server</code> names a client service registered with <code>define-dde-client</code>, the registered service name is used as the DDE service name. If <code>server</code> is any other symbol, the print name of the symbol is used as the DDE service name. If <code>server</code> is a string, that string is used as the DDE service name.</p> <p>The <code>topic</code> argument specifies the DDE topic name to be used in the conversation. If it is a symbol, the symbol's print name is used. If it is a string, the string is used.</p> <p>If necessary, the function <code>dde-execute-string*</code> will create a conversation for the duration of the transaction, but if a suitable conversation already exists, the transaction will be executed over that conversation. Hence, if several transactions will be made with the same <code>service</code> and <code>topic</code>, placing them inside a <code>with-dde-conversation</code> prevents a new conversation being established for each transaction.</p> |                     |

If *new-conversation-p* is set to `t` a new conversation is always established for the transaction. This new conversation is always automatically disconnected when the transaction is completed.

If *connect-error-p* is `t` (the default value), then LispWorks signals an error if a conversation cannot be established. If it is `nil`, `dde-execute-string*` returns `nil` if a conversation cannot be established. This allows the caller to distinguish between the cases when the server is not running, and when the server is running but the transaction fails.

Upon success, the function returns `t`. On failure, the behavior depends on the value of the *errorp* argument. If *errorp* is `t` (the default value), LispWorks signals an error. If it is `nil`, the function returns `nil` to indicate failure.

See also

`dde-execute`  
`dde-execute-command`  
`dde-execute-string`

**dde-item**

*Accessor*

Summary

An accessor which can perform a request transaction or a poke transaction.

Package

`win32`

Signature

`dde-item conversation item &key format type errorp => result`

Arguments

*conversation*      A conversation object.

*item*                A string or symbol.

*format*             A clipboard format specifier.

*type*                A keyword.

*errorp*             A boolean.

Values      ***result***      A boolean.

Description      The accessor **dde-item** performs a request transaction when read. It performs a poke transaction when set.

To illustrate, the following **dde-request** command

```
(dde-request conversation item :format format :type type
:errorp errorp)
```

can also be issued using **dde-item** as follows:

```
(dde-item conversation item :FORMAT format :TYPE type
:ERRORP errorp)
```

Similarly, the following **dde-poke** command

```
(dde-poke conversation item data :format format :type type
:errorp errorp)
```

can be issued using **dde-item** as follows:

```
(setf (dde-item conversation item :format format :type type
:errorp errorp) data)
```

except that the *format* always returns *data*.

Upon success, this function returns a *result* of t. On failure, the behavior depends on the value of the *errorp* argument. If *errorp* is t (the default value), LispWorks signals an error. If it is nil, the function returns nil to indicate failure.

See also      **dde-item\***  
**dde-poke**  
**dde-request**

## **dde-item\*** *Accessor*

Summary      An accessor which can perform a request transaction or a poke transaction on an automatically managed conversation.

Package      **win32**

|           |                                                                                                                       |                               |
|-----------|-----------------------------------------------------------------------------------------------------------------------|-------------------------------|
| Signature | <code>dde-item* service topic item &amp;key format type errorp connect-error-p new-conversation-p =&gt; result</code> |                               |
| Arguments | <i>service</i>                                                                                                        | A string or symbol.           |
|           | <i>topic</i>                                                                                                          | A string or symbol.           |
|           | <i>item</i>                                                                                                           | A string or symbol.           |
|           | <i>format</i>                                                                                                         | A clipboard format specifier. |
|           | <i>type</i>                                                                                                           | A keyword.                    |
|           | <i>errorp</i>                                                                                                         | A boolean.                    |
|           | <i>connect-error-p</i>                                                                                                | A boolean.                    |
|           | <i>new-conversation-p</i>                                                                                             |                               |
|           |                                                                                                                       | A boolean.                    |
| Values    | <i>result</i>                                                                                                         | A boolean.                    |

Description The accessor `dde-item*` is similar to `dde-item`, and performs a request transaction when read. It performs a poke transaction when set.

To illustrate, the following `dde-request*` command

```
(dde-request* service topic item :format format :type type  
:errorp errorp connect-error-p new-conversation-p)
```

can also be issued using `dde-item*` as follows:

```
(dde-item* service topic item :FORMAT format :TYPE type  
:ERRORP errorp connect-error-p new-conversation-p)
```

Similarly, the following `dde-poke*` command

```
(dde-poke* conversation item data :format format :type type  
:errorp errorp connect-error-p new-conversation-p)
```

can be issued using `dde-item*` as follows:

```
(setf (dde-item* conversation item :format format :type type  
:errorp errorp connect-error-p new-conversation-p) data)
```

except that the *format* always returns *data*.

If necessary, the accessor `dde-item*` creates a conversation for the duration of the transaction, but if a suitable conversation already exists, the transaction is executed over that conversation. If you need to make several transactions with the same *service* and *topic*, placing them inside a `with-dde-conversation` prevents a new conversation being established for each transaction.

If *new-conversation-p* is set to `t` a new conversation is always established for the transaction. This new conversation is always automatically disconnected when the transaction is completed.

If *connect-error-p* is `t` (the default value), then LispWorks signals an error if a conversation cannot be established. If it is `nil`, `dde-item*` returns `nil` if a conversation cannot be established. This allows the caller to distinguish between the cases when the server is not running, and when the server is running but the transaction fails.

On success, the function returns `t`. On failure, the behavior depends on the value of the *errorp* argument. If *errorp* is `t` (the default value), LispWorks signals an error. If it is `nil`, the function returns `nil` to indicate failure.

See also

`dde-item`  
`dde-poke`  
`dde-request`

### `dde-poke`

### *Function*

Summary

Issues a poke transaction on a conversation, to set the value of a specified item.

Package

`win32`

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                               |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| Signature   | <code>dde-poke <i>conversation item data &amp;key format type errorp =&gt; result</i></code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                               |
| Arguments   | <i>conversation</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | A conversation object.        |
|             | <i>item</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | A string or symbol.           |
|             | <i>data</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | A string.                     |
|             | <i>format</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | A clipboard format specifier. |
|             | <i>type</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | A keyword.                    |
|             | <i>errorp</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | A boolean.                    |
| Values      | <i>result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | A boolean.                    |
| Description | The function <code>dde-poke</code> issues a poke transaction on <i>conversation</i> to set the value of the item specified by <i>item</i> to the value specified by <i>data</i> . The argument <i>item</i> should be a string, or a symbol. If it is a symbol its print name is used.<br><br>The argument <i>format</i> should be one of the following:                                                                                                                                                                                                                                                                                                                                            |                               |
|             | <ul style="list-style-type: none"><li>• A DDE format specifier, consisting of either a standard clipboard format or a registered clipboard format.</li><li>• A string containing either the name of a standard clipboard format (without the <code>CF_</code> prefix), or the name of a registered clipboard format.</li><li>• A symbol, in which case its print name is taken to specify the clipboard format.</li><li>• The keyword <code>:text</code>. This is the default value.</li></ul> <p>The keyword <code>:text</code> is treated specially. If supported by the server it uses the <code>CF_UNICODETEXT</code> clipboard format, otherwise it used the <code>CF_TEXT</code> format.</p> |                               |
|             | For text transactions, the default value of <i>type</i> indicates that <i>data</i> is a Lisp string to be used. If <i>type</i> is <code>:string-list</code> , then <i>data</i> is taken to be a list of strings, and is sent as a tab-separated string.                                                                                                                                                                                                                                                                                                                                                                                                                                            |                               |

Alternatively, *data* can be a `clipboard-item` structure, containing a foreign pointer to the data to send and the length of the data. In this case the *type* argument is ignored.

On success, this function returns `t`. On failure, the behavior depends on the value of the *errorp* argument. If *errorp* is `t` (the default value), LispWorks signals an error. If it is `nil`, the function returns `nil` to indicate failure.

See also  
[dde-item](#)  
[dde-request](#)

|                           | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                |                     |              |                     |             |                     |             |           |               |                               |             |            |               |            |                        |            |                           |            |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---------------------|--------------|---------------------|-------------|---------------------|-------------|-----------|---------------|-------------------------------|-------------|------------|---------------|------------|------------------------|------------|---------------------------|------------|
| <b>dde-poke*</b>          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                |                     |              |                     |             |                     |             |           |               |                               |             |            |               |            |                        |            |                           |            |
| Summary                   | Issues a poke transaction on an automatically managed conversation, to set the value of a specified item.                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                |                     |              |                     |             |                     |             |           |               |                               |             |            |               |            |                        |            |                           |            |
| Package                   | <code>win32</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                |                     |              |                     |             |                     |             |           |               |                               |             |            |               |            |                        |            |                           |            |
| Signature                 | <code>dde-poke* service topic item data &amp;key format type errorp connect-error-p new-conversation-p =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                |                     |              |                     |             |                     |             |           |               |                               |             |            |               |            |                        |            |                           |            |
| Arguments                 | <table border="0"> <tr> <td><i>service</i></td><td>A symbol or string.</td></tr> <tr> <td><i>topic</i></td><td>A symbol or string.</td></tr> <tr> <td><i>item</i></td><td>A string or symbol.</td></tr> <tr> <td><i>data</i></td><td>A string.</td></tr> <tr> <td><i>format</i></td><td>A clipboard format specifier.</td></tr> <tr> <td><i>type</i></td><td>A keyword.</td></tr> <tr> <td><i>errorp</i></td><td>A boolean.</td></tr> <tr> <td><i>connect-error-p</i></td><td>A boolean.</td></tr> <tr> <td><i>new-conversation-p</i></td><td>A boolean.</td></tr> </table> | <i>service</i> | A symbol or string. | <i>topic</i> | A symbol or string. | <i>item</i> | A string or symbol. | <i>data</i> | A string. | <i>format</i> | A clipboard format specifier. | <i>type</i> | A keyword. | <i>errorp</i> | A boolean. | <i>connect-error-p</i> | A boolean. | <i>new-conversation-p</i> | A boolean. |
| <i>service</i>            | A symbol or string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                |                     |              |                     |             |                     |             |           |               |                               |             |            |               |            |                        |            |                           |            |
| <i>topic</i>              | A symbol or string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                |                     |              |                     |             |                     |             |           |               |                               |             |            |               |            |                        |            |                           |            |
| <i>item</i>               | A string or symbol.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                |                     |              |                     |             |                     |             |           |               |                               |             |            |               |            |                        |            |                           |            |
| <i>data</i>               | A string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                |                     |              |                     |             |                     |             |           |               |                               |             |            |               |            |                        |            |                           |            |
| <i>format</i>             | A clipboard format specifier.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                |                     |              |                     |             |                     |             |           |               |                               |             |            |               |            |                        |            |                           |            |
| <i>type</i>               | A keyword.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                |                     |              |                     |             |                     |             |           |               |                               |             |            |               |            |                        |            |                           |            |
| <i>errorp</i>             | A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                |                     |              |                     |             |                     |             |           |               |                               |             |            |               |            |                        |            |                           |            |
| <i>connect-error-p</i>    | A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                |                     |              |                     |             |                     |             |           |               |                               |             |            |               |            |                        |            |                           |            |
| <i>new-conversation-p</i> | A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                |                     |              |                     |             |                     |             |           |               |                               |             |            |               |            |                        |            |                           |            |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |            |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Values      | <i>result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | A boolean. |
| Description | <p>The function <code>dde-poke*</code> is the same as <code>dde-poke</code>, except that conversations are managed automatically. The function issues a poke transaction to set the value of the item specified by <i>item</i> to the value specified by <i>data</i>. The argument <i>item</i> should be a string, or a symbol. If it is a symbol its print name is used.</p> <p>If <i>server</i> names a client service registered with <code>define-dde-client</code>, the registered service name is used as the DDE service name. If <i>server</i> is any other symbol, the print name of the symbol is used as the DDE service name. If <i>server</i> is a string, that string is used as the DDE service name.</p> <p>The <i>topic</i> argument specifies the DDE topic name to be used in the conversation. If it is a symbol, the symbol's print name is used. If it is a string, the string is used.</p> <p>For information on the <i>format</i>, <i>type</i>, and <i>errorp</i> arguments, see <code>dde-poke</code>.</p> <p>If necessary, the function <code>dde-poke*</code> creates a conversation for the duration of the transaction, but if a suitable conversation already exists, the transaction is executed over that conversation. Hence, if several transactions are made with the same <i>service</i> and <i>topic</i>, placing them inside a <code>with-dde-conversation</code> prevents a new conversation being established for each transaction.</p> <p>If <i>new-conversation-p</i> is set to <code>t</code> a new conversation is always established for the transaction. This new conversation is always automatically disconnected when the transaction is completed.</p> <p>If <i>connect-error-p</i> is <code>t</code> (the default value), LispWorks signals an error if a conversation cannot be established. If it is <code>nil</code>, <code>dde-poke*</code> returns <code>nil</code> if a conversation cannot be established. This allows the caller to distinguish between the cases when</p> |            |

the server is not running, and when the server is running but the transaction fails.

See also

`dde-item`  
`dde-request`

|             |                                                                                                                                                                                                                               | <i>Function</i>                                                                              |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| Summary     | Issues a request transaction on a conversation for a specified item.                                                                                                                                                          |                                                                                              |
| Package     | <code>win32</code>                                                                                                                                                                                                            |                                                                                              |
| Signature   |                                                                                                                                                                                                                               | <code>dde-request conversation item &amp;key format type errorp =&gt; result successp</code> |
| Arguments   | <code>conversation</code> A conversation object.<br><code>item</code> A string or symbol.<br><code>format</code> A clipboard format specifier.<br><code>type</code> A keyword.<br><code>errorp</code> A boolean.              |                                                                                              |
| Values      | <code>result</code> The return value of the transaction.<br><code>successp</code> A boolean.                                                                                                                                  |                                                                                              |
| Description | The function <code>dde-request</code> issues a request transaction on <i>conversation</i> for the specified <i>item</i> . The argument <i>item</i> should be a string, or a symbol. If it is a symbol its print name is used. |                                                                                              |
|             | The argument <i>format</i> should be one of the following:                                                                                                                                                                    |                                                                                              |
|             | <ul style="list-style-type: none"> <li>• A DDE format specifier, consisting of either a standard clipboard format or a registered clipboard format.</li> </ul>                                                                |                                                                                              |

- A string containing either the name of a standard clipboard format (without the `CF_` prefix), or the name of a registered clipboard format.
- A symbol, in which case its print name is taken to specify the clipboard format.
- The keyword `:text`. This is the default value.

The keyword `:text` is treated specially. If supported by the server it uses the `CF_UNICODETEXT` clipboard format, otherwise it used the `CF_TEXT` format.

The default conversation class only supports text formats, unless `type` is specified as `:foreign`. The argument `type` specifies how the response data should be converted to a Lisp object. For text formats, the default value indicates that a Lisp string should be created. The value `:string-list` may be specified for `type` to indicate that the return value should be taken as a tab-separated list of strings; in this case the Lisp return value is a list of strings. The value `:foreign` can be used with any clipboard format. It returns a `clipboard-item` structure, containing a foreign pointer to the data, the data length, and the format identifier.

This function returns two values, `result` and `successp`. If successful, `result` is the return value of the transaction (which may be `nil` in the case of `:string-list`), and `successp` is true to indicate success.

On failure, the result of the function depends on the `errorp` argument. If `errorp` is `t` (the default), the function signals an error. If `errorp` is `nil`, the function returns `(values nil nil)`.

See also

`dde-item`  
`dde-poke`  
`dde-request*`

| <b>dde-request*</b>       | <i>Function</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                |                     |              |                     |             |                     |               |                               |             |            |               |            |                        |            |                           |            |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---------------------|--------------|---------------------|-------------|---------------------|---------------|-------------------------------|-------------|------------|---------------|------------|------------------------|------------|---------------------------|------------|
| Summary                   | Issues a request transaction on an automatically managed conversation for a specified item.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                |                     |              |                     |             |                     |               |                               |             |            |               |            |                        |            |                           |            |
| Package                   | <code>win32</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                |                     |              |                     |             |                     |               |                               |             |            |               |            |                        |            |                           |            |
| Signature                 | <code>dde-request* service topic item &amp;key format type errorp connect-error-p new-conversation-p =&gt; result successp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                |                     |              |                     |             |                     |               |                               |             |            |               |            |                        |            |                           |            |
| Arguments                 | <table> <tr> <td><i>service</i></td><td>A symbol or string.</td></tr> <tr> <td><i>topic</i></td><td>A symbol or string.</td></tr> <tr> <td><i>item</i></td><td>A string or symbol.</td></tr> <tr> <td><i>format</i></td><td>A clipboard format specifier.</td></tr> <tr> <td><i>type</i></td><td>A keyword.</td></tr> <tr> <td><i>errorp</i></td><td>A boolean.</td></tr> <tr> <td><i>connect-error-p</i></td><td>A boolean.</td></tr> <tr> <td><i>new-conversation-p</i></td><td>A boolean.</td></tr> </table>                                                                                                                                                    | <i>service</i> | A symbol or string. | <i>topic</i> | A symbol or string. | <i>item</i> | A string or symbol. | <i>format</i> | A clipboard format specifier. | <i>type</i> | A keyword. | <i>errorp</i> | A boolean. | <i>connect-error-p</i> | A boolean. | <i>new-conversation-p</i> | A boolean. |
| <i>service</i>            | A symbol or string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                |                     |              |                     |             |                     |               |                               |             |            |               |            |                        |            |                           |            |
| <i>topic</i>              | A symbol or string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                |                     |              |                     |             |                     |               |                               |             |            |               |            |                        |            |                           |            |
| <i>item</i>               | A string or symbol.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                |                     |              |                     |             |                     |               |                               |             |            |               |            |                        |            |                           |            |
| <i>format</i>             | A clipboard format specifier.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                |                     |              |                     |             |                     |               |                               |             |            |               |            |                        |            |                           |            |
| <i>type</i>               | A keyword.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                |                     |              |                     |             |                     |               |                               |             |            |               |            |                        |            |                           |            |
| <i>errorp</i>             | A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                |                     |              |                     |             |                     |               |                               |             |            |               |            |                        |            |                           |            |
| <i>connect-error-p</i>    | A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                |                     |              |                     |             |                     |               |                               |             |            |               |            |                        |            |                           |            |
| <i>new-conversation-p</i> | A boolean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                |                     |              |                     |             |                     |               |                               |             |            |               |            |                        |            |                           |            |
| Values                    | <i>result</i> The return value of the transaction.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                |                     |              |                     |             |                     |               |                               |             |            |               |            |                        |            |                           |            |
| Description               | <p>The function <code>dde-request*</code> is similar to <code>dde-request</code>, except that conversations are managed automatically. The function issues a request transaction for the specified <i>item</i>. The argument <i>item</i> should be a string, or a symbol. If it is a symbol its print name is used.</p> <p>If <i>server</i> names a client service registered with <code>define-dde-client</code>, the registered service name is used as the DDE service name. If <i>server</i> is any other symbol, the print name of the symbol is used as the DDE service name. If <i>server</i> is a string, that string is used as the DDE service name.</p> |                |                     |              |                     |             |                     |               |                               |             |            |               |            |                        |            |                           |            |

The *topic* argument specifies the DDE topic name to be used in the conversation. If it is a symbol, the symbol's print name is used. If it is a string, the string is used.

For information on the *format*, *type*, and *errorp* arguments see **dde-request**.

If necessary, the function **dde-request\*** will create a conversation for the duration of the transaction, but if a suitable conversation already exists, the transaction will be executed over that conversation. Hence, if several transactions will be made with the same *service* and *topic*, placing them inside a **with-dde-conversation** prevents a new conversation being established for each transaction.

If *new-conversation-p* is set to **t** a new conversation is always established for the transaction. This new conversation is always automatically disconnected when the transaction is completed.

If *connect-error-p* is **t** (the default value), then LispWorks signals an error if a conversation cannot be established. If it is **nil**, **dde-request\*** returns **nil** if a conversation cannot be established. This allows the caller to distinguish between the cases when the server is not running, and when the server is running but the transaction fails.

See also

**dde-item**  
**dde-poke**  
**dde-request**

## define-dde-client

*Macro*

Summary      Registers a client service.

Package      **win32**

Signature      **define-dde-client name &key service class => name**

|             |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arguments   | <code>name</code>    | A symbol.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|             | <code>service</code> | A string.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|             | <code>class</code>   | A subclass of <code>dde-client-conversation</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Values      | <code>name</code>    | A symbol.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Description |                      | <p>The macro <code>define-dde-client</code> defines a mapping from the symbol <code>name</code> to the DDE service name with which to establish a conversation, and the conversation class to use for this conversation. The argument <code>service</code> is a string which names the DDE service. It defaults to the print-name of <code>name</code>. The argument <code>class</code> is a subclass of <code>dde-client-conversation</code> which is used for all conversations with this service. It defaults to <code>dde-client-conversation</code>. Specifying a subclass allows various aspects of the behavior of the conversation to be specialized.</p> <p>Note that it is generally not necessary to register client services unless a specialized conversation type is required. However, it is sometimes convenient to register a client service in order to allow the service name to be changed in the future.</p> <p>If the macro executes successfully, the <code>name</code> of the DDE service is returned.</p> |
| See also    |                      | <code>dde-connect</code><br><code>dde-disconnect</code><br><code>with-dde-conversation</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

## with-dde-conversation *Macro*

|         |                                                                           |
|---------|---------------------------------------------------------------------------|
| Summary | Dynamically binds a conversation to a server across a given body of code. |
| Package | <code>win32</code>                                                        |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                        |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Signature   | <code>with-dde-conversation (conv service topic &amp;key errorp<br/>new-conversation-p) &amp;body body =&gt; result</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                        |
| Arguments   | <i>conv</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | A conversation object. |
|             | <i>service</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | A symbol or string.    |
|             | <i>topic</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | A symbol or string.    |
|             | <i>errorp</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | A boolean.             |
|             | <i>new-conversation-p</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | A boolean.             |
|             | <i>body</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | A list of Lisp forms.  |
| Values      | <i>result</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | A boolean.             |
| Description | <p>The macro <code>with-dde-conversation</code> dynamically binds a conversation with a server across the scope of a body of code specified by <i>body</i>. The argument <i>conv</i> is bound to a conversation with the server specified by <i>service</i>, and the topic specified by <i>topic</i>.</p> <p>If <i>server</i> names a client service registered with <code>define-dde-client</code>, the registered service name is used as the DDE service name. If <i>server</i> is any other symbol, the print name of the symbol is used as the DDE service name. If <i>server</i> is a string, that string is used as the DDE service name.</p> <p>The <i>topic</i> argument specifies the DDE topic name to be used in the conversation. If it is a symbol, the symbol's print name is used. If it is a string, the string is used.</p> <p>An existing conversation may be used, if available, unless <i>new-conversation-p</i> is true, in which case a new conversation is always created.</p> <p>If a new conversation is created, it is disconnected after <i>body</i> has executed as an implicit program.</p> |                        |

If a conversation cannot be established, the result returned by the function depends on the value of *errorp*. If *errorp* is `t` (the default value), then LispWorks signals an error. If *errorp* is `nil`, the body is not executed, and `nil` is returned.

See also      `define-dde-client`

# 53

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## The DDE server interface

This chapter describes the Dynamic Data Exchange (DDE) server interface which is available in the `WIN32` package. You should use this chapter in conjunction with Chapter 22, “Dynamic Data Exchange”.

The `WIN32` package also includes “Miscellaneous WIN32 symbols”, “The Windows registry API” and “The DDE client interface”. These are documented in separate chapters in this manual.

**Note:** the `WIN32` package is not a supported implementation of the Win32 API. You should not use symbols in the `WIN32` package unless they are documented in this manual. Instead, define your own interfaces to Windows functions as you need - see the *LispWorks Foreign Language Interface User Guide and Reference Manual* for details.

**Note:** this chapter applies only to LispWorks for Windows, and not the UNIX, Linux, x86/x64 Solaris, FreeBSD, AIX or Mac OS X platforms.

| <code>dde-server-poke</code> | <i>Generic Function</i> |
|------------------------------|-------------------------|
|------------------------------|-------------------------|

|         |                                             |
|---------|---------------------------------------------|
| Summary | Called when a poke transaction is received. |
|---------|---------------------------------------------|

|         |                    |
|---------|--------------------|
| Package | <code>win32</code> |
|---------|--------------------|

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                  |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| Signature   | <code>dde-server-poke server topic item data &amp;key format &amp;allow-other-keys =&gt; successp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                  |
| Arguments   | <code>server</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | A server object. |
|             | <code>topic</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | A topic object.  |
|             | <code>item</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | A string.        |
|             | <code>data</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | A string.        |
|             | <code>format</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | A keyword.       |
| Values      | <code>successp</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | A boolean.       |
| Description | <p>The generic function <code>dde-server-poke</code> is called in response to a poke transaction. A method specializing on the classes of <code>server</code> and <code>topic</code> should poke the data given by <code>data</code> into the item specified by <code>item</code>.</p> <p>The keyword <code>format</code> indicates the format in which the item is being requested. By default, only text transfers are supported (and the <code>format</code> argument will have the value <code>:text</code>).</p> <p>The set of supported formats may be extended in future releases, so applications should always check the value of the <code>format</code> parameter and reject transactions which use formats not supported by the application.</p> <p>If the poke transaction is successful, non-nil should be returned, and <code>nil</code> should be returned for failure.</p> |                  |
| See also    | <a href="#">dde-poke</a><br><a href="#">dde-request</a><br><a href="#">dde-server-request</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                  |

**dde-server-request***Generic Function*

Summary      Called when a request transaction is received.

*This chapter applies only to LispWorks for Windows*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                    |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| Package     | <code>win32</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                    |
| Signature   | <code>dde-server-request server topic item &amp;key format &amp;allow-other-keys =&gt; data</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                    |
| Arguments   | <code>server</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A server object.   |
|             | <code>topic</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | A topic object.    |
|             | <code>item</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | A string.          |
|             | <code>format</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A keyword.         |
| Values      | <code>data</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | The returned data. |
| Description | <p>The generic function <code>dde-server-request</code> is called in response to a request transaction. A method specializing on the classes of <code>server</code> and <code>topic</code> should return the data in <code>item</code>. The expected format of the data is given by <code>format</code>, which defaults to <code>:text</code>. The set of supported formats may be extended in future releases, so applications should always check the value of the <code>format</code> parameter and reject transactions which use formats not supported by the application.</p> <p>If the request fails, <code>nil</code> should be returned.</p> |                    |
| See also    | <code>dde-poke</code><br><code>dde-request</code><br><code>dde-server-poke</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                    |

## **dde-server-topic**

## *Generic Function*

|           |                                                                              |
|-----------|------------------------------------------------------------------------------|
| Summary   | Called whenever a client attempts to connect to a server with a given topic. |
| Package   | <code>win32</code>                                                           |
| Signature | <code>dde-server-topic server topic-name =&gt; topic</code>                  |

|             |                                                                                                                                                                                                                                                                                                                                                                                                                             |           |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Arguments   | <i>server</i>                                                                                                                                                                                                                                                                                                                                                                                                               | A server. |
|             | <i>topic-name</i>                                                                                                                                                                                                                                                                                                                                                                                                           | A string. |
| Values      | <i>topic</i>                                                                                                                                                                                                                                                                                                                                                                                                                | A topic.  |
| Description | The generic function <code>dde-server-topic</code> is called whenever a client attempts to make a connection to the server. The argument <i>topic-name</i> is a string identifying a topic. If the server recognizes the topic, a method specializing on the server should return an instance of one of the server's topic classes. If the server does not recognize the topic, the method should return <code>nil</code> . |           |
| See also    | <a href="#">dde-server-topics</a><br><a href="#">dde-topic-items</a>                                                                                                                                                                                                                                                                                                                                                        |           |

## **dde-server-topics** *Generic Function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                    |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| Summary     | Returns a list of the available general topics on a given server.                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                    |
| Package     | <code>win32</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                    |
| Signature   | <code>dde-server-topics server =&gt; topic-list</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                    |
| Arguments   | <i>server</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | A server object.   |
| Values      | <i>topic-list</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | A list of strings. |
| Description | The generic function <code>dde-server-topics</code> returns a list of the available general topics on a given server. A suitable method specializing on the server class should be defined. Dispatching topics (see <code>define-dde-dispatch-topic</code> ) should not be returned, as they are handled automatically by LispWorks. If you do not provide a <code>dde-server-topics</code> method, the default method returns <code>:unknown</code> , which prevents the DDE server from responding to the topics request. |                    |

Generally only one canonical name should be returned for each topic, even though the server may recognize several alternative forms of name for a topic. For example, if an application implements a topic for each open file, the topics `foo`, `foo.doc` and `c:\foo.doc` may all be acceptable strings for referring to the same topic; however `dde-server-topics` should return each topic once only.

The application must also provide a method on the `dde-server-topic` generic function.

See also      `dde-server-topic`  
                  `dde-topic-items`

## **dde-system-topic** *Class*

Summary      A built-in topic class for the `:system` topic.

Package      `win32`

Superclasses    `dde-topic`

Description      The class `dde-system-topic` is a built-in topic class for the `:system` topic.  
  
See “The system topic” on page 329 for details of the items implemented by this topic.

See also      `dde-topic`

## **dde-topic** *Class*

Summary      The ancestor of all topic classes.

Package      `win32`

|              |                                                                                                                                                                                                                                                                                                                                       |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Superclasses | <code>standard-object</code>                                                                                                                                                                                                                                                                                                          |
| Subclasses   | <code>dde-system-topic</code>                                                                                                                                                                                                                                                                                                         |
| Description  | The class <code>dde-topic</code> is the superclass of all topic objects. You can define subclasses using <code>defclass</code> and return instances of them by defining a method for the <code>dde-server-topic</code> generic function. This allows you to create topics with arbitrary internal state that can be accessed via DDE. |
| Examples     | See <code>examples\dde\server-dispatching.lisp</code>                                                                                                                                                                                                                                                                                 |
| See also     | <code>dde-server-topic</code><br><code>dde-system-topic</code>                                                                                                                                                                                                                                                                        |

## **dde-topic-items** *Generic Function*

|             |                                                                                                                                                                                                                                                                                                                                                                      |                    |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| Summary     | Returns the valid items in a topic.                                                                                                                                                                                                                                                                                                                                  |                    |
| Package     | <code>win32</code>                                                                                                                                                                                                                                                                                                                                                   |                    |
| Signature   | <code>dde-topic-items server topic =&gt; item-strings</code>                                                                                                                                                                                                                                                                                                         |                    |
| Arguments   | <code>server</code>                                                                                                                                                                                                                                                                                                                                                  | A server object.   |
|             | <code>topic</code>                                                                                                                                                                                                                                                                                                                                                   | A topic object.    |
| Values      | <code>item-strings</code>                                                                                                                                                                                                                                                                                                                                            | A list of strings. |
| Description | <p>The generic function <code>dde-topic-items</code> returns a list of strings corresponding to the valid items in the topic. A method specializing on a server and topic should be defined.</p> <p>If it is not practical to return a list of the items (for example, if the list is potentially infinite), the generic function returns <code>:unknown</code>.</p> |                    |

See also      **dde-server-topic**  
                **dde-server-topics**

## **define-dde-dispatch-topic** *Macro*

Summary      Defines a dispatch topic.

Package      **win32**

Signature      **define-dde-dispatch-topic name &key server topic-name => name**

Arguments      *name*      A symbol.

*server*      A server class.

*topic-name*      A string.

Values      *name*      A symbol.

Description      The macro **define-dde-dispatch-topic** defines a dispatching topic. A dispatching topic is a topic which has a fixed name and always exists. Dispatching topics provide dispatching capabilities, whereby appropriate application-supplied code is executed for each supported transaction. Note that the server implementation also provides some dispatching capabilities.

The name of the dispatching topic object is specified by *name*.

The topic is identified by the string *topic-name*.

The class of the server to attach the topic to is given by *server*.

The macro **define-dde-dispatch-topic** returns the name of the dispatching topic, *name*.

Use **define-dde-server-function** with the :topic option to define items for a dispatch topic.

|          |                                                                                                                                                                                |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Example  | <pre>(define-dde-dispatch-topic topic1 :server demo-server)  (define-dde-server-function (item1 :topic topic1)     :request     ()     ..handle topic1.item1 request...)</pre> |
| See also | <code>dde-server-topic</code><br><code>dde-server-topics</code><br><code>define-dde-server-function</code>                                                                     |

## **define-dde-server**

*Macro*

|                           |                                                                                                                                                                                                                                                                                                                                                                                                                  |                         |               |                           |           |                           |                         |                         |                                          |                      |                   |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|---------------|---------------------------|-----------|---------------------------|-------------------------|-------------------------|------------------------------------------|----------------------|-------------------|
| Summary                   | Defines a class for a Lisp DDE server.                                                                                                                                                                                                                                                                                                                                                                           |                         |               |                           |           |                           |                         |                         |                                          |                      |                   |
| Package                   | <code>win32</code>                                                                                                                                                                                                                                                                                                                                                                                               |                         |               |                           |           |                           |                         |                         |                                          |                      |                   |
| Signature                 | <code>define-dde-server class-name service-name =&gt; class-name</code><br><br><code>define-dde-server class-name superclasses slot-specs options =&gt; class-name</code>                                                                                                                                                                                                                                        |                         |               |                           |           |                           |                         |                         |                                          |                      |                   |
| Arguments                 | <table border="0"> <tr> <td><code>class-name</code></td> <td>A class name.</td> </tr> <tr> <td><code>service-name</code></td> <td>A string.</td> </tr> <tr> <td><code>superclasses</code></td> <td>A list of superclasses.</td> </tr> <tr> <td><code>slot-specs</code></td> <td>The specifications for the class' slots.</td> </tr> <tr> <td><code>options</code></td> <td>A keyword option.</td> </tr> </table> | <code>class-name</code> | A class name. | <code>service-name</code> | A string. | <code>superclasses</code> | A list of superclasses. | <code>slot-specs</code> | The specifications for the class' slots. | <code>options</code> | A keyword option. |
| <code>class-name</code>   | A class name.                                                                                                                                                                                                                                                                                                                                                                                                    |                         |               |                           |           |                           |                         |                         |                                          |                      |                   |
| <code>service-name</code> | A string.                                                                                                                                                                                                                                                                                                                                                                                                        |                         |               |                           |           |                           |                         |                         |                                          |                      |                   |
| <code>superclasses</code> | A list of superclasses.                                                                                                                                                                                                                                                                                                                                                                                          |                         |               |                           |           |                           |                         |                         |                                          |                      |                   |
| <code>slot-specs</code>   | The specifications for the class' slots.                                                                                                                                                                                                                                                                                                                                                                         |                         |               |                           |           |                           |                         |                         |                                          |                      |                   |
| <code>options</code>      | A keyword option.                                                                                                                                                                                                                                                                                                                                                                                                |                         |               |                           |           |                           |                         |                         |                                          |                      |                   |
| Values                    | <code>class-name</code> A class name.                                                                                                                                                                                                                                                                                                                                                                            |                         |               |                           |           |                           |                         |                         |                                          |                      |                   |
| Description               | <p>The macro <code>define-dde-server</code> defines a class for a Lisp DDE server. The class inherits from <code>dde-server</code>.</p> <p>The long form of the macro is similar to <code>defclass</code>, but with one extra option, <code>:service</code>, which is used to specify the service name string to which this server will respond.</p>                                                             |                         |               |                           |           |                           |                         |                         |                                          |                      |                   |

The short form is provided to handle the common simple case; *class-name* is the name of the Lisp class to be defined, and *service-name* is the service name string to which this server will respond.

- Example      The first example uses the short version of `define-dde-server` to define a class, called `lisp-server`, which has the service name “LISP”.

```
(define-dde-server lisp-server "LISP")
```

The second example shows how to use the long form of the macro to define the same class, and illustrates the use of the *superclasses* and *options* arguments.

```
(define-dde-server lisp-server (dde-server)
  ())
  (:service "LISP"))
```

- See also      `dde-server-topic`  
                 `dde-server-topics`  
                 `dde-topic-items`

## **define-dde-server-function** *Macro*

- Summary      Defines a server function that is called when a specific transaction occurs.

- Package      `win32`

- Signature      `define-dde-server-function name-and-options transaction  
(binding*) form* => name`  
  
`name-and-options ::= name | (name [[option]])`  
  
`transaction ::= :request | :poke | :execute`  
  
`option ::= :server server | :topic-class topic-class | :topic  
topic | :item item | :format format | :command command |  
:result-type result-type | :advisep advisep`

```

binding ::= var-binding | execute-arg-binding

var-binding ::= (var :server) | (var :topic) | (var :data
[data-type] ) | (var :format)

execute-arg-binding ::= var | (var type-spec)

```

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                   |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|
| Arguments   | <i>name</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | A symbol.                         |
|             | <i>transaction</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | A keyword.                        |
|             | <i>server</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | A server object.                  |
|             | <i>topic-class</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | A topic class.                    |
|             | <i>topic</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | A symbol naming a dispatch topic. |
|             | <i>item</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | A string.                         |
|             | <i>format</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | A keyword.                        |
|             | <i>command</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A string.                         |
|             | <i>result-type</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | A data type.                      |
|             | <i>advisep</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | A boolean.                        |
|             | <i>var</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | A variable.                       |
|             | <i>data-type</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | A data type.                      |
|             | <i>type-spec</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | A data type.                      |
|             | <i>form</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | A Lisp form.                      |
| Values      | <i>name</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | A symbol.                         |
| Description | <p>The macro <b>define-dde-server-function</b> is used to define a server function, called <i>name</i>, which is called when a specific transaction occurs. The defined function may either be attached to a server class (using the dispatching capabilities built into the server implementation) or to a named dispatch topic.</p> <ul style="list-style-type: none"> <li>• To attach the definition to a server, <b>:server</b> should be used to specify the server class. <b>:topic-class</b> may be used to specify the topic-class for which this definition</li> </ul> |                                   |

should be used. It can be a symbol which names a `topic-class`, or `t` (meaning All topics, this is the default for execute transactions), or `:system` (The System topic), or `:non-system` (any topic except the System topic). In the case of execute transactions only, `:topic-class` defaults to `t`; in all other cases, it must be specified. Typically, execute transactions ignore the topic of the conversation. Alternatively, you may choose to only support execute transactions in the system topic.

- A server function may instead be attached to a particular instance of `dde-dispatch-topic`, previously defined by `define-dde-dispatch-topic`. This is the main use of dispatching topics. In this case `:topic` should be provided with a symbol that names a dispatching topic. The function is installed on that topic, and only applies to that topic.

In the case of a request or poke transaction, `item` is a string defining the item name for which this definition should be invoked. It defaults to the capitalized print-name of `name`, with hyphens removed.

For request transactions, the `:format` option is used to specify the format understood. It defaults to `:text`. It can be specified as `:all`, in which case the `:format` binding may be used to determine the actual format requested (see below).

In the case of an execute transaction, `command` is a string specifying the name of the command for which this definition should be invoked. It defaults to the capitalized print-name of `name`, with hyphens removed.

The `execute-arg-bindings` are only used with execute transactions. They specify the arguments expected. `type-spec` should be one of `t`, `string`, `number`, `integer` or `float`. If not specified, `t` is assumed.

The `var-bindings` may appear anywhere in the binding list, and in any order. Binding variables to `:server` and `:topic` is

useful with all transaction types. A `:server` binding causes the variable to be bound to the server object, whereas a `:topic` binding causes the variable to be bound to the topic object. This allows the server and/or the topic to be referred to in the body of the function.

A `:format` binding can only be used with request and poke transactions, where an *option* of `:format :all` has been specified. It causes the variable specified by `var` to be bound to the format of data requested or supplied. The body of the defined function should fail the transaction if it does not support the requested format.

A `:data` binding can only be used with poke transactions. It binds a variable to the data to be poked. For text transfers, the data variable is normally bound to a string. However, if `datatype` is specified as `:string-list`, the data in the transaction is interpreted as a tab-separated list of strings, and the data variable is bound to a list of strings.

For execute and poke transactions, the body of the defined function is expected to return `t` for success and `nil` for failure.

For request transactions, the body of the defined function is normally expected to return a result value, or `nil` for failure.

The `result-type` option may only be specified for request transactions. If it is specified as `:string-list`, then for text requests the body is expected to return a list of strings, which are used to create a tab-separated list to be returned to the client.

Sometimes, it may be necessary to support returning `nil` to mean the empty list, rather than failure. In this case, the `result-type` can be specified as `(:string-list t)`. The body is then expected to return two values: a list of strings, and a flag indicating success.

In the case of execute transactions, the command name and arguments are unmarshalled by the default argument

unmarshalling. This is compatible with the default argument unmarshalling described under `dde-execute-command`. The execute string is expected to be of the following syntax:

```
[command1(arg1,arg2,...)] [command2(arg1,arg2,...)] ...]
```

Note that multiple commands may be packed into a single execute transaction. However, `dde-execute-command` does not currently generate such strings.

See also

`dde-execute-command`  
`define-dde-client`  
`define-dde-dispatch-topic`  
`define-dde-server`

**start-dde-server** *Function*

Summary      Creates and starts an instance of a DDE server.

Package      `win32`

Signature      `start-dde-server name => server`

Arguments      `name`      A DDE server class

Values      `server`      A server object

Description      The function `start-dde-server` creates an instance of a server of the class specified by `name` which then starts accepting transactions. If successful the function returns the server, otherwise `nil` is returned.

You need to call `start-dde-server` in a thread that will process Windows messages. This can either be done by using `capi:execute-with-interface` to run it in the thread of an application's main window (if there is one) or by running it in a dedicated thread as in the example. DDE callbacks will happen in this thread.

## Example

```
(mp:process-run-function
  "DDE Server"
  ()
  #'(lambda ()
      (win32:start-dde-server 'lispworks-dde-server)
      (loop
        (mp:wait-processing-events
         nil
         :wait-reason "DDE Request Loop"))))
```

## See also

**define-dde-server**

# 54

---

## Dynamic library C functions

This chapter describes the C functions available in a LispWorks dynamic library, that is a library created by passing *dll-exports* or *dll-added-files* to **save-image** or **deliver**.

For an overview of this functionality with examples of use, see Chapter 14, “LispWorks as a dynamic library”.

**Note:** this chapter applies only to LispWorks on Microsoft Windows, Macintosh, Linux, x86/x64 Solaris and FreeBSD.

### **InitLispWorks** *C function*

**Summary** Provides control over the initialization of a LispWorks dynamic library.

**Signature** On Windows:

```
int __stdcall InitLispWorks (int MilliTimeOut, void  
*BaseAddress, size_t ReserveSize)
```

On Linux, Macintosh, x86/x64 Solaris and FreeBSD:

```
int InitLispWorks (int MilliTimeOut, void *BaseAddress,  
size_t ReserveSize)
```

**Description** The C function `InitLispWorks` allows you to relocate a LispWorks dynamic library if this is necessary, and offers control of the initialization process.

A LispWorks dynamic library is automatically initialized by any call to its exported symbols, so in most cases there is no need to call `InitLispWorks`. It is however necessary when you need to relocate LispWorks or when you need finer control over the initialization process.

For more information about relocating a LispWorks dynamic library, see “Startup relocation” on page 459)

*MilliTimeOut* specifies the time in milliseconds to wait for LispWorks to finish initializing before returning. `InitLispWorks` checks whether the library was initialized and if not initiates initialization. It then waits at most *MilliTimeOut* milliseconds before returning.

*BaseAddress* specifies the base address for relocation. Can be 0.

*ReserveSize* specifies the reserve size for relocation. Can be 0.

*BaseAddress* and *ReserveSize* are interpreted as described in “Startup relocation” on page 459.

Non-negative return values indicate success:

1           LispWorks was already initialized or in the process of initializing, and finished initializing by the time `InitLispWorks` returned.

0           `InitLispWorks` initialized LispWorks and the initialization finished successfully.

Values in the inclusive range [-1, -99] indicate a timeout:

-1           `InitLispWorks` started initialization and timed out before LispWorks finished mapping itself from the file.

- 2 LispWorks already started initialization, and `InitLispWorks` timed out before LispWorks finished mapping itself from the file.
- 3 `InitLispWorks` started initialization and timed out after LispWorks mapped itself from the file, but before the initialization was complete.
- 4 LispWorks already started initialization, and `InitLispWorks` timed out before after LispWorks mapped itself from the file, but before the initialization was complete.

After `InitLispWorks` times out, the state of LispWorks can be queried by `LispWorksState`.

Lower values indicate failure, as follows:

- 1000 Failure to start a thread to do the initialization.
- 1401 The file seems to be corrupted.
- 1402 Failure to map into memory.
- 1403 Failure to read the LispWorks header from the file.
- 1406 Bad base address.

Additionally, a value *value* in the inclusive range [-1400, -1001] on Linux, Macintosh, FreeBSD and x86/x64 Solaris platforms indicates an error in a system call. Calculate the errno number by -1001 - *value*.

**Note:** If LispWorks is already initialized or in the process of being initialized, `InitLispWorks` does not initiate the process of initialization. Therefore the arguments to `InitLispWorks` have no effect if LispWorks was already initialized when it is called. On Microsoft Windows, the default behavior is to initialize a LispWorks dynamic library automatically during loading, so this needs to be disabled to use

**InitLispWorks** effectively. Disable automatic initialization of a library as described for **deliver** and **save-image**.

**Note:** Once **QuitLispWorks** has returned 0, LispWorks can be initialized again. It is possible to quit and restart Lisp-Works several times, at the same address or at a different address.

**Note:** On Linux, Macintosh, FreeBSD and x86/x64 Solaris you can create wrappers to the C functions described in this chapter from your application by writing them in C and adding them to the dynamic library using *dll-added-files* in **deliver** and **save-image**. Such wrappers can be used to add calls to **InitLispWorks** before actually calling into Lisp.

**InitLispWorks** is defined in each LispWorks dynamic library. For information about creating a LispWorks dynamic library, see **deliver** and **save-image**. For an overview of LispWorks as a dynamic library, see Chapter 14, “LispWorks as a dynamic library”.

#### See also

**deliver**  
**LispWorksState**  
**save-image**  
**QuitLispWorks**

## LispWorksDlsym

### *C function*

Summary      Returns the address of a foreign callable.

Signature      On Windows:

```
void __stdcall *LispWorksDlsym (const char * name)
```

On Linux, Macintosh, FreeBSD and x86/x64 Solaris:

```
void *LispWorksDlsym (const char * name)
```

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | <p>The C function <code>LispWorksDlsym</code> returns the address of a foreign callable <i>name</i> which is defined in Lisp using <code>fli:define-foreign-callable</code>.</p> <p><code>LispWorksDlsym</code> first checks whether the LispWorks dynamic library finished initializing, and if not uses <code>InitLispWorks</code> to initialize it (with <i>MilliTimeOut</i> 200). If this fails <code>LispWorksDlsym</code> returns NULL. When the LispWorks dynamic library is initialized, <code>LispWorksDlsym</code> returns the address of <i>name</i>, or NULL if it is not defined.</p> <p><code>LispWorksDlsym</code> is defined in each LispWorks dynamic library. For information about creating a LispWorks dynamic library, see <code>deliver</code> and <code>save-image</code>. For an overview of LispWorks as a dynamic library, see Chapter 14, “LispWorks as a dynamic library”.</p> |
| See also    | <code>InitLispWorks</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

## LispWorksState *C function*

|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summary     | Returns the state of a LispWorks dynamic library.                                                                                                                                                                                                                                                                                                                                                                                                          |
| Signature   | <p>On Windows:</p> <pre>int __stdcall LispWorksState (int MilliTimeOut)</pre> <p>On Linux, Macintosh, FreeBSD and x86/x64 Solaris:</p> <pre>int LispWorksState (int MilliTimeOut)</pre>                                                                                                                                                                                                                                                                    |
| Description | <p>The C function <code>LispWorksState</code> returns the state of a LispWorks dynamic library.</p> <p><i>MilliTimeOut</i> specifies the time to wait in milliseconds if LispWorks is in the process of initialization.</p> <p>If LispWorks has not been initialized, or has been quit by <code>QuitLispWorks</code>, <code>LispWorksState</code> returns -100. Otherwise, it returns the same values as <code>InitLispWorks</code>. In particular, if</p> |

LispWorks is already properly initialized it returns 1, and if LispWorks is still in the process of initialization it returns -2 or -4. Otherwise it returns a more negative number indicating an error.

`LispWorksState` is defined in each LispWorks dynamic library. For information about creating a LispWorks dynamic library, see `deliver` and `save-image`. For an overview of LispWorks as a dynamic library, see Chapter 14, “LispWorks as a dynamic library”.

See also      [\*\*InitLispWorks\*\*](#)  
[\*\*QuitLispWorks\*\*](#)

## **SimpleInitLispWorks** *C function*

Summary      Initializes a LispWorks dynamic library.

Signature      On Windows:

```
int __stdcall SimpleInitLispWorks (void)
```

On Linux, Macintosh, FreeBSD and x86/x64 Solaris:

```
int SimpleInitLispWorks (void)
```

Description      The C function `SimpleInitLispWorks` calls `InitLispWorks(0,0,0)` and returns the value of that call. `SimpleInitLispWorks` is defined in each LispWorks dynamic library. For information about creating a LispWorks dynamic library, see `deliver` and `save-image`. For an overview of LispWorks as a dynamic library, see Chapter 14, “LispWorks as a dynamic library”.

See also      [\*\*InitLispWorks\*\*](#)

## QuitLispWorks

*C function*

Summary     Allows a LispWorks dynamic library to be unloaded.

Signature    On Windows:

```
int __stdcall QuitLispWorks(int Force, int MilliTimeOut)
```

On Linux, Macintosh, FreeBSD and x86/x64 Solaris:

```
int QuitLispWorks(int Force, int MilliTimeOut)
```

Description    The C function `QuitLispWorks` allows a LispWorks dynamic library to be unloaded. You should make a LispWorks dynamic library 'quit' by calling `QuitLispWorks` before unloading the library. This call causes LispWorks to cleanup everything it uses, in particular the memory and threads.

In general, `QuitLispWorks` should be called only when the LispWorks dynamic library is idle. That is, when there is no callback into the library that has not returned, and there are no processes that has started by a callback. All callbacks should return, and any processes should be killed before calling `QuitLispWorks`.

*Force* should be 0 or 1. It specifies whether to force quitting even if LispWorks is still executing something.

*MilliTimeOut* specifies how long to wait for LispWorks to complete the cleanup.

If LispWorks is idle, `QuitLispWorks` signals it to quit, and waits *MilliTimeOut* milliseconds for it to finish the cleanup. If LispWorks finished cleanup, `QuitLispWorks` return 0 (SUCCESS). If the cleanup is not finished it returns -2 (TIMEOUT).

If LispWorks is not idle, that is there are still some active callbacks or there are processes that have started by a callback (even if they are inside `process-wait`), `QuitLispWorks` checks the value of *Force*. If *Force* is 0, `QuitLispWorks` returns -1 (NOT\_IDLE). If *Force* is 1, `QuitLispWorks` signals it to quit and behaves as if LispWorks is idle, described above.

`QuitLispWorks` can be called repeatedly to check whether LispWorks finished the cleanup.

When `QuitLispWorks` returns NOT\_IDLE, it has done nothing, and the LispWorks dynamic library can be used for further callbacks. Once `QuitLispWorks` returns any other value, callbacks into the dynamic library will result in undefined behavior.

Once `QuitLispWorks` returns SUCCESS, it is safe to unload the dynamic library. Unloading it before `QuitLispWorks` returns SUCCESS gives undefined results.

Once `QuitLispWorks` returns SUCCESS, LispWorks can be initialized again. Calling any exported function (supplied to `save-image` or `deliver` in *dll-exports*) or any of `InitLispWorks`, `SimpleInitLispWorks` and `LispWorksDlsym` will cause LispWorks to initialize again.

**Note:** On Linux, Macintosh, FreeBSD and x86/x64 Solaris it is possible to add calls to `QuitLispWorks` at the right places via *dll-added-files*.

**Note:** A possible reason for failure to finish the cleanup is that a LispWorks process is stuck inside a foreign call. Dynamic library applications that need to be unloaded should be careful to ensure that they do not get stuck in a foreign function call.

`QuitLispWorks` is defined in each LispWorks dynamic library. For information about creating a LispWorks dynamic library, see `deliver` and `save-image`. For an overview of LispWorks as a dynamic library, see Chapter 14, “LispWorks as a dynamic library”.

See also

`deliver`  
`dll-quit`  
`save-image`

---

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# Index

## Symbols

`!` 188  
`-` 552  
`:<` debugger command 15  
`$`(dollar) variable 38  
`$$` variable 38  
`$$$` variable 38  
`:>` debugger command 15  
`>` SQL operator 363  
`:?` listener command 7  
`[...]` syntax in Common SQL 359

## Numerics

`16-bit-string` type 1082  
`8-bit-string` type 1081

## A

`:a` debugger command 20  
`abort` restart 12  
`accepting-handle` type 517  
`accepting-handle-collection` function 518  
`accepting-handle-local-port` function 520  
`accepting-handle-name` function 519  
`accepting-handle-socket` function 520  
`accepting-handle-user-info` function 521  
`accepts-n-syntax` function 1527  
`accept-tcp-connections-creating-async-io-states` function 412, 416, 422, 513  
`accessor-method-slot-defini-`

`tion` generic function 250  
`accessors`  
`code-coverage-data-create-time` 870  
`code-coverage-data-name` 870  
`code-coverage-file-stats-called` 879  
`code-coverage-file-stats-counters-count` 879  
`code-coverage-file-stats-counters-executed` 879  
`code-coverage-file-stats-counters-hidden` 879  
`code-coverage-file-stats-fully-covered` 879  
`code-coverage-file-stats-hidden-covered` 879  
`code-coverage-file-stats-lambdas-count` 879  
`code-coverage-file-stats-not-called` 879  
`code-coverage-file-stats-partially-covered` 879  
`code-coverage-file-stats-source-file` 879  
`dde-item` 1957  
`dde-item*` 1958  
`fdf-handle-directory-p` 930  
`fdf-handle-directory-string` 930  
`fdf-handle-last-access` 930  
`fdf-handle-last-modify` 930  
`fdf-handle-link-p` 930  
`fdf-handle-size` 930  
`fdf-handle-writable-p` 930  
`field-access-exception-set-`

p 1236  
**field-exception-class-**  
 name 1237  
**field-exception-field-**  
 name 1237  
**java-array-error-array** 1263  
**java-array-error-caller** 1263  
**java-array-indices-error-**  
 indices 1264  
**java-array-indices-error-**  
 rank 1264  
**java-bad-object-caller** 1265  
**java-bad-object-object** 1265  
**java-definition-error-**  
 class-name 1266  
**java-definition-error-**  
 name 1266  
**java-exception-exception-**  
 name 1268  
**java-exception-java-**  
 backtrace 1268  
**java-exception-string** 1268  
**java-field-error-field-**  
 name 1266  
**java-field-error-static-**  
 p 1266  
**java-field-setting-error-**  
 class-name 1269  
**java-field-setting-error-**  
 class-name-for-  
 setting 1269  
**java-field-setting-error-**  
 field-name 1269  
**java-field-setting-error-**  
 new-value 1269  
**java-instance-jobject** 219,  
 1316  
**java-method-error-args-**  
 num 1266  
**java-method-error-method-**  
 name 1266  
**java-method-exception-**  
 args 1272  
**java-method-exception-**  
 class-name 1272  
**java-method-exception-**  
 method-name 1272  
**java-method-exception-**  
 name 1272  
**lob-stream-lob-locator** 1578  
**socket-stream-socket** 613  
**sql-database-data-error** 1644  
  
**sql-error-database-**  
 message 1644  
**sql-error-secondary-error-**  
 id 1644  
**storage-exhausted-gen-**  
 num 1885  
**storage-exhausted-size** 1885  
**storage-exhausted-**  
 static 1885  
**storage-exhausted-type** 1885  
**stream-read-timeout** 613  
**stream-write-timeout** 613  
action lists 95  
defining 96  
examples 97  
undefining 96  
**\*active-finders\*** variable 791  
**add-code-coverage-data**  
function 839  
adding actions to action lists 96  
**addMessage** Java method 1352  
**add-method** generic function 251  
address space  
in 32-bit LispWorks 458, 460  
in 64-bit LispWorks 461, 477  
**add-special-free-action**  
function 164, 841  
**add-sql-stream** function 372, 1528  
**add-symbol-profiler** function 842  
**adjust-array** function 266  
advice  
after 65  
around 65  
before 65  
example of use 70  
facility 63  
for macros 67  
for methods 67  
main chapter 63, 75  
removing 66  
after advice 65  
**:after** keyword 50  
**:all** debugger command 18  
**:all** keyword 309  
**allocated-in-its-own-segment-p** function 1715  
**:allocation** keyword 55  
allocation of stacks 164, 1738  
**allocation-in-gen-num**  
macro 137, 146, 843  
**allowing-block-interrupts**  
macro 289, 1359

**analysing-special-variables-**  
  **usage** macro 844  
**Android interface**  
  Java side 1339  
  Lisp side 223, 224  
  overview 223  
**Android runtimes**  
  creating 224  
  example 227  
**android-build-value** function 848  
**android-funcall-in-main-**  
  **thread** function 849  
**android-funcall-in-main-**  
  **thread-list** function 849  
**android-get-current-activity**  
  function 851  
**android-main-thread-p**  
  function 852  
**ANSI**  
  Common Lisp 252, 351  
  SQL mode 334, 375  
**ANSI Common Lisp Standard**  
  menu command 639  
**ANSI\_QUOTES**  
  SQL mode 375  
**any** SQL operator 363  
**any-capi-window-displayed-p**  
  function 853  
**any-other-process-non-inter-**  
  **nal-server-p** function 1361  
**appendf** macro 1083  
**append-file** function 1082  
**apply-in-pane-process**  
  function 267  
**apply-in-wait-state-collec-**  
  **tion-process** function 411,  
  522  
**apply-with-allocation-in-**  
  **gen-num** function 147, 1716  
**approaching-memory-limit**  
  condition 1717  
**apropos** function 639  
**apropos-list** function 640  
**argument list** 1137  
**arguments**  
  command line 454  
  lisp function 1137  
**arguments for traced functions** 50  
**around advice** 65  
**array-dimension-limit**  
  constant 479  
**array-single-thread-p**  
  function 854  
**array-total-size-limit**  
  constant 479  
**array-weak-p** function 854  
**ASCII** 444, 447  
**:ascii** external format 444  
**ASDF** 306, 311  
**ASDF2** 306, 311  
**async-io-state** structure type 412,  
  523  
**async-io-state-abort**  
  function 413, 417, 523  
**async-io-state-abort-and-**  
  **close** function 417, 525  
**async-io-state-address**  
  function 526  
**async-io-state-attach-ssl**  
  function 422, 425, 526  
**async-io-state-buffered-**  
  **data-length** function 414,  
  528  
**async-io-state-collection**  
  function 530  
**async-io-state-ctx** function 431,  
  529  
**async-io-state-detach-ssl**  
  function 425, 529  
**async-io-state-discard**  
  function 413, 417, 531  
**async-io-state-finish**  
  function 413, 417, 532  
**async-io-state-get-buffered-**  
  **data** function 414, 417, 533  
**async-io-state-handshake**  
  function 534  
**async-io-state-max-read**  
  function 535  
**async-io-state-name** function 536  
**async-io-state-object**  
  function 536  
**async-io-state-old-length**  
  function 537  
**async-io-state-peer-address**  
  function 538  
**async-io-state-read-buffer**  
  function 413, 416, 538  
**async-io-state-read-status**  
  function 540  
**async-io-state-read-timeout**  
  function 541  
**async-io-state-read-with-**  
  **checking** function 413, 416,

**542**  
**async-io-state-receive-mes-**  
 sage function 413, 416, 545  
**async-io-state-send-message**  
 function 413, 416, 547  
**async-io-state-send-message-**  
 to-address function 413, 416,  
 549  
**async-io-state-ssl** function 431,  
 551  
**async-io-state-ssl-side**  
 function 431, 551  
**async-io-state-user-info**  
 function 412, 553  
**async-io-state-write-buffer**  
 function 413, 416, 552  
**async-io-state-write-status**  
 function 540  
**async-io-state-write-timeout**  
 function 541  
**at-location** macro 792  
**atomic-decf** macro 1718  
**atomic-exchange** macro 1719  
**atomic-fixnum-decf** macro 1719  
**atomic-fixnum-incf** macro 1719  
**atomic-incf** macro 1718  
 atomicity and thread-safety  
   in CAPI 267  
   in the editor 266  
   in the LispWorks implementation 265  
**atomic-pop** macro 1720  
**atomic-push** macro 1721  
**attach-ssl** function 420, 422, 554  
**attribute-type** function 353, 1529  
**augmented-string** type 1722  
**augmented-string-p** function 1722  
**augment-environment** function 855  
**\*autoload-asdf-integration\***  
   variable 1083  
**avoid-gc** function 146, 857

**B**

**:b** debugger command 14  
**\*background-input\*** variable 858  
**\*background-output\*** variable 858  
**\*background-query-io\***  
   variable 858  
**backtrace** 13  
   quick backtrace 14  
   verbose backtrace 14  
**:backtrace** keyword 52  
**barrier** system class 1362

**barrier-arriver-count**  
   function 1362  
**barrier-block-and-wait**  
   function 1363  
**barrier-change-count**  
   function 1366  
**barrier-count** function 1367  
**barrier-disable** function 287, 1368  
**barrier-enable** function 287, 1368  
**barrier-name** function 1369  
**barrier-pass-through**  
   function 1370  
**barrier-unblock** function 1370  
**barrier-wait** function 287, 1372  
**base slot** 354  
**base-char** type 436, 1084  
**base-character** type 1084  
**base-character-p** function 1084  
**base-char-code-limit**  
   constant 1085  
**base-char-p** function 1085  
**base-char-ref** function 1821  
**base-string** type 438, 641  
**base-string-p** function 1086  
**:base-table** class option 1554  
**before advice** 65  
**:before** keyword 49  
**binary files** 101  
**\*binary-file-type\*** variable 649,  
 1723  
**\*binary-file-types\*** variable 649,  
 1723  
**:bindings** keyword 757  
**binds-who** function 860  
**block-promotion** macro 861  
**:bmp** external format 444, 827  
**bmp-char** type 436, 1086  
**bmp-char-p** function 1087  
**:bmp-native** external format 446, 827  
**:bmp-reversed** external format 446,  
 827  
**bmp-string** type 438, 1088  
**bmp-string-p** function 1089  
**BOM** 448, 450  
**Bordeaux threads**  
   APIs needed for 1447  
**:bq** debugger command 15  
**:break** keyword 51  
**break-new-instances-on-**  
   access function 485  
**break-on-access** function 486  
**:break-on-exit** keyword 51

**break-on-unresolved-functions** function 1075  
**browser** 1089  
**\*browser-location\*** variable 1089  
**browsing** documentation 1089  
**buffered-stream** class 1681  
**:bug-form** listener command 7  
**BugFormLogsList** Java class 1357  
**BugFormViewer** Java class 1357  
**building-universal-intermediate-p** function 862  
**byte order**  
  big-endian architectures 1069  
  little-endian architectures 1069  
**Byte Order Mark** 448, 450

**C**

**:c** debugger command 20  
**C functions**  
  **dlopen** 191  
  **dlsym** 191  
  **GetProcAddress** 191  
  **InitLispWorks** 194, 460, 1985  
  **LispWorksDlsym** 1988  
  **LispWorksState** 194, 1989  
  **LoadLibrary** 191  
  **QuitLispWorks** 195, 1991  
  **SimpleInitLispWorks** 1990  
**cache-table-queries** function 349, 1531  
**\*cache-table-queries-default\*** variable 1532  
**call** Unix functions from Lisp 462  
**callDoubleA** Java method 1332  
**callDoubleV** Java method 1332  
**calling AppleScript** 1725  
**callIntA** Java method 1332  
**CallIntV** Java method 1332  
**call-java-method** function 1209  
**call-java-method-error**  
  condition 1210  
**call-next-advice** function 66, 73, 1090  
**callObjectA** Java method 1332  
**callObjectV** Java method 1332  
**calls-who** function 863  
**call-system** function 1724  
**call-system-showing-output**  
  function 1727  
**callVoidA** Java method 1332  
**callVoidV** Java method 1332  
**call-wait-state-collection**  
  function 411, 413, 556  
**canonicalize-dspec** function 793  
**canonicalize-sid-string**  
  function 1895  
**catch frame**, examining 12  
**:catchers** keyword 760  
**catching-exceptions-bind**  
  macro 1211  
**catching-java-exceptions**  
  macro 1211  
**:caused-by** keyword 309  
**:cc** debugger command 18  
**cd** macro 864  
**cdr-assoc** function 1730  
**change-directory** function 187, 864  
**change-process-priority**  
  function 295, 1375  
**character** type 436  
**character types** 436  
**char-external-code** function 833  
**checked-read-java-field**  
  function 1302  
**check-fragmentation** function 145, 146, 865  
**check-java-field** function 1302  
**check-lisp-calls-initialized**  
  function 1213  
**checkLispSymbol** Java method 1334  
**\*check-network-server\***  
  variable 1731  
**choose-unicode-string-hash-function** function 1092  
**class options**  
  parsing of 495  
  **:base-table** 1554  
  **:extra-initargs** 487, 489, 658  
  **:optimize-slot-access** 250, 253, 504, 658  
**classes**  
  **buffered-stream** 1681  
  **dde-system-topic** 1975  
  **dde-topic** 1975  
  **eql-specializer** 250  
  **funcallable-standard-object** 494  
  **fundamental-binary-input-stream** 1683  
  **fundamental-binary-output-stream** 1684  
  **fundamental-binary-stream** 1684  
  **fundamental-character-**

**input-stream** 1685  
**fundamental-character-out-**  
  **put-stream** 1686  
**fundamental-character-**  
  **stream** 1687  
**fundamental-input-**  
  **stream** 1687  
**fundamental-output-**  
  **stream** 1688  
**fundamental-stream** 1688  
**lob-stream** 380, 384, 389, 1577  
**method-combination** 251  
**socket-error** 612  
**socket-stream** 418, 422, 612  
**ssl-closed** 431, 623  
**ssl-condition** 431, 623  
**ssl-error** 431, 624  
**ssl-failure** 431, 624  
**ssl-x509-lookup** 431, 626  
**standard-accessor-method** 250  
**standard-db-object** 354, 1666  
**standard-java-object** 1315  
**standard-reader-method** 250  
**standard-writer-method** 250  
**storage-exhausted** 1884  
**wait-state-collection** 411, 636  
**class-extra-initargs** generic  
  function 487  
**clean-down** function 136, 163, 866  
**clean-generation-0** function 146,  
  868  
**clearBugFormLogs** Java method 1350  
**clear-code-coverage** function 869  
**client-remote-debugging** system  
  class 765  
**CLOS Metaobject Protocol**  
  menu command 249  
**close** generic function 641  
**close-accepting-handle**  
  function 557  
**close-async-io-state**  
  function 414, 415, 417, 558  
**close-registry-key** function 468,  
  1923  
**close-remote-debugging-con-**  
  nection function 36, 729  
**close-serial-port** function 1519  
**close-wait-state-collection**  
  function 411, 559  
**:clos-initarg-checking** delivery  
  keyword 501  
**Cocoa application** 1397  
**Cocoa application bundle**  
  saving 179  
**Cocoa event loop** 1397  
**Code Coverage**  
  HTML output 875  
  HTML output index file 876  
  Source files HTML coloring 877  
**code coverage** 119  
**Code Coverage Current Buffer**  
  Editor command 883  
**Code Coverage File Editor**  
  command 883  
**code signing**  
  in saved image 1006  
**code-coverage-data** type 870  
**code-coverage-data-create-**  
  time accessor 870  
**code-coverage-data-generate-**  
  coloring-html function 871  
**code-coverage-data-generate-**  
  statistics function 877  
**code-coverage-data-name**  
  accessor 870  
**code-coverage-file-stats**  
  type 879  
**code-coverage-file-stats-**  
  called accessor 879  
**code-coverage-file-stats-**  
  counters-count  
  accessor 879  
**code-coverage-file-stats-**  
  counters-executed  
  accessor 879  
**code-coverage-file-stats-**  
  counters-hidden  
  accessor 879  
**code-coverage-file-stats-**  
  fully-covered accessor 879  
**code-coverage-file-stats-**  
  hidden-covered  
  accessor 879  
**code-coverage-file-stats-**  
  lambdas-count accessor 879  
**code-coverage-file-stats-**  
  not-called accessor 879  
**code-coverage-file-stats-**  
  partially-covered  
  accessor 879  
**code-coverage-file-stats-**  
  source-file accessor 879  
**code-coverage-set-editor-**  
  colors function 881

**code-coverage-set-editor-**  
  **default-data** function 883  
**code-coverage-set-html-back-**  
  **ground-colors** function 884  
**code-page** external format 443  
**coerce** function 642  
**coerce-to-gesture-spec**  
  function 1731  
**\*coff-loading-verbose\*** 1080  
**collect-generation-2**  
  function 144, 146, 885  
**collect-highest-generation**  
  function 146, 886  
**collect-registry-subkeys**  
  function 468, 1924  
**collect-registry-values**  
  function 468, 1925  
**command line** 454  
**command line arguments** 1795  
  **-build** 454  
  **-display** 455  
  **-env** 455  
  **-environment** 455  
  **-eval** 455  
  **-IIOPhost** 455  
  **-IIOPnumeric** 456  
  **-init** 456  
  **-load** 456  
  **-lw-no-redirection** 456  
  **-multiprocessing** 456  
  **-no-restart-function** 456  
  **-ORBport** 457  
  **--relocate-image** 457  
  **--reserve-size** 457  
  **-siteinit** 457  
**command line processing** 1795  
**commands**  
  **listener** 1740  
  **top level** 1740  
**commit** function 348, 350, 382, 1532  
**Common Lisp**  
  systems. *See system*  
**Common SQL**  
  [...] syntax 359  
  case of names 374  
  database connection 338  
  database encoding 375  
  date fields 370, 378  
  encoding 339  
  errors 372  
  Functional DDL 353  
  Functional DML 346  
  functional interface 346  
  I/O recording 372  
  initialization 334  
  iteration 358  
  main chapter 331  
  Object Oriented DDL 355  
  Object Oriented DML 357  
  object-oriented interface 354  
  ODBC compliance 333  
  programmatic interface 368  
  result types 347, 377  
  supported databases 333  
  symbolic syntax 358  
  transaction handling 339, 350, 377  
  utilities 370  
**Common SQL errors**  
  **sql-connection-error** 373  
  **sql-database-data-error** 372  
  **sql-database-error** 372  
  **sql-fatal-error** 373  
  **sql-temporary-error** 372  
  **sql-timeout-error** 373  
  **sql-user-error** 372  
**compare-and-swap** macro 1733  
**compilation-speed** 105  
**Compile Buffer** Editor command 120  
**Compile File** Editor command 120  
**compile** function 643  
**compile-file** function 645  
**compile-file-if-needed**  
  function 887  
**compiler**  
  comparison with interpreter 101  
  control 104  
  levels of safety 105  
  main chapter 101  
  optimization of 104-108  
  workings of 103  
**compiler explanations** 111, 651  
**compiler help** 111, 651  
**\*compiler-break-on-error\***  
  variable 887  
**compile-system** function 306, 1092  
**compiling**  
  arbitrary forms 103  
  functions 102  
  source files 103  
**compute-applicable-methods-**  
  **using-classes** generic  
  function 251  
**compute-class-potential-initargs** generic function 488

**compute-discriminating-function** generic function 251, 490  
**compute-effective-method-function-from-classes** generic function 490  
**concatenate** function 650  
**concatenate-system** function 1094  
 Condition variables 285  
 Conditionalization  
     LispWorks architectures 675  
     LispWorks implementations 672  
     LispWorks versions 674  
 Conditionalization for LispWorks  
     versions 674  
 Conditionalization for the LispWorks  
     architectures 675  
 Conditionalization for the LispWorks  
     implementations 672  
 conditions  
     **approaching-memory-limit** 1717  
     **call-java-method-error** 1210  
     **create-java-object-error** 1217  
     **external-format-error** 835  
     **fasl-error** 929  
     **field-access-exception** 1236  
     **field-exception** 1237  
     **file-encoding-resolution-error** 1751  
     **java-array-error** 1263  
     **java-array-indices-error** 1263  
     **java-array-simple-error** 1265  
     **java-bad-object** 1265  
     **java-class-error** 1266  
     **java-definition-error** 1266  
     **java-exception** 1267  
     **java-field-error** 1266  
     **java-field-setting-error** 1268  
     **java-id-exception** 1269  
     **java-instance-without-job-object-error** 1270  
     **java-interface-error** 1270  
     **java-low-level-exception** 1271  
     **java-method-error** 1266  
     **java-method-exception** 1271  
     **java-normal-exception** 1272  
     **java-not-a-java-object-error** 1273  
  
**java-not-an-array-error** 1274  
**java-out-of-bounds-error** 1276  
**java-serious-exception** 1278  
**java-storing-wrong-type-error** 1276  
**sql-connection-error** 1643  
**sql-database-data-error** 1643  
**sql-database-error** 1643  
**sql-fatal-error** 1648  
**sql-temporary-error** 1665  
**sql-timeout-error** 1665  
**sql-user-error** 395, 396, 1653, 1659, 1665  
**condition-variable** system  
     class 1376  
**condition-variable-broadcast**  
     function 286, 1376  
**condition-variable-signal**  
     function 286, 1377  
**condition-variable-wait**  
     function 285, 1378  
**condition-variable-wait-count** function 286, 1379  
**configure-remote-debugging-spec** function 26, 27, 33, 730  
 configuring the printer 189  
**connect** function 334, 338, 339, 374, 1533  
 Connect Remote Debugging Editor  
     command 747  
**connected-databases** function 338, 1542  
**\*connect-if-exists\*** variable 1541  
 connecting to a database  
     MySQL 339  
     ODBC 339  
     Oracle 338  
     PostgreSQL 342  
**connect-to-named-pipe**  
     function 1896  
**connect-to-tcp-server**  
     function 572  
**console** 1002  
 console application 1002  
 constants  
     **array-dimension-limit** 479  
     **array-total-size-limit** 479  
     **base-char-code-limit** 1085  
     **\*java-null\*** 1274  
     **most-positive-fixnum** 479  
 continue restart 12  
**copy-code-coverage-data**

**function** 889  
**copy-current-code-coverage**  
  function 889  
**copy-file** function 1096  
**copy-from-sqlite-raw-blob**  
  function 394, 1655  
**copy-preferences-from-older-version** function 1734  
**copy-standard-object**  
  function 493  
**copy-to-weak-simple-vector**  
  function 165, 891  
**count-gen-num-allocation**  
  function 150, 1735  
Counting semaphores 287  
**count-regexp-occurrences**  
  function 1097  
**create-and-run-wait-state-collection** function 411, 560  
**create-async-io-state**  
  function 412, 415, 562  
**create-async-io-state-and-connected-tcp-socket**  
  function 412, 422, 564  
**create-async-io-state-and-connected-udp-socket**  
  function 413, 567  
**create-async-io-state-and-udp-socket** function 412, 569  
**create-client-remote-debugging-connection**  
  function 28, 734  
**create-ide-remote-debugging-connection** function 734  
**create-index** function 354, 1542  
**create-instance-from-jobject**  
  function 1213  
**create-instance-jobject**  
  function 1214  
**create-instance-jobject-list**  
  function 1214  
**create-java-object** function 1216  
**create-java-object-error**  
  condition 1217  
**createLispProxy** Java method 1335  
**create-macos-application-bundle** function 892  
**create-registry-key** function 468, 1927  
**create-table** function 354, 1543  
**create-temp-file** function 467, 895  
**create-universal-binary**  
  function 897  
**create-view** function 354, 1545  
**create-view-from-class**  
  function 355, 1546  
creation of process 262  
cross-referencing 860, 863, 1040, 1059, 1060  
**:ctx-configure-callback**  
  initarg 613  
current frame 15  
current process 262  
**current-function-name**  
  function 897  
**current-pathname** function 1099  
**\*current-process\*** variable 262, 1380  
**current-process-block-interrupts** function 289, 1380  
**current-process-in-cleanup-p**  
  function 1381  
**current-process-kill**  
  function 1382  
**current-process-pause**  
  function 1383  
**current-process-send**  
  function 1385  
**current-process-set-terminal-method** function 1386  
**current-process-unblock-interrupts** function 289, 1387  
**current-stack-length**  
  function 898  
customization  
  main chapter 178  
  of editor 185  
**:cv** inspector command 39

**D**

**:d** inspector command 39  
database  
  connection in Common SQL 338  
  encoding in Common SQL 375  
  table names 374  
**database-name** function 338, 1546  
databases  
  supported 333  
dates  
  in Common SQL 370, 378  
**date-string** function 899  
**dde-advise-client-data** generic function 324  
**dde-advise-start** function 324, 1941  
**dde-advise-start\*** function 324,

```

1944
dde-advice-stop function 325, 1945
dde-advice-stop* function 325, 1947
dde-client-advice-data generic
    function 1948
dde-connect function 323, 1949
dde-disconnect function 323, 1950
dde-execute function 1950
dde-execute* function 1951
dde-execute-command function 326,
    1952
dde-execute-command*
    function 326, 1953
dde-execute-string function 326,
    1955
dde-execute-string* function 326,
    1955
dde-item accessor 1957
dde-item* accessor 1958
dde-item function 326
dde-poke function 325, 1960
dde-poke* function 1962
dde-request function 325, 1964
dde-request* function 1966
dde-server-poke generic
    function 327, 1971
dde-server-request generic
    function 327, 1972
dde-server-topic generic
    function 1973
dde-server-topics generic
    function 328, 1974
dde-system-topic class 1975
dde-topic class 1975
dde-topic-items generic
    function 1976
DDL 353, 355
debug 105
debugger
    break gesture 10
    commands 13
    commands not recognized 23
    control variables 23
    invoking from the tracer 51
    keyboard interrupt 10
    main chapter 9
    remote 25
    troubleshooting 23
debugger commands
    :< 15
    :> 15
    :a 20
:all 18
:b 14
:bq 15
:c 20
:cc 18
:ed 18
:error 18
:func 19
:l 17
:lambda 19
:lf 19
:n 16
:p 15
:res 21
:ret 21
:top 21
:v 16
*debug-initialization-
    errors-in-snap-shot*
    variable 1736
*debug-io* variable 23, 705
debug-other-process
    function 1388
*debug-print-length* variable 23,
    738
*debug-print-level* variable 24,
    738
declare macro 110, 650
declaration
    alias 651
    :explain 651
    invisible-frame 651
    lambda-list 651
    special-dynamic 113, 651
    special-fast-access 113, 651
    special-global 113, 651
    values 651
declaration-information
    function 900
declare :explain 111, 651
declare special form 104, 109, 651
decode-external-string
    function 834
decode-to-db-standard-date
    function 1547
decode-to-db-standard-times-
    tamp function 1547
def macro 794
defadvice macro 67, 73, 1100
default directory 952
default file directory 952
*default-action-list-sort-

```

**time\*** variable 1103, 97  
**\*default-character-element-type\*** parameter 438, 440, 441, 442, 449, 1104  
**\*default-client-remote-debugging-server-port\*** variable 27, 739  
**default-constructor-arguments** generic function 1217  
**\*default-database\*** variable 1549  
**\*default-database-type\*** variable 1550  
**default-eol-style** function 1737  
**\*default-ide-remote-debugging-server-port\*** variable 27, 740  
**\*default-libraries\*** variable 1079  
**default-name-constructor** function 1218  
**\*default-package-use-list\*** variable 901  
**:default-pathname** keyword 307  
**\*default-process-priority\*** variable 1389  
**\*default-profiler-collapse\*** variable 901  
**\*default-profiler-cutoff\*** variable 902  
**\*default-profiler-limit\*** variable 902  
**\*default-profiler-sort\*** variable 903  
**\*default-stack-group-list-length\*** variable 164, 1738  
**\*default-update-objects-max-len\*** variable 1550  
**defclass** macro 657  
**defglobal-parameter** macro 903  
**defglobal-variable** macro 904  
**define-action** macro 96, 1105  
**define-action-list** macro 96, 1107  
**define-atomic-modify-macro** macro 1738  
**define-dde-client** function 325  
**define-dde-client** macro 1967  
**define-dde-dispatch-topic** macro 329, 1977  
**define-dde-server** macro 327, 1978  
**define-dde-server-function** macro 327, 1979  
**define-declaration** macro 905  
**define-dspec-alias** macro 795  
**define-dspec-class** macro 796  
**define-field-accessor** macro 1219  
**define-foreign-callable** macro 297  
**define-form-parser** macro 90, 799  
**define-java-caller** macro 1220  
**define-java-callers** macro 1223  
**define-java-constructor** macro 1220  
**define-lisp-proxy** macro 1225  
**define-top-loop-command** macro 1740  
**definition specs** 58  
**defpackage** macro 661  
**defparameter** macro 904  
**defparser** error handling with 316  
**defparser** macro 1515  
functions defined by 315  
**defrule** compiling a rule dynamically 103  
**defstruct** macro 189  
**\*defstruct-generates-print-object-method\*** variable 189  
**defsystem** macro 305–311, 1109  
examples of use 310  
**\*defsystem-verbose\*** variable 1115  
**deftransform** macro 725  
**defvar** macro 904  
**def-view-class** macro 332, 354, 355, 1551  
**delete-advice** macro 66, 73, 907  
**delete-directory** function 1115  
**delete-duplicates** function 116  
**delete-instance-records** generic function 357, 1558, 1572  
**delete-records** function 348, 349, 1559  
**delete-registry-key** function 468, 1929  
**delete-sql-stream** function 372, 1560  
**deliver** function 191, 454, 460, 1116  
**deliverable**  
filename 454, 1149  
pathname 454, 1149  
**delivered-image-p** function 908  
delivering a DLL 191  
delivering a dynamic library 191  
**deliver-to-android-project**

**function** 909  
**delivery keywords**  
  `:clos-initarg-checking` 501  
  `:multiprocessing` 264  
  `:quit-when-no-windows` 1176  
  `:startup-bitmap-file` 1898  
**describe** function 37, 663  
`*describe-length*` variable 1117, 39  
`*describe-level*` variable 1117, 38  
**describe-object** generic function 38  
`*describe-print-length*` variable 1119, 38  
`*describe-print-level*` variable 1119, 38  
**destroy-prepared-statement** function 1561  
**destroy-ssl** function 431, 574  
**destroy-ssl-ctx** function 431, 575  
**destructive-add-code-cover-** age-data function 839  
**destructive-reverse-sub-** tract-code-coverage-data function 839  
**destructive-subtract-code-** coverage-data function 839  
**detach-ssl** function 425, 575  
**detect-eol-style** function 1742  
**detect-japanese-encoding-in-** file function 1743  
**detect-unicode-bom** function 1744  
**detect-utf32-bom** function 1744  
**detect-utf8-bom** function 1744  
**diagnostic utilities**  
  for action lists 97  
`:direction` initarg 613, 1577, 1681  
**directory** function 663  
`*directory-link-transpar-` ency\* variable 664, 1745  
**disable-sql-reader-syntax** function 370, 1561  
`*disable-trace*` variable 914  
**disassemble** function 668  
**discard-source-info** function 803  
**disconnect** function 338, 1562  
**dismiss-splash-screen** function 1898  
**DLL** 191  
  filename 454, 1149  
  pathname 454, 1149  
**dll-quit** function 195, 1120  
**dlopen** C function 191  
**dlsym** C function 191  
`:dm` inspector command 39  
**DML** 346, 357  
**DNS** 578  
**documentation** generic function 668  
`$(dollar)` variable 38  
`$$` variable 38  
`$$$` variable 38  
**domain** 578  
**do-nothing** function 1123  
`:dont-know` keyword 17  
**do-profiling** function 169, 915  
**do-query** macro 351, 381, 1563  
**do-rand-seed** function 576  
**DOS command**  
  `call-system` 1724  
  `call-system-showing-` output 1727  
  `open-pipe` 1823  
**DOS window**  
  controlling, in `call-system` 1725, 1726  
**dotted-list-length** function 1122  
**dotted-list-p** function 1123  
**double-float** type 669  
`:dr` inspector command 39  
**drop-index** function 354, 1564  
**drop-table** function 354, 1565  
**drop-view** function 354, 1565  
**drop-view-from-class** function 355, 1566  
**dspec-class** function 803  
`*dspec-classes*` variable 804  
**dspec-defined-p** function 804  
**dspec-definition-locations** function 805  
**dspec-equal** function 806  
**dspec-name** function 806  
**dspec-primary-name** function 807  
**dspec-progenitor** function 808  
**dspecs**  
  aggregate 82  
  canonical 76  
  displaying definitions 89  
  examples 75  
  finding definitions 89  
  for subfunctions 85  
  grouping definitions 82  
  new defining forms 80  
  parts 82  
  recording definitions 87  
**dspec-subclass-p** function 808

**dspec-undefiner** function 809  
**dump-form** function 1067  
**dump-forms-to-file** function 1067  
**dylib** 191  
**dynamic libraries** 191, 459  
**dynamic library** 191  
  memory clash 194  
  relocation 194

**E**

**:ed** debugger command 18  
**editor**  
  customizing 185  
**editor source code** 186  
**editor-color-code-coverage**  
  function 917  
**ef-spec** 443  
**:ef-spec** initarg 1751  
**:element-type** initarg 613, 1682  
**Emacs** 3  
**enable-sql-reader-syntax**  
  function 346, 370, 1567  
**encode-db-standard-date**  
  function 1548  
**encode-db-standard-timestamp**  
  function 1548  
**encode-lisp-string** function 835  
**encoding**  
  changing default for files 449  
**enlarge-generation** function 144,  
  146, 920  
**enlarge-static** function 921  
**ensure-hash-entry** function 922  
**ensure-is-object** function 1247  
**ensure-lisp-classes-from-**  
  tree function 1233  
**ensure-loads-after-loads**  
  function 272, 1746  
**ensure-memory-after-store**  
  function 1746  
**ensure-objc-initialized**  
  function 243  
**ensure-process-cleanup**  
  function 1389  
**ensure-remote-debugging-connection** function 36, 741  
**ensure-ssl** function 431, 577  
**ensure-stores-after-memory**  
  function 1747  
**ensure-stores-after-stores**  
  function 269, 273, 275, 1748  
**ensure-supers-contain-**

**java.lang.object**  
  function 1235  
**\*enter-debugger-directly\***  
  variable 1124  
**:entrycond** keyword 52  
**enum-registry-value** function 468,  
  1929  
**environment access API** 857, 901, 940, 1059  
**environment-variable**  
  function 1125  
**eql-specializer** class 250  
**eql-specializer-object**  
  function 250  
**errno-value** function 1126  
**:error** debugger command 18  
**error handlers**  
  in applications 756  
**error handling**  
  in parser generator 316  
**error output** 1810  
**\*error-output\*** variable 705  
**errors in Common SQL** 372  
**error-situation-forms** macro 923  
**EUC-JP** 444  
**:euc-jp** external format 444  
**:eval-after** keyword 51  
**:eval-before** keyword 50  
**evaluating**  
  forms during tracing 49–51  
**example-compile-file**  
  function 1127  
**example-edit-file** function 1128  
**example-file** function 1127  
**example-load-binary-file**  
  function 1129  
**exception handlers**  
  in applications 756  
**exception handling**  
  for action lists 96  
**exceptions**  
  handling 756  
**executable** 454  
  filename 454, 1149  
  pathname 454, 1149  
**executable-log-file** function 741  
**execute-actions** macro 1129  
**execute-command** function 352, 1567  
**execute-with-interface**  
  function 267  
**execution functions** 95  
**execution profiling** 167  
**execution stack**

examining 12  
`:exitcond` keyword 52  
`expand-generation-1` function 146, 924  
`extend-current-stack`  
     function 925  
`extended-char` type 1131  
`extended-character` type 1131  
`extended-character-p`  
     function 1132  
`extended-char-p` function 1132  
`*extended-spaces*` variable 1203, 1748  
`extended-time` macro 149, 163, 173, 926  
 external format  
     changing default for files 449  
 external format specification 443  
 external formats 443  
     `:ascii` 444  
     `:bmp` 444, 827  
     `:bmp-native` 446, 827  
     `:bmp-reversed` 446, 827  
     `code-page` 443  
     `:euc-jp` 444  
     `:gbk` 445  
     `:jis` 444  
     `:koi-8` 445  
     `:latin-1` 443  
     `:latin-1-safe` 444  
     `:latin-1-terminal` 443  
     `:macos-roman` 444  
     `:sjis` 444  
     `:unicode` 444  
     `:utf-16` 444  
     `:utf-16be` 446, 830  
     `:utf-16le` 446, 830  
     `:utf-16-native` 446, 830  
     `:utf-16-reversed` 446, 830  
     `:utf-32` 444  
     `:utf-8` 444  
     `:windows-cp936` 444  
 external programs  
     calling from Lisp 462  
`external-format-error`  
     condition 835  
`external-format-foreign-type`  
     function 836  
`*external-formats*` variable 1133  
`external-format-type`  
     function 836  
`:extra-initargs` class option 487, 489, 658

**F**

`false` function 1134  
`fasl` (fast load)  
     description 101  
`fasl-error` condition 929  
`fast-directory-files`  
     function 930  
`FDDL` 353  
`fdf-handle-directory-p`  
     accessor 930  
`fdf-handle-directory-string`  
     accessor 930  
`fdf-handle-last-access`  
     accessor 930  
`fdf-handle-last-modify`  
     accessor 930  
`fdf-handle-link-p` accessor 930  
`fdf-handle-size` accessor 930  
`fdf-handle-writable-p`  
     accessor 930  
`FDML` 357  
`*features*` variable 670  
`field-access-exception`  
     condition 1236  
`field-access-exception-set-p`  
     accessor 1236  
`field-exception` condition 1237  
`field-exception-class-name`  
     accessor 1237  
`field-exception-field-name`  
     accessor 1237  
 file descriptor, of socket-stream 613  
 file descriptor, on UNIX 1436, 1761  
`file-directory-p` function 1134  
`*file-encoding-detection-algorithm*` variable 448, 1749  
`file-encoding-resolution-error` condition 1751  
`*file-eol-style-detection-algorithm*` variable 448, 1751  
 filename of deliverable 454, 1149  
 filename of DLL 454, 1149  
 filename of dynamic library 1149  
 filename of executable 454, 1149  
 filename of lisp image 454, 1149  
`*filename-pattern-encoding-matches*` variable 1752  
 files  
     load-on-demand 188  
`file-stat-blocks` function 1762

**file-stat-device** function 1761  
**file-stat-device-type**  
  function 1762  
**file-stat-group-id** function 1762  
**file-stat-inode** function 1761  
**file-stat-last-access**  
  function 1762  
**file-stat-last-change**  
  function 1762  
**file-stat-last-modify**  
  function 1762  
**file-stat-links** function 1762  
**file-stat-mode** function 1762  
**file-stat-owner-id** function 1761  
**file-stat-size** function 1762  
**file-string** function 932  
**file-writable-p** function 933  
  (*setf fill-pointer*) function 266  
**filter-code-coverage-data**  
  function 933  
**Find Source**  
  menu command 799  
**Find Source Editor** command 186,  
  1222  
**Find Source For Dspec Editor**  
  command 816  
**find-database** function 338, 1568  
**find-dspec-locations**  
  function 809  
**find-encoding-option**  
  function 1752  
**find-external-char** function 837  
**find-filename-pattern-encoding-match** function 1753  
**find-java-class** function 1238  
**find-name-locations** function 810  
**find-object-size** function 145, 935  
**find-process-from-name**  
  function 1391  
**find-regexp-in-string**  
  function 1135  
**find-throw-tag** function 936  
**finish-heavy-allocation**  
  function 936  
**fixnum** type 477  
**fixnum-safety** 105  
**flag-not-special-free-action**  
  function 165, 937  
**flag-special-free-action**  
  function 164, 938  
**FLI types**  
  **lpcstr** 1916  
  
**lpctstr** 1917  
**lpcwstr** 1918  
**lpstr** 1916  
**lptstr** 1917  
**lpwstr** 1918  
**p-oci-env** 385, 1625  
**p-oci-file** 385, 1626  
**p-oci-lob-locator** 385, 1626  
**p-oci-lob-or-file** 1626  
**p-oci-svc-ctx** 385, 1626  
**ssl-cipher-pointer** 427, 622  
**ssl-cipher-pointer-stack** 622  
**ssl-ctx-pointer** 427, 624  
**ssl-pointer** 427, 625  
**str** 1916  
**tstr** 1917  
**wstr** 1918  
**float** 105  
**float calculations, optimizing** 112  
**foreign callbacks** 297  
**foreign-slot-value** function 116  
**foreign-symbol-address**  
  function 1076  
**format-to-java-host**  
  function 1239  
**forms**  
  evaluating when tracing 49–51  
**frame, examining** 12  
**:free-lob-locator-on-close**  
  initarg 1577  
**:func** debugger command 19  
**funcallable-standard-class**  
  class 251  
**funcallable-standard-instance-access**  
  function 250  
**funcallable-standard-object**  
  class 252, 494  
**funcall-async** function 1392  
**funcall-async-list** function 1392  
**function dspecs** 84  
**function, altering with advice** 63  
**Functional DDL** 353  
**Functional DML** 346  
**functional interface in Common SQL** 346  
**function-information**  
  function 939  
**function-lambda-list**  
  function 1137  
**functions**  
  **accepting-handle-collection** 518

accepting-handle-local-  
port 520  
accepting-handle-name 519  
accepting-handle-socket 520  
accepting-handle-user-  
info 521  
accepts-n-syntax 1527  
accept-tcp-connections-cre-  
ating-async-io-  
states 412, 416, 422, 513  
add-code-coverage-data 839  
add-special-free-action 164,  
841  
add-sql-stream 372, 1528  
add-symbol-profiler 842  
allocated-in-its-own-seg-  
ment-p 1715  
android-build-value 848  
android-funcall-in-main-  
thread 849  
android-funcall-in-main-  
thread-list 849  
android-get-current-  
activity 851  
android-main-thread-p 852  
any-capi-window-displayed-  
p 853  
any-other-process-non-  
internal-server-p 1361  
append-file 1082  
apply-in-wait-state-collec-  
tion-process 411, 522  
apply-with-allocation-in-  
gen-num 147, 1716  
apropos 639  
apropos-list 640  
array-single-thread-p 854  
array-weak-p 854  
async-io-state-abort 413, 417,  
523  
async-io-state-abort-and-  
close 417, 525  
async-io-state-address 526  
async-io-state-attach-  
ssl 422, 425, 526  
async-io-state-buffered-  
data-length 414, 528  
async-io-state-  
collection 530  
async-io-state-ctx 431, 529  
async-io-state-detach-  
ssl 425, 529  
async-io-state-discard 413,  
417, 531  
async-io-state-finish 413,  
417, 532  
async-io-state-get-buff-  
ered-data 414, 417, 533  
async-io-state-handshake 534  
async-io-state-max-read 535  
async-io-state-name 536  
async-io-state-object 536  
async-io-state-old-  
length 537  
async-io-state-peer-  
address 538  
async-io-state-read-  
buffer 413, 416, 538  
async-io-state-read-  
status 540  
async-io-state-read-  
timeout 541  
async-io-state-read-with-  
checking 413, 416, 542  
async-io-state-receive-  
message 413, 416, 545  
async-io-state-send-  
message 413, 416, 547  
async-io-state-send-mes-  
sage-to-address 413, 416, 549  
async-io-state-ssl 431, 551  
async-io-state-ssl-side 431,  
551  
async-io-state-user-  
info 412, 553  
async-io-state-write-  
buffer 413, 416, 552  
async-io-state-write-  
status 540  
async-io-state-write-  
timeout 541  
attach-ssl 420, 422, 554  
attribute-type 353, 1529  
augmented-string-p 1722  
augment-environment 855  
avoid-gc 146, 857  
barrier-arriver-count 1362  
barrier-block-and-wait 1363  
barrier-change-count 1366  
barrier-count 1367  
barrier-disable 287, 1368  
barrier-enable 287, 1368  
barrier-name 1369  
barrier-pass-through 1370

**barrier-unblock** 1370  
**barrier-wait** 287, 1372  
**base-character-p** 1084  
**base-char-p** 1085  
**base-char-ref** 1821  
**base-string-p** 1086  
**binds-who** 860  
**bmp-char-p** 1087  
**bmp-string-p** 1089  
**break-new-instances-on-access** 485  
**break-on-access** 486  
**break-on-unresolved** 1075  
**building-universal-intermediate-p** 862  
**cache-table-queries** 349, 1531  
**call-java-method** 1209  
**call-next-advice** 66, 73, 1090  
**calls-who** 863  
**call-system** 1724  
**call-system-showing-output** 1727  
**call-wait-state-collection** 411, 413, 556  
**canonicalize-dspec** 793  
**canonicalize-sid-string** 1895  
**cdr-assoc** 1730  
**change-directory** 187, 864  
**change-process-priority** 295, 1375  
**char-external-code** 833  
**checked-read-java-field** 1302  
**check-fragmentation** 145, 146, 865  
**check-java-field** 1302  
**check-lisp-calls-initialized** 1213  
**choose-unicode-string-hash-function** 1092  
**clean-down** 136, 163, 866  
**clean-generation-0** 146, 868  
**clear-code-coverage** 869  
**close-accepting-handle** 557  
**close-async-io-state** 414, 415, 417, 558  
**close-registry-key** 468, 1923  
**close-remote-debugging-connection** 36, 729  
**close-serial-port** 1519  
**close-wait-state-collection** 411, 559  
**code-coverage-data-gener-**  
**ate-coloring-html** 871  
**code-coverage-data-generate-**  
**ate-statistics** 877  
**code-coverage-set-editor-**  
**colors** 881  
**code-coverage-set-editor-**  
**default-data** 883  
**code-coverage-set-html-**  
**background-colors** 884  
**coerce** 642  
**coerce-to-gesture-spec** 1731  
**collect-generation-2** 144, 146, 885  
**collect-highest-generation** 146, 886  
**collect-registry-subkeys** 468, 1924  
**collect-registry-values** 468, 1925  
**commit** 348, 350, 382, 1532  
**compile** 643  
**compile-file** 645  
**compile-file-if-needed** 887  
**compile-system** 306, 1092  
**concatenate** 650  
**concatenate-system** 1094  
**condition-variable-broadcast** 286, 1376  
**condition-variable-signal** 286, 1377  
**condition-variable-wait** 285, 1378  
**condition-variable-wait-count** 286, 1379  
**configure-remote-debugging-spec** 26, 27, 33, 730  
**connect** 338, 339, 374, 1533  
**connected-databases** 338, 1542  
**connect-to-named-pipe** 1896  
**connect-to-tcp-server** 572  
**copy-code-coverage-data** 889  
**copy-current-code-coverage** 889  
**copy-file** 1096  
**copy-from-sqlite-raw-blob** 394, 1655  
**copy-preferences-from-older-version** 1734  
**copy-standard-object** 493  
**copy-to-weak-simple-vector** 165, 891  
**count-gen-num-**

**allocation** 150, 1735  
**count-regexp-**  
  **occurrences** 1097  
**create-and-run-wait-state-**  
  **collection** 411, 560  
**create-async-io-state** 412,  
  415, 562  
**create-async-io-state-and-**  
  **connected-tcp-socket** 412,  
  422, 564  
**create-async-io-state-and-**  
  **connected-udp-socket** 413,  
  567  
**create-async-io-state-and-**  
  **udp-socket** 412, 569  
**create-client-remote-debug-**  
  **ging-connection** 28, 734  
**create-ide-remote-debug-**  
  **ging-connection** 734  
**create-index** 354, 1542  
**create-instance-from-**  
  **jobject** 1213  
**create-instance-jobject** 1214  
**create-instance-jobject-**  
  **list** 1214  
**create-java-object** 1216  
**create-macos-application-**  
  **bundle** 892  
**create-registry-key** 468, 1927  
**create-table** 354, 1543  
**create-temp-file** 467, 895  
**create-universal-binary** 897  
**create-view** 354, 1545  
**create-view-from-class** 355,  
  1546  
**current-function-name** 897  
**current-pathname** 1099  
**current-process-block-**  
  **interrupts** 289, 1380  
**current-process-in-cleanup-**  
  **p** 1381  
**current-process-kill** 1382  
**current-process-pause** 1383  
**current-process-send** 1385  
**current-process-set-termi-**  
  **nate-method** 1386  
**current-process-unblock-**  
  **interrupts** 289, 1387  
**current-stack-length** 898  
**database-name** 338, 1546  
**date-string** 899  
**dde-advise-start** 1941  
**dde-advise-start\*** 1944  
**dde-advise-stop** 1945  
**dde-advise-stop\*** 1947  
**dde-connect** 1949  
**dde-disconnect** 1950  
**dde-execute** 1950  
**dde-execute\*** 1951  
**dde-execute-command** 1952  
**dde-execute-command\*** 1953  
**dde-execute-string** 1955  
**dde-execute-string\*** 1955  
**dde-poke** 1960  
**dde-poke\*** 1962  
**dde-request** 1964  
**dde-request\*** 1966  
**debug-other-process** 1388  
**declaration-information** 900  
**decode-external-string** 834  
**decode-to-db-standard-**  
  **date** 1547  
**decode-to-db-standard-**  
  **timestamp** 1547  
**default-eol-style** 1737  
**default-name-**  
  **constructor** 1218  
**delete-directory** 1115  
**delete-duplicates** 116  
**delete-records** 348, 349, 1559  
**delete-registry-key** 468, 1929  
**delete-sql-stream** 372, 1560  
**deliver** 191, 454, 460, 1116  
**delivered-image-p** 908  
**deliver-to-android-**  
  **project** 909  
**describe** 37, 663  
**destroy-prepared-**  
  **statement** 1561  
**destroy-ssl** 431, 574  
**destroy-ssl-ctx** 431, 575  
**destructive-add-code-cover-**  
  **age-data** 839  
**destructive-reverse-sub-**  
  **tract-code-coverage-**  
  **data** 839  
**destructive-subtract-code-**  
  **coverage-data** 839  
**detach-ssl** 425, 575  
**detect-eol-style** 1742  
**detect-japanese-encoding-**  
  **in-file** 1743  
**detect-unicode-bom** 1744  
**detect-utf32-bom** 1744

detect-utf8-bom 1744  
directory 663  
disable-sql-reader-  
    syntax 370, 1561  
disassemble 668  
discard-source-info 803  
disconnect 338, 1562  
dismiss-splash-screen 1898  
dll-quit 195, 1120  
do-nothing 1123  
do-profiling 169, 915  
do-rand-seed 576  
dotted-list-length 1122  
dotted-list-p 1123  
drop-index 354, 1564  
drop-table 354, 1565  
drop-view 354, 1565  
drop-view-from-class 355, 1566  
dspec-class 803  
dspec-defined-p 804  
dspec-definition-  
    locations 805  
dspec-equal 806  
dspec-name 806  
dspec-primary-name 807  
dspec-progenitor 808  
dspec-subclass-p 808  
dspec-undefiner 809  
dump-form 1067  
dump-forms-to-file 1067  
editor-color-code-  
    coverage 917  
enable-sql-reader-  
    syntax 346, 370, 1567  
encode-db-standard-date 1548  
encode-db-standard-  
    timestamp 1548  
encode-lisp-string 835  
enlarge-generation 144, 146, 920  
enlarge-static 921  
ensure-hash-entry 922  
ensure-is-jobject 1247  
ensure-lisp-classes-from-  
    tree 1233  
ensure-loads-after-  
    loads 272, 1746  
ensure-memory-after-  
    store 1746  
ensure-objc-initialized 243  
ensure-process-cleanup 1389  
ensure-remote-debugging-  
    connection 36, 741  
ensure-ssl 431, 577  
ensure-stores-after-  
    memory 1747  
ensure-stores-after-  
    stores 269, 273, 275, 1748  
ensure-supers-contain-  
    java.lang.object 1235  
enum-registry-value 468, 1929  
environment-variable 1125  
eql-specializer-object 250  
errno-value 1126  
example-compile-file 1127  
example-edit-file 1128  
example-file 1127  
example-load-binary-  
    file 1129  
executable-log-file 741  
execute-command 352, 1567  
expand-generation-1 146, 924  
extend-current-stack 925  
extended-character-p 1132  
extended-char-p 1132  
external-format-foreign-  
    type 836  
external-format-type 836  
false 1134  
fast-directory-files 930  
file-directory-p 1134  
file-stat-blocks 1762  
file-stat-device 1761  
file-stat-device-type 1762  
file-stat-group-id 1762  
file-stat-inode 1761  
file-stat-last-access 1762  
file-stat-last-change 1762  
file-stat-last-modify 1762  
file-stat-links 1762  
file-stat-mode 1762  
file-stat-owner-id 1761  
file-stat-size 1762  
file-string 932  
file-writable-p 933  
filter-code-coverage-  
    data 933  
find-database 338, 1568  
find-dspec-locations 809  
find-encoding-option 1752  
find-external-char 837  
find-filename-pattern-  
    encoding-match 1753  
find-java-class 1238  
find-name-locations 810

**find-object-size** 145, 935  
**find-process-from-name** 1391  
**find-regexp-in-string** 1135  
**find-throw-tag** 936  
**finish-heavy-allocation** 936  
**flag-not-special-free-**  
    action 165, 937  
**flag-special-free-**  
    action 164, 938  
**foreign-slot-value** 116  
**foreign-symbol-address** 1076  
**format-to-java-host** 1239  
**funcallable-standard-**  
    instance-access 250  
**funcall-async** 1392  
**funcall-async-list** 1392  
**function-information** 939  
**function-lambda-list** 1137  
**gc-generation** 136, 138, 146, 150,  
    942  
**gc-if-needed** 146, 946  
**generate-code-coverage** 946  
**generate-java-class-**  
    definitions 1239  
**generation-number** 144, 1755  
**gen-num-segments-fragmenta-**  
    tion-state 150, 1754  
**gensym** 164  
**gesture-spec-data** 1758  
**gesture-spec-modifiers** 1758  
**gesture-spec-p** 1759  
**gesture-spec-to-**  
    character 1760  
**get-code-coverage-delta** 940  
**get-current-process** 262, 263,  
    1394  
**get-default-generation** 146,  
    949  
**get-default-local-ipv6-**  
    address 578  
**get-file-stat** 1761  
**get-folder-path** 467, 1762  
**get-foreign-symbol** 1077  
**get-form-parser** 811  
**get-gc-parameters** 146, 950  
**get-gc-timing** 1031  
**gethash-ensuring** 952  
**get-host-entry** 578  
**get-host-java-virtual-**  
    machine 1245  
**get-ip-default-zone-id** 581  
**get-java-virtual-**  
    machine 1246  
**get-jobject** 1247  
**get-maximum-allocated-in-**  
    generation-2-after-
        gc 1765  
**get-primitive-array-**  
    region 1248  
**get-process** 263, 1395  
**get-process-private-**  
    property 1396  
**get-serial-port-state** 1520  
**get-service-entry** 582  
**get-socket-address** 583  
**get-socket-peer-address** 584  
**get-superclass-and-inter-**  
    faces-tree 1250  
**get-temp-directory** 951  
**get-unix-error** 1142  
**get-user-profile-**  
    directory 467, 1767  
**get-verification-mode** 585  
**get-working-directory** 952  
**guess-external-format** 448,  
    1769  
**hardcopy-system** 1147  
**ide-attach-remote-output-**  
    stream 30, 744  
**ide-connect-remote-**  
    debugging 27, 28, 745  
**ide-eval-form-in-remote** 29,  
    30, 747  
**ide-find-remote-debugging-**  
    connection 35, 750  
**ide-funcall-in-remote** 29, 30,  
    747  
**ide-list-remote-debugging-**  
    connections 35, 750  
**ide-open-a-listener** 25, 28, 753  
**ide-set-default-remote-**  
    debugging-connection 35,  
    750  
**ide-set-remote-symbol-**  
    value 30, 747  
**immediatep** 1770  
**initialize-database-**  
    type 1569  
**initialize-**  
    multiprocessing 263, 1397  
**init-java-interface** 1253  
**insert-records** 348, 381, 1570  
**inspect** 38  
**int32\*** 1773

```

int32+ 473, 1773
int32- 473, 1773
int32/ 1773
int32/= 1775
int32< 1775
int32<< 1776
int32<= 1775
int32= 1775
int32> 1775
int32>= 1775
int32>> 1776
int32-1+ 1774
int32-1- 1774
int32-aref 1777
int32-logand 1778
int32-logandc1 1778
int32-logandc2 1778
int32-logbitp 1778
int32-logeqv 1778
int32-logior 1778
int32-lognand 1778
int32-lognor 1778
int32-lognot 1778
int32-logorc1 1778
int32-logorc2 1778
int32-logtest 1778
int32-logxor 1778
int32-minusp 1781
int32-plusp 1781
int32-to-int64 1781
int32-to-integer 1782
int32-zerop 1781
int64* 1784
int64+ 474, 1784
int64- 474, 1784
int64/ 1784
int64/= 1786
int64< 1786
int64<< 1787
int64<= 1786
int64= 1786
int64> 1786
int64>= 1786
int64>> 1787
int64-1+ 1785
int64-1- 1785
int64-aref 1788
int64-logand 1789
int64-logandc1 1789
int64-logandc2 1789
int64-logbitp 1789
int64-logeqv 1789
int64-logior 1789
int64-lognand 1789
int64-lognor 1789
int64-lognot 1789
int64-logorc1 1789
int64-logorc2 1789
int64-logtest 1789
int64-logxor 1789
int64-minusp 1791
int64-plusp 1791
int64-to-int32 1792
int64-to-integer 1793
int64-zerop 1791
integer-to-int32 1793
integer-to-int64 1794
interactive-stream-p 676
intern-and-export-list 1260
intern-eql-specializer 250
ip-address-string 585
ipv6-address 586
ipv6-address-p 587
ipv6-address-scope-id 587
ipv6-address-string 588
jaref 1260
java-array-element-type 1262
java-array-length 1264
java-field-class-name-for-
    setting 1302
java-object-array-element-
    type 1275
java-objects-eq 1275
java-primitive-array-ele-
    ment-type 1277
java-type-to-lisp-array-
    type 1278
jobject-class-name 1282
jobject-ensure-global 1283
jobject-of-class-p 1284
jobject-p 1285
jobject-pretty-class-
    name 1285
jobject-string 1286
jobject-to-lisp 1287
jvref 1288
known-sid-integer-to-sid-
    string 1901
last-callback-on-thread 1399
lisp-array-to-primitive-
    array 1299
lisp-array-type-to-java-
    type 1278
lisp-image-name 454, 1149

```

lisp-java-instance-p 1290  
lisp-name-to-foreign-  
    name 1078  
lisp-to-object 1290  
list-all-processes 263, 1400  
list-attributes 353, 1574  
list-attribute-types 353, 1573  
list-classes 357, 1575  
list-sql-streams 372, 1576  
list-tables 353, 1576  
load-all-patches 1152  
load-code-coverage-data 889  
load-data-file 957  
load-logical-pathname-  
    translations 677  
load-system 1153  
lob-stream-lob-locator 384  
local-dspec-p 812  
locale-file-encoding 1796  
locally-disable-sql-reader-  
    syntax 370, 1578  
locally-enable-sql-reader-  
    syntax 370, 1579  
lock-and-condition-vari-  
    able-broadcast 1401  
lock-and-condition-vari-  
    able-signal 1402  
lock-and-condition-vari-  
    able-wait 1404  
lock-locked-p 1406  
lock-name 277, 1409  
lock-owned-by-current-pro-  
    cess-p 1407  
lock-owner 277, 1409  
lock-recursively-locked-  
    p 1408  
lock-recursive-p 1407  
log-bug-form 754  
logs-directory 755  
long-namestring 454, 1903, 1915  
long-site-name 453, 678  
loop-processing-wait-state-  
    collection 411, 413, 589  
low-level-atomic-place-  
    p 1797  
mailbox-count 1411  
mailbox-empty-p 1412  
mailbox-full-p 1413  
mailbox-not-empty-p 1414  
mailbox-peek 1414  
mailbox-read 1415  
mailbox-reader-process 1416  
mailbox-send 1417  
mailbox-send-limited 1418  
mailbox-size 1420  
mailbox-wait 1421  
mailbox-wait-for-event 1422  
make-array 165, 276, 680  
make-barrier 287, 1424  
make-condition-variable 1426  
make-current-allocation-  
    permanent 1798  
make-gesture-spec 1800  
make-hash-table 165, 276, 682  
make-java-array 1291  
make-java-instance 1292  
make-lisp-proxy 1293  
make-lisp-proxy-with-  
    overrides 1293  
make-lock 1427  
make-mailbox 1429  
make-mt-random-state 1156  
make-named-timer 1430  
make-object-permanent 1805  
make-permanent-simple-  
    vector 1807  
make-ring 962  
make-semaphore 288, 1431  
make-sequence 685  
make-simple-int32-  
    vector 1808  
make-simple-int64-  
    vector 1809  
make-ssl-ctx 422, 423, 588  
make-stderr-stream 1810  
make-string 686  
make-string-output-  
    stream 687  
make-symbol 164  
make-timer 293, 1432  
make-typed-aref-vector 1811  
make-unlocked-queue 964  
make-unregistered-action-  
    list 1154  
make-wait-state-  
    collection 411, 590  
map 688  
map-all-processes 1433  
map-all-processes-  
    backtrace 1433  
map-code-coverage-data 966  
map-environment 1812  
map-java-object-array 1295  
map-process-backtrace 1434

**map-processes** 1435  
**map-query** 351, 381, 1582  
**map-ring** 967  
**mark-and-sweep** 967  
**marking-gc** 150, 1813  
**memory-growth-margin** 146, 1815  
**merge** 688  
**merge-code-coverage-data** 970  
**merge-ef-specs** 1816  
**mobile-gc-p** 1817  
**mobile-gc-sweep-objects** 1818  
**modify-hash** 971  
**mt-random** 1157  
**mt-random-state-p** 1158  
**name-defined-dspecs** 813  
**name-definition-locations** 814  
**named-pipe-stream-name** 1904  
**name-only-form-parser** 815  
**normal-gc** 146, 972  
**notice-fd** 1436  
**object-address** 1819  
**object-dspec** 816  
**object-pointer** 1820  
**octet-ref** 1821  
**open** 689  
**open-named-pipe-stream** 1905  
**open-pipe** 1823  
**open-registry-key** 468, 1932  
**open-serial-port** 1517  
**openssl-version** 599  
**open-tcp-stream** 420, 422, 591  
**open-tcp-stream-using-java** 595  
**open-temp-file** 467, 895  
**open-url** 1827  
**ora-lob-append** 388, 1586  
**ora-lob-assign** 387, 1587  
**ora-lob-char-set-form** 386, 1587  
**ora-lob-char-set-id** 1588  
**ora-lob-close** 388, 1589  
**ora-lob-copy** 388, 1590  
**ora-lob-create-empty** 381, 387, 1591  
**ora-lob-create-temporary** 389, 1592  
**ora-lob-disable-buffering** 389, 1593  
**ora-lob-element-type** 386, 1594  
**ora-lob-enable-buffering** 389, 1595  
**ora-lob-env-handle** 384, 1596  
**ora-lob-erase** 388, 1596  
**ora-lob-file-close** 388, 1597  
**ora-lob-file-close-all** 388, 1598  
**ora-lob-file-exists** 1599  
**ora-lob-file-get-name** 1600  
**ora-lob-file-is-open** 1600  
**ora-lob-file-open** 388, 1601  
**ora-lob-file-set-name** 388, 1602  
**ora-lob-flush-buffer** 389, 1603  
**ora-lob-free** 387, 1604  
**ora-lob-free-temporary** 389, 1605  
**ora-lob-get-buffer** 384, 389, 1605  
**ora-lob-get-chunk-size** 387, 1608  
**ora-lob-get-length** 387, 1608  
**ora-lob-internal-lob-p** 386, 387, 1609  
**ora-lob-is-equal** 387, 1610  
**ora-lob-is-open** 387, 1610  
**ora-lob-is-temporary** 387, 389, 1611  
**ora-lob-load-from-file** 388, 1612  
**ora-lob-lob-locator** 384, 1613  
**ora-lob-locator-is-init** 387, 1614  
**ora-lob-open** 388, 1614  
**ora-lob-read-buffer** 386, 389, 1615  
**ora-lob-read-foreign-buffer** 384, 386, 389, 1619  
**ora-lob-read-into-plain-file** 389, 1618  
**ora-lob-svc-ctx-handle** 384, 1620  
**ora-lob-trim** 388, 1620  
**ora-lob-write-buffer** 386, 389, 1621, 1624  
**ora-lob-write-foreign-buffer** 384, 386, 389  
**ora-lob-write-from-plain-file** 389, 1623  
**output-backtrace** 756  
**package-flagged-p** 1827  
**parse-float** 975  
**parse-form-dspec** 817  
**pathname-location** 1159

pem-read 426, 602  
 pipe-close-connection 1828  
 pipe-exit-status 1829  
 pipe-kill-process 1830  
 pointer-from-address 1832  
 position-in-ring 976  
 position-in-ring-forward 976  
 precompile-regexp 1160  
 prepare-statement 1627  
 primitive-array-to-lisp-  
     array 1299  
 print-action-lists 97, 1161  
 print-actions 97, 1161  
 print-pretty-gesture-  
     spec 1833  
 print-profile-list 171, 977  
 print-query 348, 1629  
 process-alive-p 1436  
 process-all-events 1437  
 process-allow-  
     scheduling 262, 1438  
 process-arrest-reasons 1438  
 process-break 1439  
 process-continue 1439  
 processes-count 263, 1482  
 process-exclusive-lock 1440  
 process-exclusive-  
     unlock 1441  
 process-idle-time 1442  
 process-internal-server-  
     p 1444  
 process-interrupt 290, 1445  
 process-interrupt-list 1446  
 process-join 1447  
 process-kill 1448  
 process-lock 277, 1449  
 process-mailbox 1450  
 process-name 263, 1450  
 process-p 1451  
 process-plist 294, 1451  
 process-poke 1452  
 process-priority 295, 1454  
 process-private-  
     property 1455  
 process-property 294, 1456  
 process-reset 1457  
 process-run-function 262, 1458  
 process-run-reasons 1461  
 process-run-time 1462  
 process-send 1463  
 process-sharing-lock 1465  
 process-sharing-unlock 1466  
 process-stop 296, 1467  
 process-stopped 296  
 process-stopped-p 1468  
 process-terminate 1468  
 process-unlock 1470  
 process-unstop 296, 1471  
 process-wait 285, 1472  
 process-wait-for-event 1473  
 process-wait-function 1474  
 process-wait-local 1474  
 process-wait-local-with-  
     periodic-checks 1477  
 process-wait-local-with-  
     timeout 1478  
 process-wait-local-with-  
     timeout-and-periodic-  
     checks 1479  
 process-wait-with-  
     timeout 281, 285, 1480  
 process-whostate 1482  
 proclaim 104, 109, 693  
 product-registry-path 464,  
     1835  
 profiler-tree-from-  
     function 983  
 profiler-tree-to-  
     function 984  
 ps 263, 1485  
 pushnew-to-process-private-  
     property 294, 1483  
 pushnew-to-process-  
     property 294, 1484  
 query 352, 380, 1631  
 query-registry-key-info 468,  
     1933  
 query-registry-value 468, 1934  
 quit 4, 463, 1165  
 read-dhparams 426, 603  
 read-foreign-modules 1078  
 read-java-field 1302  
 read-serial-port-char 1521  
 read-serial-port-string 1521  
 reconnect 338, 1632  
 record-definition 817  
 record-java-class-lisp-  
     symbol 1304  
 record-message-in-windows-  
     event-log 1909  
 reduce-memory 164, 985  
 references-who 987  
 regexp-find-symbols 1168  
 registry-key-exists-p 468,

**1935**  
**registry-value** 468, 1935  
**remote-debugging-connection-add-close-cleanup** 36, 765  
**remote-debugging-connection-name** 36, 767  
**remote-debugging-connection-peer-address** 36, 768  
**remote-debugging-connection-remove-close-cleanup** 36, 765  
**remote-inspect** 25, 27, 28, 34, 770  
**remote-object-connection** 29, 35, 772  
**remote-object-p** 29, 772  
**remove-advice** 66, 73, 1169  
**remove-duplicates** 116  
**remove-from-process-private-property** 294, 1486  
**remove-from-process-property** 294, 1486  
**remove-process-private-property** 294, 1487  
**remove-process-property** 294, 1488  
**remove-special-free-action** 165, 988  
**remove-symbol-profiler** 989  
**replace-from-sqlite-blob** 395, 1650  
**replace-from-sqlite-raw-blob** 395, 1655  
**replace-into-sqlite-blob** 395, 1650  
**replace-socket-stream-socket** 604  
**replace-standard-object** 499  
**report-error-to-javahost** 1305  
**reset-code-coverage** 869  
**reset-code-coverage-snapshot** 940  
**reset-java-interface-for-new-jvm** 1306  
**reset-profiler** 989  
**reset-ring** 990  
**restore-code-coverage-data** 869  
**restore-sql-reader-syntax-state** 370, 1633  
**results for traced** 50  
**reverse-subtract-code-average-data** 839  
**ring-length** 991  
**ring-name** 992  
**ringp** 991  
**ring-pop** 992  
**ring-push** 993  
**ring-ref** 994  
**rollback** 348, 350, 382, 1634  
**room** 145, 146, 149, 458, 695  
**room-values** 458, 1838  
**rotate-byte** 1172  
**rotate-ring** 995  
**round-to-single-precision** 1172  
**run-shell-command** 1839  
**safe-format-to-limited-string** 996  
**safe-format-to-string** 996  
**safe-locale-file-encoding** 1844  
**safe-prin1-to-string** 996  
**safe-princ-to-string** 996  
**save-argument-real-p** 997  
**save-code-coverage-data** 889  
**save-current-code-coverage** 889  
**save-current-profiler-tree** 174, 998  
**save-current-session** 1000  
**save-image** 179, 191, 454, 460, 464, 1001  
**save-image-with-bundle** 1010  
**save-tags-database** 821  
**save-universal-from-script** 1011  
**sbchar** 1173  
**schedule-timer** 293, 1489  
**schedule-timer-milliseconds** 1491  
**schedule-timer-relative** 1493  
**schedule-timer-relative-milliseconds** 1494  
**security-description-string-for-open-named-pipe** 1910  
**select** 346, 357, 1634  
**semaphore-acquire** 288, 1496  
**semaphore-count** 288, 1498  
**semaphore-name** 288, 1498  
**semaphore-release** 288, 1499  
**semaphore-wait-count** 288, 1500

send-message-to-java-host 1307  
sequencep 1174  
serial-port 1520  
serial-port-input-available-p 1522  
server-terminate 605  
set-application-themed 1914  
set-approaching-memory-limit-callback 1845  
set-array-single-thread-p 1012  
set-array-weak 165, 1012  
set-automatic-gc-callback 150, 1846  
set-blocking-gen-num 150, 1848  
set-clos-initarg-checking 501  
set-code-coverage-snapshot 940  
set-debugger-options 773  
set-default-character-element-type 439, 442, 443, 1174  
set-default-generation 137, 146, 1014  
set-default-remote-debugging-connection 34, 774  
set-default-segment-size 151, 1851  
set-delay-promotion 151, 1852  
set-expected-allocation-in-generation-2-after-gc 1853  
setf cdr-assoc 1730  
setf timer-name 1503  
set-file-dates 1857  
set-funcall-async-limit 1500  
set-gc-parameters 139, 146, 1015  
set-generation-2-gc-options 1858  
set-gen-num-gc-threshold 150, 1860  
set-hash-table-weak 165, 1017  
set-java-field 1302  
set-make-instance-argument-checking 502  
set-maximum-memory 146, 1862  
set-maximum-segment-size 148, 150, 1863  
set-memory-check 1865  
set-memory-exhausted-callback 1866  
set-minimum-free-space 139, 146, 1019  
set-prepared-statement-variables 1639  
set-primitive-array-region 1248  
set-process-profiling 169, 170, 1020  
set-profiler-threshold 1022  
set-promote-generation-1 1868  
set-promotion-count 1023  
set-quit-when-no-windows 1176  
set-registry-value 468, 1937  
set-remote-debugging-connection 33, 775  
set-reserved-memory-policy 1869  
set-serial-port-state 1523  
set-signal-handler 1870  
set-spare-keeping-policy 151, 1871  
set-split-promotion 1872  
set-ssl-ctx-dh 426, 608  
set-ssl-ctx-options 426, 610  
set-ssl-ctx-password-callback 426, 610  
set-ssl-library-path 420, 611  
set-static-segment-size 1874  
sets-who 1030  
set-system-message-log 1024  
set-temp-directory 468, 1875  
setup-atomic-funcall 1876  
setup-deliver-dynamic-library-for-java 217, 1308  
setup-field-accessor 1312  
setup-java-caller 1313  
setup-java-constructor 1313  
setup-java-interface-callbacks 1253  
setup-lisp-proxy 1315  
set-up-profiler 168, 1025  
set-verification-mode 606  
short-namestring 454  
short-site-name 453, 701  
sid-string-to-user-name 1916  
simple-augmented-string-p 1722  
simple-base-string-p 1086  
simple-bmp-string-p 1089  
simple-char-p 1177

simple-int32-vector-length 1879  
simple-int32-vector-p 1879  
simple-int64-vector-length 1880  
simple-int64-vector-p 1881  
simple-lock-and-condition-variable-wait 1501  
simple-text-string-p 1186  
single-form-form-parser 822  
single-form-with-options-form-parser 822  
socket-stream-address 617  
socket-stream-ctx 431, 618  
socket-stream-handshake 618  
socket-stream-peer-address 619  
socket-stream-shutdown 620  
socket-stream-ssl 431, 621  
socket-stream-ssl-side 431, 622  
software-type 453, 703  
software-version 453, 704  
source-debugging-on-p 1031  
specific-valid-file-encoding 1882  
split-sequence 1177  
split-sequence-if 1178  
split-sequence-if-not 1179  
sql 368, 1642  
sql-expression 368, 1645  
sqlite-blob-length 1650  
sqlite-blob-p 1650  
sqlite-close-blob 395, 1650  
sqlite-last-insert-rowid 1649  
sqlite-open-blob 395, 1650  
sqlite-raw-blob-length 395, 1655  
sqlite-raw-blob-p 1655  
sqlite-raw-blob-ref 395, 1655  
sqlite-raw-blob-valid-p 395, 1655  
sqlite-reopen-blob 1650  
sql-operation 368, 1660  
sql-operator 368, 1662  
sql-recording-p 372, 1663  
sql-stream 372, 1664  
ssl-add-client-ca 427  
ssl-cipher-get-bits 427  
ssl-cipher-get-name 427  
ssl-cipher-get-version 427  
ssl-clear-num-renegotiations 427  
ssl-ctrl 428  
ssl-ctx-add-client-ca 428  
ssl-ctx-add-extra-chain-cert 428  
ssl-ctx-ctrl 428  
ssl-ctx-get-max-cert-list 428  
ssl-ctx-get-mode 428  
ssl-ctx-get-options 428  
ssl-ctx-get-read-ahead 428  
ssl-ctx-get-verify-mode 428  
ssl-ctx-load-verify-locations 428  
ssl-ctx-need-tmp-rsa 428  
ssl-ctx-sess-get-cache-mode 428  
ssl-ctx-sess-get-cache-size 428  
ssl-ctx-sess-set-cache-mode 428  
ssl-ctx-sess-set-cache-size 428  
ssl-ctx-set-client-ca-list 428  
ssl-ctx-set-max-cert-list 428  
ssl-ctx-set-mode 428  
ssl-ctx-set-options 428  
ssl-ctx-set-read-ahead 428  
ssl-ctx-set-tmp-dh 428  
ssl-ctx-set-tmp-rsa 428  
ssl-ctx-use-certificate-chain-file 428  
ssl-ctx-use-certificate-file 429  
ssl-ctx-use-privatekey-file 429  
ssl-ctx-use-rsaprivatekey-file 429  
ssl-get-current-cipher 429  
ssl-get-max-cert-list 429  
ssl-get-mode 429  
ssl-get-options 429  
ssl-get-verify-mode 429  
ssl-get-version 429  
ssl-load-client-ca-file 429  
ssl-need-tmp-rsa 429  
ssl-new 431, 625  
ssl-num-renegotiations 429  
ssl-session-reused 429

ssl-set-accept-state 424, 429  
ssl-set-client-ca-list 429  
ssl-set-connect-state 424, 429  
ssl-set-max-cert-list 429  
ssl-set-mode 429  
ssl-set-options 429  
ssl-set-tmp-dh 429  
ssl-set-tmp-rsa 429  
ssl-total-renegotiations 429  
ssl-use-certificate-file 430  
ssl-use-privatekey-file 430  
ssl-use-rsaprivatekey-  
    file 430  
standard-instance-access 250  
start-client-remote-debug-  
    ging-server 27, 33, 776  
start-dde-server 1983  
start-gc-timing 1031  
start-ide-remote-debugging-  
    server 26, 27, 779  
start-profiling 169, 170, 1033  
start-remote-listener 25, 27,  
    28, 34, 781  
start-sql-recording 372, 1666  
start-tty-listener 1180  
start-up-server 626  
start-up-server-and-mp 632  
staticp 1884  
status 338, 1667  
stchar 1181  
stop-gc-timing 1031  
stop-profiling 169, 170, 1036  
stop-sql-recording 372, 1668  
string-append 1182  
string-append\* 1183  
string-ip-address 633  
string-needs-n-prefix 1668  
string-prefix-with-n-if-  
    needed 1669  
string-trim-whitespace 1035  
structurep 1184  
subtract-code-coverage-  
    data 839  
sweep-all-objects 164, 1037  
sweep-gen-num-objects 1885  
switch-open-tcp-stream-  
    with-ssl-to-java 634  
switch-static-  
    allocation 136, 137, 1038  
symbol-dynamically-bound-  
    p 1039  
symeval-in-process 295, 1503  
table-exists-p 1670  
text-string-p 1186  
throw-an-exception 1317  
timer-expired-p 1504  
timer-name 1505  
toggle-source-debugging 117,  
    1040  
total-allocation 145, 1042  
traceable-dspec-p 823  
trace-new-instances-on-  
    access 505  
trace-on-access 506  
tracing-enabled-p 824  
tracing-state 825  
true 1186  
truename 720  
try-compact-in-  
    generation 144, 146, 1051  
try-move-in-generation 144,  
    146, 1052  
typed-aref 1886  
unbreak-new-instances-on-  
    access 509  
unbreak-on-access 509  
undefine-declaration 1054  
unicode-alpha-char-p 451, 1188  
unicode-alphanumericp 451,  
    1189  
unicode-both-case-p 451, 1190  
unicode-char-equal 451, 1191  
unicode-char-greaterp 451,  
    1192  
unicode-char-lessp 451, 1192  
unicode-char-not-equal 451,  
    1191  
unicode-char-not-  
    greaterp 451, 1193  
unicode-char-not-lessp 451,  
    1193  
unicode-lower-case-p 451, 1194  
unicode-string-equal 451, 1194  
unicode-string-greaterp 451,  
    1196  
unicode-string-lessp 451, 1196  
unicode-string-not-  
    equal 451, 1194  
unicode-string-not-  
    greaterp 451, 1197  
unicode-string-not-  
    lessp 451, 1197  
unicode-upper-case-p 451, 1198  
unlocked-queue-count 964

**unlocked-queue-peek** 964  
**unlocked-queue-read** 964  
**unlocked-queue-ready** 964  
**unlocked-queue-send** 964  
**unlocked-queue-size** 964  
**unnotice-fd** 1506  
**unschedule-timer** 1506  
**untrace-new-instances-on-access** 510  
**untrace-on-access** 510  
**update-instance-for-different-class** 722  
**update-instance-for-redefined-class** 723  
**update-objects-joins** 1672  
**update-records** 348, 349, 381, 1673  
**user-homedir-pathname** 227, 466, 1764  
**user-name-to-sid-string** 1919  
**user-preference** 464, 1199  
**valid-external-format-p** 838  
**variable-information** 1058  
**vector-pop** 276  
**vector-push** 276  
**vector-push-extend** 276  
**verify-java-caller** 1320  
**verify-java-callers** 1321  
**verify-lisp-proxies** 1324  
**verify-lisp-proxy** 1324  
**wait-for-input-streams** 1888  
**wait-for-input-streams-returning-first** 1889  
**wait-for-wait-state-collection** 411, 635  
**wait-processing-events** 1508  
**wait-serial-port-state** 1524  
**wait-state-collection-stop-loop** 411, 415, 636  
**whitespace-char-p** 1203  
**who-binds** 1059  
**who-calls** 1060  
**who-references** 1061  
**who-sets** 1061  
**with-remote-debugging-connection** 33  
**write-java-class-definitions-to-file** 1326  
**write-java-class-definitions-to-stream** 1326  
**write-serial-port-char** 1524  
**write-serial-port-string** 1525  
**write-string-with-properties** 1072  
**yield** 1514  
**fundamental-binary-input-stream** class 1683  
**fundamental-binary-output-stream** class 1684  
**fundamental-binary-stream** class 1684  
**fundamental-character-input-stream** class 400, 1685  
**fundamental-character-output-stream** class 400, 1686  
**fundamental-input-stream** class 1687  
**fundamental-output-stream** class 1688  
**fundamental-stream** class 1688

**G**

garbage collection, see also memory management  
 main chapter 129  
**GBK** 445  
**:gbk** external format 445  
**gc-generation** function 136, 138, 146, 150, 942  
**gc-if-needed** function 146, 946  
**general-handle-event** generic function 1393  
**generate-code-coverage** function 946  
**generate-java-class-definitions** function 1239  
**generation**  
 definition 130  
**generation 2** 144  
**generation-number** function 144, 1755  
**generic functions**  
**accessor-method-slot-definition** 250  
**add-method** 251  
**class-extra-initargs** 487  
**close** 641  
**compute-applicable-methods-using-classes** 251  
**compute-class-potential-initargs** 488  
**compute-discriminating-function** 251, 490  
**compute-effective-method-**

```

        function-from-classes 490
dde-client-advise-data 1948
dde-server-poke 1971
dde-server-request 1972
dde-server-topic 1973
dde-server-topics 1974
dde-topic-items 1976
default-constructor-
    arguments 1217
delete-instance-records 357,
    1558, 1572
describe-object 38
documentation 668
general-handle-event 1393
get-inspector-values 1138
input-stream-p 676
instance-refreshed 357
make-instance 684
make-method-lambda 250
open-stream-p 691
output-stream-p 692
print-object 189
process-a-class-option 495
process-a-slot-option 497
remote-debugging-stream-
    peer-address 769
slot-boundp-using-class 249,
    502
slot-makunbound-using-
    class 249, 503
slot-value-using-class 249,
    504
sort-inspector-p 1138
stream-advance-to-
    column 1689
stream-check-eof-no-
    hang 1690
stream-clear-input 402, 1690
stream-clear-output 403, 1691
stream-element-type 400, 709
stream-file-position 1692
stream-fill-buffer 1692
stream-finish-output 403, 1693
stream-flush-buffer 1694
stream-force-output 403, 1695
stream-fresh-line 1695
stream-line-column 403, 1696
stream-listen 402, 1697
stream-output-width 1698
stream-peek-char 1698
stream-read-buffer 1699
stream-read-byte 1700
stream-read-char 401, 1701
stream-read-char-no-
    hang 1701
stream-read-line 1702
stream-read-sequence 1703
stream-read-timeout 1704
stream-start-line-p 403, 1704
stream-terpri 1705
stream-unread-char 401, 1706
stream-write-buffer 1706
stream-write-byte 1707
stream-write-char 402, 1708
stream-write-sequence 1708
stream-write-string 1709
update-instance-from-
    records 357, 1671
update-record-from-
    instance 1674
update-record-from-slot 357,
    1675
update-records-from-
    instance 357
update-slot-from-record 357,
    1675
wait-for-connection 1919
:gen-num initarg 1884
gen-num-segments-fragmenta-
    tion-state function 150, 1754
gensym function 164
gesture-spec-accelerator-bit
    variable 1756
gesture-spec-caps-lock-bit
    variable 1756
gesture-spec-control-bit
    variable 1756
gesture-spec-data function 1758
gesture-spec-hyper-bit
    variable 1756
gesture-spec-meta-bit
    variable 1756
gesture-spec-modifiers
    function 1758
gesture-spec-p function 1759
gesture-spec-shift-bit
    variable 1756
gesture-spec-super-bit
    variable 1756
gesture-spec-to-character
    function 1760
get 851
:get listener command 6
getApplicationContext Java

```

**method** 1355  
**getClassLoader** Java method 1355  
**get-code-coverage-delta**  
  function 940  
**get-current-process** function 262,  
  263, 1394  
**get-default-generation**  
  function 146, 949  
**get-default-local-ipv6-address**  
  function 578  
**get-file-stat** function 1761  
**get-folder-path** function 467, 1762  
**get-foreign-symbol** function 1077  
**get-form-parser** function 811  
**get-gc-parameters** function 146,  
  950  
**get-gc-timing** function 1031  
**gethash-ensuring** function 952  
**get-host-entry** function 578  
**get-host-java-virtual-machine**  
  function 1245  
**get-inspector-values** generic  
  function 1138  
**get-ip-default-zone-id**  
  function 581  
**get-java-virtual-machine**  
  function 1246  
**get-job-object** function 1247  
**get-maximum-allocated-in-generation-2-after-gc**  
  function 1765  
**get-primitive-array-region**  
  function 1248  
**GetProcAddress** C function 191  
**get-process** function 263, 1395  
**get-process-private-property**  
  function 1396  
**get-serial-port-state**  
  function 1520  
**get-service-entry** function 582  
**get-socket-address** function 583  
**get-socket-peer-address**  
  function 584  
**get-superclass-and-interface-tree**  
  function 1250  
**get-temp-directory** function 951  
**get-unix-error** function 1142  
**get-user-profile-directory**  
  function 467, 1767  
**get-verification-mode**  
  function 585  
**get-working-directory**  
  function 952  
**globally-accessible** macro 269,  
  270, 273, 274, 1768  
**grammar**  
  non-terminal 314  
  resolving ambiguities 315  
  rules 313  
**graphics ports** liii  
**> SQL operator** 363  
**\*grep-command\*** variable 1142  
**\*grep-command-format\***  
  variable 1143  
**\*grep-fixed-args\*** variable 1144  
**guess-external-format**  
  function 448, 1769  
**GUI application** 1002

## H

**:h** inspector command 39  
**\*handle-existing-action-in-action-list\*** variable 1144,  
  96  
**\*handle-existing-action-list\*** variable 1145, 96  
**\*handle-existing-defpackage\***  
  variable 954  
**\*handle-missing-action-in-action-list\*** variable 1146,  
  97  
**\*handle-missing-action-list\***  
  variable 1145, 97  
**\*handle-old-in-package\***  
  variable 955  
**\*handle-old-in-package-used-as-make-package\***  
  variable 956  
**handler frame**, examining 12  
**:handler** keyword 761  
**\*handle-warn-on-redefinition\*** variable 187, 1146  
**hardcopy-system** function 1147  
**hash tables**  
  weak 682  
**heap size**  
  in 32-bit LispWorks 460, 478  
  in 64-bit LispWorks 461, 478  
**:help** listener command 7  
**HFS+** filesystem 469  
**:hidden** keyword 743  
**\*hidden-packages\*** variable 24, 742  
**:his** listener command 7  
**hook functions** 95

host 578  
 host name 578  
 hostname 578

**I**

- :i inspector command 39
- i18n 435
- ide-attach-remote-output-stream** function 30, 744
- ide-connect-remote-debugging** function 27, 28, 745
- ide-eval-form-in-remote** function 29, 30, 747
- ide-find-remote-debugging-connection** function 35, 750
- ide-funcall-in-remote** function 29, 30, 747
- ide-list-remote-debugging-connections** function 35, 750
- ide-open-a-listener** function 25, 28, 753
- ide-remote-debugging system** class 765
- ide-set-default-remote-debugging-connection** function 35, 750
- ide-set-remote-symbol-value** function 30, 747
- image
  - saving 179
- image size 457
- immediatep** function 1770
- impersonating-named-pipe-client** macro 1899
- impersonating-user** macro 1900
- import-java-class-definitions** macro 1251
- incf** macro 267
- init file 1148
- init Java method 1341
- init\_result\_code Java method 1344
- \*init-file-name\* variable 1148
- initialization
  - of Common SQL 334
- initialization file 1148
- initialize-database-type** function 1569
- \*initialized-database-types\* variable 1570
- initialize-multiprocessing** function 263, 1397
- \*initial-processes\* variable 195,
- 263, 1398

**init-java-interface**  
 function 1253

**InitLispWorks** C function 194, 460, 1985

**input-stream-p** generic function 676

**insert-records** function 348, 381, 1570

**:inside** keyword 55

**inspect** function 38

inspector
 

- main chapter 37
- REPL 37
- teletype 37

inspector commands

- :cv 39
- :d 39
- :dm 39
- :dr 39
- :h 39
- :i 39
- :m 39, 40
- :q 39
- :s 39
- :sh 39
- :u 39
- :ud 39, 40

\***inspect-print-length\***  
 variable 39

\***inspect-print-level\***  
 variable 39

\***inspect-through-gui\***  
 variable 1149

**instance-refreshed** generic function 357

**in-static-area** macro 137, 1771

**int32\*** function 1773

**int32+** function 473, 1773

**int32-** function 473, 1773

**int32 type** 472, 1772

**int32/** function 1773

**int32/=** function 1775

**int32<** function 1775

**int32<<** function 1776

**int32<=** function 1775

**int32=** function 1775

**int32>** function 1775

**int32>=** function 1775

**int32>>** function 1776

+**int32-0** symbol macro 1774

**int32-1+** function 1774

**int32-1-** function 1774

**+int32-1+** symbol macro 1774  
**int32-aref** function 1777  
**int32-logand** function 1778  
**int32-logandc1** function 1778  
**int32-logandc2** function 1778  
**int32-logbitp** function 1778  
**int32-logeqv** function 1778  
**int32-logior** function 1778  
**int32-lognand** function 1778  
**int32-lognor** function 1778  
**int32-lognot** function 1778  
**int32-logorc1** function 1778  
**int32-logorc2** function 1778  
**int32-logtest** function 1778  
**int32-logxor** function 1778  
**int32-minusp** function 1781  
**int32-plusp** function 1781  
**int32-to-int64** function 1781  
**int32-to-integer** function 1782  
**int32-zeroop** function 1781  
**int64\*** function 1784  
**int64+** function 474, 1784  
**int64-** function 474, 1784  
**int64-type** 474, 1783  
**int64/** function 1784  
**int64/=** function 1786  
**int64<** function 1786  
**int64<<** function 1787  
**int64<=** function 1786  
**int64=** function 1786  
**int64>** function 1786  
**int64>=** function 1786  
**int64>>** function 1787  
**+int64-0+** symbol macro 1785  
**int64-1+** function 1785  
**int64-1-** function 1785  
**+int64-1+** symbol macro 1785  
**int64-aref** function 1788  
**int64-logand** function 1789  
**int64-logandc1** function 1789  
**int64-logandc2** function 1789  
**int64-logbitp** function 1789  
**int64-logeqv** function 1789  
**int64-logior** function 1789  
**int64-lognand** function 1789  
**int64-lognor** function 1789  
**int64-lognot** function 1789  
**int64-logorc1** function 1789  
**int64-logorc2** function 1789  
**int64-logtest** function 1789  
**int64-logxor** function 1789  
**int64-minusp** function 1791  
**int64-plusp** function 1791  
**int64-to-int32** function 1792  
**int64-to-integer** function 1793  
**int64-zeroop** function 1791  
**integer-to-int32** function 1793  
**integer-to-int64** function 1794  
**interactive-stream-p**  
    function 676  
**interface**  
    between parser generator and lexical analyzer 317  
    Common SQL initialization 334  
**intern-and-export-list**  
    function 1260  
**Internationalization** 435  
**intern-eql-specializer**  
    function 250  
**interpreter**  
    differences from compiler 101  
**interruptable** 105  
**invalid superclass** 253  
**:invisible keyword** 762  
**iOS interface**  
    overview 241  
**iOS runtimes**  
    creating 241  
    example 244  
**IP Address** 578  
**ip-address-string** function 585  
**IPv4** 578  
**IPv6** 410, 578  
    on Mac OS X 410  
    on Windows 410  
**IPv6 support** 585, 600  
**ipv6-address** function 586  
**ipv6-address-p** function 587  
**ipv6-address-scope-id**  
    function 587  
**ipv6-address-string** function 588  
**ISO8859-1** 443

**J**

**jaref** function 1260  
**Java classes**  
    **BugFormLogsList** 1357  
    **BugFormViewer** 1357  
    **LispCalls** 1331  
    **Manager** 1339  
**Java fields**  
    **mMaxErrorLogsNumber** 1350  
    **mMessagesMaxLength** 1352  
**Java interface**

Java side 1331  
 Lisp side 197  
 Java interfaces  
   **LispErrorReporter** 1347  
   **LispGuiErrorReporter** 1347  
   **MessageHandler** 1354  
 Java methods  
   **addMessage** 1352  
   **callDoubleA** 1332  
   **callDoubleV** 1332  
   **callIntA** 1332  
   **CallIntV** 1332  
   **callObjectA** 1332  
   **callObjectV** 1332  
   **callVoidA** 1332  
   **callVoidV** 1332  
   **checkLispSymbol** 1334  
   **clearBugFormLogs** 1350  
   **createLispProxy** 1335  
   **getApplicationContext** 1355  
   **getClassLoader** 1355  
   **init** 1341  
   **init\_result\_code** 1344  
   **loadLibrary** 1346  
   **mInitErrorString** 1346  
   **setCurrentActivity** 1356  
   **setErrorReporter** 1347  
   **setGuiErrorReporter** 1347  
   **setMessageHandler** 1354  
   **setTextView** 1354  
   **showBugFormLogs** 1351  
   **status** 1343  
 Java virtual machine 201  
**java-array-element-type**  
   function 1262  
**java-array-error** condition 1263  
**java-array-error-array**  
   accessor 1263  
**java-array-error-caller**  
   accessor 1263  
**java-array-indices-error**  
   condition 1263  
**java-array-indices-error-indices**  
   accessor 1264  
**java-array-indices-error-rank**  
   accessor 1264  
**java-array-length** function 1264  
**java-array-simple-error**  
   condition 1265  
**java-bad-object** condition 1265  
**java-bad-object-caller**  
   accessor 1265  
**java-bad-object-object**  
   accessor 1265  
**java-class-error** condition 1266  
**java-definition-error**  
   condition 1266  
**java-definition-error-class-name**  
   accessor 1266  
**java-definition-error-name**  
   accessor 1266  
**java-exception** condition 1267  
**java-exception-exception-name**  
   accessor 1268  
**java-exception-java-backtrace**  
   accessor 1268  
**java-exception-string**  
   accessor 1268  
**java-field-class-name-for-setting**  
   function 1302  
**java-field-error** condition 1266  
**java-field-error-field-name**  
   accessor 1266  
**java-field-error-static-p**  
   accessor 1266  
**java-field-setting-error**  
   condition 1268  
**java-field-setting-error-class-name**  
   accessor 1269  
**java-field-setting-error-class-name-for-setting**  
   accessor 1269  
**java-field-setting-error-field-name**  
   accessor 1269  
**java-field-setting-error-new-value**  
   accessor 1269  
**java-id-exception** condition 1269  
**java-instance-object**  
   accessor 219, 1316  
**java-instance-without-object-error** condition 1270  
**java-interface-error**  
   condition 1270  
**java-low-level-exception**  
   condition 1271  
**java-method-error** condition 1266  
**java-method-error-args-num**  
   accessor 1266  
**java-method-error-method-name**  
   accessor 1266  
**java-method-exception**  
   condition 1271  
**java-method-exception-args**  
   accessor 1272

**java-method-exception-class-name** accessor 1272  
**java-method-exception-method-name** accessor 1272  
**java-method-exception-name-accessor** 1272  
**java-normal-exception-condition** 1272  
**java-not-a-java-object-error-condition** 1273  
**java-not-an-array-error-condition** 1274  
**\*java-null\* constant** 1274  
**java-object-array-element-type** function 1275  
**java-objects-eq** function 1275  
**java-out-of-bounds-error-condition** 1276  
**java-primitive-array-element-type** function 1277  
**java-serious-exception-condition** 1278  
**java-storing-wrong-type-error** condition 1276  
**java-type-to-lisp-array-type-function** 1278  
**java-vm-poi** type 1280  
**jboolean** type 1280  
**jbyte** type 1280  
**jchar** type 1280  
**jdouble** type 1280  
**jfloat** type 1280  
**jint** type 1280  
**JIS** 444  
**:jis** external format 444  
**jlong** type 1280  
**JNI\_CreateJavaVM** 1255, 1257  
**JNI\_GetCreatedJavaVMs** 1247  
**JNI\_OnLoad** 1257  
**jni-env-poi** type 1281  
**:jobject** initarg 1316  
**jobject** type 1281  
**jobject-class-name** function 1282  
**jobject-ensure-global** function 1283  
**jobject-of-class-p** function 1284  
**jobject-p** function 1285  
**jobject-pretty-class-name** function 1285  
**jobject-string** function 1286  
**jobject-to-lisp** function 1287  
**join slot** 354

**jshort** type 1280  
**JVM** 201  
**jvref** function 1288

## K

keywords  
**:after** 50  
**:all** 309  
**:allocation** 55  
**:backtrace** 52  
**:before** 49  
**:bindings** 757  
**:break** 51  
**:break-on-exit** 51  
**:catchers** 760  
**:caused-by** 309  
**:default-pathname** 307  
**:dont-know** 17  
**:entrycond** 52  
**:eval-after** 51  
**:eval-before** 50  
**:exitcond** 52  
**:handler** 761  
**:hidden** 743  
**:inside** 55  
**:invisible** 762  
**:maximum-overflow** 143  
**:members** 307  
**:minimum-for-sweep** 139, 143  
**:minimum-overflow** 143  
**:new-generation-size** 144  
**:package** 307  
**:previous** 309  
**:process** 54  
**:requires** 309, 310  
**:restarts** 764  
**:rules** 308  
**:source-only** 308  
**:step** 52  
**:trace-output** 54  
**:when** 55

KnowledgeWorks rules  
 compiling dynamically 103  
**known-sid-integer-to-sid-string** function 1901  
**KOI8** 445  
**:koi-8** external format 445  
**KOI8-R** 445

## L

**:l** debugger command 17

**:lambda** debugger command 19  
**last-callback-on-thread**  
 function 1399  
**Latin-1** 443  
**:latin-1** external format 443  
**\*latin-1-code-pages\***  
 variable 1902  
**:latin-1-safe** external format 444  
**:latin-1-terminal** external  
 format 443  
 levels of safety, see compiler  
**:lf** debugger command 19  
 library formats 1079  
**libssl32.dll** OpenSSL DLL 420  
**\*line-arguments-list\***  
 variable 454, 1795  
**lisp** image  
 filename 454, 1149  
 pathname 454, 1149  
**lisp-array-to-primitive-**  
 array function 1299  
**lisp-array-type-to-java-type**  
 function 1278  
**LispCalls** Java class 1331  
**LispErrorReporter** Java  
 interface 1347  
**LispGuiErrorReporter** Java  
 interface 1347  
**lisp-image-name** function 454, 1149  
**lisp-java-instance-p**  
 function 1290  
**lisp-name-to-foreign-name**  
 function 1078  
**lisp-to-object** function 1290  
**LispWorks**  
 customizing 178  
 processes 261  
 quitting 4, 99  
 saving 2  
 starting 1, 99  
 threads in 261  
**LispWorks as a DLL** 191  
**LispWorks as a dynamic library** 191  
**LispWorks as a shared library** 191  
**LispWorks IDE**  
 Debugger tool 1124  
 Help menu lviii, 249, 639  
 Inspector tool 1149  
 Notifier window 1124  
 Profiler tool 999  
**\*lispworks-directory\***  
 variable 1150  
**LispWorksDlsym** C function 1988  
**LispWorksState** C function 194, 1989  
**List Callees** Editor command 863  
**List Callers** Editor command 1060  
**list-all-processes** function 263,  
 1400  
**list-attributes** function 353, 1574  
**list-attribute-types**  
 function 353, 1573  
**list-classes** function 357, 1575  
**listener** 1181  
 main chapter 5  
 top level commands 1740  
**listener commands**  
**:?** 7  
**:bug-form** 7  
**:get** 6  
**:help** 7  
**:his** 7  
**:redo** 6  
**:use** 7  
 listener process 1398  
 listener prompt 1163  
**list-sql-streams** function 372, 1576  
**list-tables** function 353, 1576  
**Load File** Editor command 120  
**load-all-patches** function 1152  
**load-code-coverage-data**  
 function 889  
**load-data-file** function 957  
**\*load-fasl-or-lisp-file\***  
 variable 961  
**LoadLibrary** C function 191  
**loadLibrary** Java method 1346  
**load-logical-pathname-trans-**  
 lations function 677  
**load-on-demand** 188  
**\*load-source-if-newer\*** 1154  
**load-system** function 1153  
**:lob-locator** initarg 1577  
**lob-stream** class 380, 384, 389, 1577  
**lob-stream-lob-locator**  
 accessor 1578  
**lob-stream-lob-locator**  
 function 384  
**local-dspec-p** function 812  
**locale-file-encoding**  
 function 1796  
**locally-disable-sql-reader-**  
 syntax function 370, 1578  
**locally-enable-sql-reader-**  
 syntax function 370, 1579

**location** macro 813  
**lock** system class 1401  
**lock-and-condition-variable-**  
  broadcast function 1401  
**lock-and-condition-variable-**  
  signal function 1402  
**lock-and-condition-variable-**  
  wait function 1404  
**lock-locked-p** function 1406  
**lock-name** function 277, 1409  
**lock-owned-by-current-process-p** function 1407  
**lock-owner** function 277, 1409  
**lock-recursively-locked-p**  
  function 1408  
**lock-recursive-p** function 1407  
locks 277  
**log-bug-form** function 754  
**logs-directory** function 755  
**long-float** type 678  
**long-namestring** function 454, 1903,  
  1915  
**long-site-name** function 453, 678  
**loop** macro 346, 351, 679, 1580  
  extensions in Common SQL 358  
**loop**, extensions in Common SQL 351  
**loop-processing-wait-state-**  
  collection function 411, 413,  
  589  
Low level atomic operations 299  
**low-level-atomic-place-p**  
  function 1797  
**lpcstr** FLI type 1916  
**lpctstr** FLI type 1917  
**lpcwstr** FLI type 1918  
**lpstr** FLI type 1916  
**lptstr** FLI type 1917  
**lpwstr** FLI type 1918

**M**

**:m** inspector command 39, 40  
Mach-O bundle 1005  
Mach-O dynamically linked shared  
  library 1003  
**:macos-roman** external format 444  
macros  
  advice 67  
  **allocation-in-gen-num** 137,  
  146, 843  
  **allowing-block-**  
    **interrupts** 289, 1359  
  **analysing-special-vari-**  
**ables-usage** 844  
**appendf** 1083  
**at-location** 792  
**atomic-decf** 1718  
**atomic-exchange** 1719  
**atomic-fixnum-decf** 1719  
**atomic-fixnum-incf** 1719  
**atomic-incf** 1718  
**atomic-pop** 1720  
**atomic-push** 1721  
**block-promotion** 861  
**catching-exceptions-**  
  **bind** 1211  
**catching-java-exceptions** 1211  
**cd** 864  
**compare-and-swap** 1733  
**declare** 110, 650  
**def** 794  
**defadvice** 67, 73, 1100  
**defclass** 657  
**defglobal-parameter** 903  
**defglobal-variable** 904  
**define-action** 96, 1105  
**define-action-list** 96, 1107  
**define-atomic-modify-**  
  macro 1738  
**define-dde-client** 1967  
**define-dde-dispatch-**  
  topic 1977  
**define-dde-server** 1978  
**define-dde-server-**  
  function 1979  
**define-declaration** 905  
**define-dspec-alias** 795  
**define-dspec-class** 796  
**define-field-accessor** 1219  
**define-foreign-callable** 297  
**define-form-parser** 799  
**define-java-caller** 1220  
**define-java-callers** 1223  
**define-java-constructor** 1220  
**define-lisp-proxy** 1225  
**define-top-loop-command** 1740  
**defpackage** 661  
**defparameter** 904  
**defparser** 315, 1515  
**defstruct** 189  
**defsystem** 305–311, 1109  
**deftransform** 725  
**defvar** 904  
**def-view-class** 354, 355, 1551

**delete-advice** 66, 73, 907  
**do-query** 351, 381, 1563  
**error-situation-forms** 923  
**execute-actions** 1129  
**extended-time** 149, 163, 173, 926  
**globally-accessible** 269, 270,  
     273, 274, 1768  
**impersonating-named-pipe-**  
     client 1899  
**impersonating-user** 1900  
**import-java-class-**  
     definitions 1251  
**in-static-area** 137, 1771  
**location** 813  
**loop** 679, 1580  
**profile** 169, 981  
**push-end** 1164  
**push-end-new** 1164  
**rebinding** 1167  
**release-object-and-**  
     nullify 1837  
**removef** 1171  
**replacement-source-form** 820  
**restart-case** 694  
**simple-do-query** 351, 381, 1640  
**step** 706  
**throw-if-tag-found** 1040  
**time** 711  
**trace** 713  
**undefine-action** 96, 1187  
**undefine-action-list** 96, 1188  
**untrace** 721  
**unwind-protect-blocking-**  
     interrupts 289, 1055  
**unwind-protect-blocking-**  
     interrupts-in-  
     cleanups 289, 1057  
**when-let** 1201  
**when-let\*** 1202  
**with-action-item-error-**  
     handling 1204  
**with-action-list-**  
     mapping 1205  
**with-code-coverage-**  
     generation 1062  
**with-dde-conversation** 1968  
**with-debugger-wrapper** 785  
**with-ensuring-gethash** 1063  
**with-exclusive-lock** 277, 1509  
**with-hash-table-locked** 1065  
**with-heavy-allocation** 146,  
     1066  
  
**with-interrupts-blocked** 289,  
     1510  
**with-lock** 277, 1510  
**with-modification-**  
     change 1890  
**with-modification-check-**  
     macro 1891  
**with-noticed-socket-**  
     stream 637  
**with-other-threads-**  
     disabled 289, 1892  
**without-code-coverage** 1071  
**without-interrupts** 289, 290,  
     1512  
**without-preemption** 289, 290,  
     1513  
**with-output-to-fasl-**  
     file 1067  
**with-output-to-string** 723  
**with-registry-key** 468, 1938  
**with-remote-debugging-**  
     connection 788  
**with-remote-debugging-**  
     spec 789  
**with-ring-locked** 1071  
**with-sharing-lock** 277, 1511  
**with-sqlite-blob** 395, 1677  
**with-stream-input-**  
     buffer 1710  
**with-stream-output-**  
     buffer 1712  
**with-transaction** 348, 350, 1678  
**with-unique-names** 1206  
**with-windows-event-log-**  
     event-source 1921  
**mailbox system class** 1411  
**mailbox-count function** 1411  
**mailbox-empty-p function** 1412  
**mailbox-full-p function** 1413  
**mailbox-not-empty-p**  
     function 1414  
**mailbox-peek function** 1414  
**mailbox-read function** 1415  
**mailbox-reader-process**  
     function 1416  
**mailbox-send function** 1417  
**mailbox-send-limited**  
     function 1418  
**mailbox-size function** 1420  
**mailbox-wait function** 1421  
**mailbox-wait-for-event**  
     function 1422

**\*main-process\*** variable 1424  
**make-array** function 165, 276, 680  
**make-barrier** function 287, 1424  
**make-condition-variable**  
  function 1426  
**make-current-allocation-permanent**  
  function 1798  
**make-gesture-spec** function 1800  
**make-hash-table** function 165, 276,  
  682  
**make-instance** generic function 684  
**make-java-array** function 1291  
**make-java-instance** function 1292  
**make-lisp-proxy** function 1293  
**make-lisp-proxy-with-overrides** function 1293  
**make-lock** function 1427  
**make-mailbox** function 1429  
**make-method-lambda** generic  
  function 250  
**make-mt-random-state**  
  function 1156  
**make-named-timer** function 1430  
**make-object-permanent**  
  function 1805  
**make-permanent-simple-vector**  
  function 1807  
**make-ring** function 962  
**make-semaphore** function 288, 1431  
**make-sequence** function 685  
**make-simple-int32-vector**  
  function 1808  
**make-simple-int64-vector**  
  function 1809  
**make-ssl-ctx** function 422, 423, 588  
**make-stderr-stream** function 1810  
**make-string** function 686  
**make-string-output-stream**  
  function 687  
**make-symbol** function 164  
**make-timer** function 293, 1432  
**make-typed-aref-vector**  
  function 1811  
**make-unlocked-queue** function 964  
**make-unregistered-action-list** function 1154  
**make-wait-state-collection**  
  function 411, 590  
**Manager** Java class 1339  
**map** function 688  
**map-all-processes** function 1433  
**map-all-processes-backtrace**  
  function 1433  
**map-code-coverage-data**  
  function 966  
**map-environment** function 1812  
**map-java-object-array**  
  function 1295  
**map-process-backtrace**  
  function 1434  
**map-processes** function 1435  
**map-query** function 351, 381, 1582  
**map-ring** function 967  
**mark**  
  and sweep 138  
**mark-and-sweep** function 967  
**marking-gc** function 150, 1813  
**\*maximum-ordinary-windows\***  
  variable 186  
**:maximum-overflow** keyword 143  
**\*max-trace-indent\*** variable 59,  
  969  
**:members** keyword 307  
memory allocation during tracing 55  
memory clashes 194  
  avoiding 459  
memory management  
  common features 163  
  garbage collection strategy in 32-bit  
  LispWorks 139  
  image reduction 163  
  image relocation 457  
  in 32-bit LispWorks 135  
  in 64-bit LispWorks 146  
main chapter 129  
mark and sweep 138  
overflow 143  
relocating the image 457  
timing in 133, 149, 163  
**memory-growth-margin**  
  function 146, 1815  
**merge** function 688  
**merge-code-coverage-data**  
  function 970  
**merge-ef-specs** function 1816  
Mersenne Twister 1157  
**MessageHandler** Java interface 1354  
Metaobject Protocol 249  
metaobject protocol  
  class options 495  
  slot options 498  
method  
  advice 67  
**method-combination** class 251

**methods**  
 tracing 57  
`waitForInitialization` 1336  
`:minimum-for-sweep` keyword 139, 143  
`:minimum-overflow` keyword 143  
`mInitErrorString` Java method 1346  
`mMaxErrorLogsNumber` Java field 1350  
`mMessagesMaxLength` Java field 1352  
`mobile-gc-p` function 1817  
`mobile-gc-sweep-objects` function 1818  
 mod  $2^{32}$  arithmetic 472  
 mod  $2^{64}$  arithmetic 474  
`modify-hash` function 266, 267, 971  
 modifying a database 348  
 MOP  
     AMOP compatibility 249  
     class options 495  
     slot options 498  
`most-positive-fixnum`  
     constant 479  
`mt-random` function 1157  
`mt-random-state` type 1158  
`*mt-random-state*` variable 1157  
`mt-random-state-p` function 1158  
`*multibyte-code-page-ef*`  
     variable 391, 1904  
 multi-processing  
     locks 277  
 multiprocessing  
     locks 277  
`:multiprocessing` delivery keyword 264  
 MySQL  
     connecting 339  
 MySQL client library 341  
     Mac OS X 341  
`*mysql-library-directories*`  
     variable 341, 342, 1583  
`*mysql-library-path*`  
     variable 341, 342, 1584  
`*mysql-library-sub-directories*` variable 341, 1585

**N**

`:n` debugger command 16  
`name-defined-dspecs` function 813  
`name-definition-locations` function 814  
`named-pipe-stream-name`

function 1904  
`name-only-form-parser`  
     function 815  
 New in LispWorks 7.0  
`accepting-handle` type 517  
`accepting-handle-collection` function 518  
`accepting-handle-local-port`  
     function 520  
`accepting-handle-name`  
     function 519  
`accepting-handle-socket`  
     function 520  
`accepting-handle-user-info`  
     function 521  
`accept-tcp-connections-creating-async-io-states`  
     function 513  
`add-code-coverage-data`  
     function 839  
`addMessage` Java method 1352  
 AIX PowerPC/32-bit LispWorks 649  
 AIX PowerPC/64-bit LispWorks 649  
`:android-delivery` feature 671  
`android-funcall-in-main-thread` function 849  
`android-funcall-in-main-thread-list` function 849  
`android-get-current-activity` function 851  
`*android-main-process-for-testing*` variable 852  
`android-main-thread-p` function 852  
`apply-in-wait-state-collection-process` function 522  
`approaching-memory-limit`  
     condition 1717  
`:arm` feature 671  
 ARM Linux/32-bit LispWorks 649  
 Asynchronous I/O 411  
`async-io-state` structure type 523  
`async-io-state-abort`  
     function 523  
`async-io-state-abort-and-close` function 525  
`async-io-state-address`  
     function 526  
`async-io-state-buffered-data-length` function 528  
`async-io-state-discard`  
     function 531

**async-io-state-finish**  
 function 532  
**async-io-state-get-buffered-data** function 533  
**async-io-state-peer-address**  
 function 538  
**async-io-state-read-buffer**  
 function 538  
**async-io-state-read-with-checking** function 542  
**async-io-state-receive-message** function 545  
**async-io-state-send-message** function 547  
**async-io-state-send-message-to-address** function 549  
**async-io-state-write-buffer**  
 function 552  
**\*background-input\*** variable 858  
**\*background-output\***  
 variable 858  
**\*background-query-io\***  
 variable 858  
*backlog* argument to `accept-tcp-connections-creating-async-io-states` 514  
*backlog* argument to `start-up-server` 626  
**base-char-ref** function 1821  
**:bmp** external format 827  
**bmp-char** type 1086  
**bmp-char-p** function 1087  
**:bmp-native** external format 827  
**:bmp-reversed** external format 827  
**bmp-string** type 1088  
**bmp-string-p** function 1089  
**brackets-limits** argument to `find-regexp-in-string` 1135  
**BugFormLogsList** Java class 1357  
**BugFormViewer** Java class 1357  
**callDoubleA** Java method 1332  
**callDoubleV** Java method 1332  
**callIntA** Java method 1332  
**CallIntV** Java method 1332  
**call-java-method** function 1209  
**call-java-method-error**  
 condition 1210  
**callObjectA** Java method 1332  
**callObjectV** Java method 1332  
**callVoidA** Java method 1332  
**callVoidV** Java method 1332  
**call-wait-state-collection**  
 function 556  
**catching-exceptions-bind**  
 macro 1211  
**catching-java-exceptions**  
 macro 1211  
**checked-read-java-field**  
 function 1302  
**check-java-field** function 1302  
**check-lisp-calls-initialized** function 1213  
**checkLispSymbol** Java  
 method 1334  
**clearBugFormLogs** Java  
 method 1350  
**clear-code-coverage**  
 function 869  
**close-accepting-handle**  
 function 557  
**close-async-io-state**  
 function 558  
**close-wait-state-collection** function 559  
**code-coverage-data** type 870  
**code-coverage-data-create-time** accessor 870  
**code-coverage-data-generate-coloring-html**  
 function 871  
**code-coverage-data-generate-statistics** function 877  
**code-coverage-data-name**  
 accessor 870  
**code-coverage-file-stats-type** 879  
**code-coverage-file-stats-called** accessor 879  
**code-coverage-file-stats-counters-count** accessor 879  
**code-coverage-file-stats-counters-executed**  
 accessor 879  
**code-coverage-file-stats-counters-hidden** accessor 879  
**code-coverage-file-stats-fully-covered** accessor 879  
**code-coverage-file-stats-hidden-covered** accessor 879  
**code-coverage-file-stats-lambdas-count** accessor 879  
**code-coverage-file-stats-not-called** accessor 879  
**code-coverage-file-stats-**

```

    partially-covered
      accessor 879
  code-coverage-file-stats-
    source-file accessor 879
  code-coverage-set-editor-
    colors function 881
  code-coverage-set-editor-
    default-data function 883
  code-coverage-set-html-
    background-colors
      function 884
  compute-effective-method-
    function-from-classes
      generic function 490
  Conditional throw and checking for
    catch in the dynamic
    environment 476
  copy-code-coverage-data
    function 889
  copy-current-code-coverage
    function 889
  copy-standard-object
    function 493
  create-and-run-wait-state-
    collection function 560
  create-async-io-state
    function 562
  create-async-io-state-and-
    connected-tcp-socket
    function 564
  create-async-io-state-and-
    connected-udp-socket
    function 567
  create-async-io-state-and-
    udp-socket function 569
  create-instance-from-job-
    ject function 1213
  create-instance-jobobject
    function 1214
  create-instance-jobobject-
    list function 1214
  create-java-object
    function 1216
  create-java-object-error
    condition 1217
  createLispProxy Java
    method 1335
  current-process-kill
    function 1382
  current-process-send
    function 1385
  current-process-set-termi-
    nate-method function 1386
  decode-to-db-standard-date
    function 1547
  decode-to-db-standard-
    timestamp function 1547
  default-constructor-argu-
    ments generic function 1217
  default-name-constructor
    function 1218
  define-field-accessor
    macro 1219
  define-java-caller macro 1220
  define-java-callers
    macro 1223
  define-java-constructor
    macro 1220
  define-lisp-proxy macro 1225
  delivered-image-p function 908
  deliver-to-android-project
    function 909
  destructive-add-code-cover-
    age-data function 839
  destructive-merge-code-cov-
    erage-data function 970
  destructive-reverse-sub-
    tract-code-coverage-data
    function 839
  destructive-subtract-code-
    coverage-data function 839
  detect-utf32-bom function 1744
  detect-utf8-bom function 1744
  dump-forms-to-file additional
    arguments and improved
    documentation 1067
  editor-color-code-coverage
    function 917
  :embedded-module member option
    for defsystem :type :c-
    file 1112
  encode-db-standard-date
    function 1548
  encode-db-standard-times-
    tamp function 1548
  ensure-hash-entry function 922
  ensure-is-object function 1247
  ensure-lisp-classes-from-
    tree function 1233
  ensure-supers-contain-
    java.lang.object
    function 1235
  :error argument in gesture-
    spec-to-character 1760

```

**`errorp`** argument to `gesture-spec-to-character` 1760  
**`error-situation-forms`**  
  macro 923  
**`example-edit-file`** function 1128  
**`fasl-error`** condition 929  
**`fast-directory-files`**  
  function 930  
**`fdf-handle-directory-p`**  
  accessor 930  
**`fdf-handle-directory-string`**  
  accessor 930  
**`fdf-handle-last-access`**  
  accessor 930  
**`fdf-handle-last-modify`**  
  accessor 930  
**`fdf-handle-link-p`** accessor 930  
**`fdf-handle-size`** accessor 930  
**`fdf-handle-writable-p`**  
  accessor 930  
**`field-access-exception`**  
  condition 1236  
**`field-access-exception-set-p`** accessor 1236  
**`field-exception`** condition 1237  
**`field-exception-class-name`**  
  accessor 1237  
**`field-exception-field-name`**  
  accessor 1237  
**`filter-code-coverage-data`**  
  function 933  
**`find-encoding-option`** supports  
  GNU Emacs coding option 1752  
**`find-java-class`** function 1238  
**`find-throw-tag`** function 936  
**`format-to-java-host`**  
  function 1239  
**`funcall-async`** function 1392  
**`funcall-async-list`**  
  function 1392  
**`generate-code-coverage`**  
  function 946  
**`generate-java-class-definitions`**  
  function 1239  
**`gesture-spec-caps-lock-bit`**  
  constant 1756  
**`getApplicationContext`** Java  
  method 1355  
**`getClassLoader`** Java method 1355  
**`get-code-coverage-delta`**  
  function 940  
**`get-default-local-ipv6-`**  
  address function 578  
**`get-folder-path`** is now available  
  on all platforms 1762  
**`get-gc-timing`** function 1031  
**`gethash-ensuring`** function 952  
**`get-ip-default-zone-id`**  
  function 581  
**`get-java-virtual-machine`**  
  function 1246  
**`get-jobject`** function 1247  
**`get-primitive-array-region`**  
  function 1248  
**`get-service-entry`** function 582  
**`get-superclass-and-interfaces-tree`** function 1250  
**`immediatep`** function 1770  
**`import-java-class-definitions`** macro 1251  
**`init`** Java method 1341  
**`init_result_code`** Java  
  method 1344  
**`int32-to-int64`** function 1781  
**`int64*`** function 1784  
**`int64+`** function 1784  
**`int64-`** function 1784  
**`int64 type`** 1783  
**`int64/`** function 1784  
**`int64/=`** function 1786  
**`int64<`** function 1786  
**`int64<<`** function 1787  
**`int64<=`** function 1786  
**`int64=`** function 1786  
**`int64>`** function 1786  
**`int64>=`** function 1786  
**`int64>>`** function 1787  
**`+int64-0+`** symbol macro 1785  
**`int64-1+`** function 1785  
**`int64-1-`** function 1785  
**`+int64-1+`** symbol macro 1785  
**`int64-aref`** function 1788  
**`int64-logand`** function 1789  
**`int64-logandc1`** function 1789  
**`int64-logandc2`** function 1789  
**`int64-logbitp`** function 1789  
**`int64-logeqv`** function 1789  
**`int64-logior`** function 1789  
**`int64-lognand`** function 1789  
**`int64-lognor`** function 1789  
**`int64-lognot`** function 1789  
**`int64-logorc1`** function 1789  
**`int64-logorc2`** function 1789  
**`int64-logtest`** function 1789

int64-logxor function 1789  
int64-plusp function 1791  
int64-to-int32 function 1792  
int64-to-integer function 1793  
int64-zerop function 1791  
integer-to-int64 function 1794  
**intern-and-export-list**  
    function 1260  
**:ios-delivery** feature 671  
**jaref** function 1260  
**java-array-element-type**  
    function 1262  
**java-array-error** condition 1263  
**java-array-error-array**  
    accessor 1263  
**java-array-error-caller**  
    accessor 1263  
**java-array-indices-error**  
    condition 1263  
**java-array-indices-error-indices** accessor 1264  
**java-array-indices-error-rank** accessor 1264  
**java-array-length** function 1264  
**java-array-simple-error**  
    condition 1265  
**java-bad-jobject** condition 1265  
**java-bad-jobject-caller**  
    accessor 1265  
**java-bad-jobject-object**  
    accessor 1265  
**java-class-error** condition 1266  
**java-definition-error**  
    condition 1266  
**java-definition-error-class-name** accessor 1266  
**java-definition-error-name**  
    accessor 1266  
**java-exception** condition 1267  
**java-exception-exception-name** accessor 1268  
**java-exception-java-backtrace** accessor 1268  
**java-exception-string**  
    accessor 1268  
**java-field-class-name-for-setting** function 1302  
**java-field-error** condition 1266  
**java-field-error-field-name**  
    accessor 1266  
**java-field-error-static-p**  
    accessor 1266  
**java-field-setting-error-condition** 1268  
**java-field-setting-error-class-name-accessor** 1269  
**java-field-setting-error-class-name-for-setting-accessor** 1269  
**java-field-setting-error-field-name-accessor** 1269  
**java-field-setting-error-new-value-accessor** 1269  
**java-id-exception-condition** 1269  
**java-instance-jobject-accessor** 1316  
**java-instance-without-jobject-error-condition** 1270  
**java-interface-error-condition** 1270  
**java-low-level-exception-condition** 1271  
**java-method-error-condition** 1266  
**java-method-error-args-num-accessor** 1266  
**java-method-error-method-name-accessor** 1266  
**java-method-exception-condition** 1271  
**java-method-exception-args-accessor** 1272  
**java-method-exception-class-name-accessor** 1272  
**java-method-exception-method-name-accessor** 1272  
**java-method-exception-name-accessor** 1272  
**java-normal-exception-condition** 1272  
**java-not-a-java-object-error-condition** 1273  
**java-not-an-array-error-condition** 1274  
**java-object-array-element-type-function** 1275  
**java-objects-eq-function** 1275  
**java-out-of-bounds-error-condition** 1276  
**java-primitive-array-element-type-function** 1277  
**java-serious-exception-condition** 1278

**java-storing-wrong-type-error** condition 1276  
**java-type-to-lisp-array-type** function 1278  
**java-vm-poi** FLI type descriptor 1280  
**jboolean** FLI type descriptor 1280  
**jbyte** FLI type descriptor 1280  
**jchar** FLI type descriptor 1280  
**jdouble** FLI type descriptor 1280  
**jfloat** FLI type descriptor 1280  
**jint** FLI type descriptor 1280  
**jlong** FLI type descriptor 1280  
**jni-env-poi** FLI type descriptor 1281  
**jobject** FLI type descriptor 1281  
**jobject-class-name** function 1282  
**jobject-ensure-global** function 1283  
**jobject-of-class-p** function 1284  
**jobject-p** function 1285  
**jobject-pretty-class-name** function 1285  
**jobject-string** function 1286  
**jobject-to-lisp** function 1287  
**jshort** FLI type descriptor 1280  
**jvref** function 1288  
**KOI8-R** external format 445  
**lisp-array-to-primitive-array** function 1299  
**lisp-array-type-to-javatype** function 1278  
**LispCalls** Java class 1331  
**LispErrorReporter** Java interface 1347  
**LispGuiErrorReporter** Java interface 1347  
**lisp-java-instance-p** function 1290  
**lisp-to jobject** function 1290  
**LispWorks for Android Runtime** 649  
**LispWorks for iOS Runtime** 649  
**load-code-coverage-data** function 889  
**loadLibrary** Java method 1346  
**loop-processing-wait-state-collection** function 589  
**mailbox-wait** function 1421  
**make-java-array** function 1291  
**make-java-instance** function 1292  
**make-lisp-proxy** function 1293  
**make-lisp-proxy-with-overrides** function 1293  
**make-ring** function 962  
**make-simple-int64-vector** function 1809  
**make-unlocked-queue** function 964  
**make-wait-state-collection** function 590  
**Manager** Java class 1339  
**map-java-object-array** function 1295  
**map-ring** function 966, 967  
**merge-code-coverage-data** function 970  
**MessageHandler** Java interface 1354  
**mInitErrorString** Java method 1346  
**mMaxErrorLogsNumber** Java field 1350  
**mMessagesMaxLength** Java field 1352  
**object-pointer** function 1820  
**octet-ref** function 1821  
**open-tcp-stream-using-java** function 595  
 Package change and additional functionality for **load-data-file** 957  
**package-flagged-p** function 1827  
**pipe-exit-status** function 1829  
**position-in-ring** function 976  
**position-in-ring-forward** function 976  
**primitive-array-to-lisp-array** function 1299  
**process-interrupt-list** function 1446  
**process-terminate** function 1468  
**read-java-field** function 1302  
**record-java-class-lisp-symbol** function 1304  
**record-message-in-windows-event-log** function 1909  
**replacement-source-form** macro 820  
**replace-socket-stream-socket** function 604  
**replace-standard-object** function 499  
**report-error-to-java-host**

**function** 1305  
**reset-code-coverage**  
  function 869  
**reset-code-coverage-snap-**  
  shot function 940  
**reset-java-interface-for-**  
  new-jvm function 1306  
**reset-ring** function 990  
**restore-code-coverage-data**  
  function 869  
**reverse-subtract-code-cov-**  
  erage-data function 839  
**ring-length** function 991  
**ring-name** function 992  
**ringp** function 991  
**ring-pop** function 992  
**ring-push** function 993  
**ring-ref** function 994  
**rotate-ring** function 995  
**run-shell-command** is imple-  
  mented on Windows 1839  
**save-code-coverage-data**  
  function 889  
**save-current-code-coverage**  
  function 889  
**save-exit-status** argument to **open-**  
  **pipe** 1823  
**send-message-to-java-host**  
  function 1307  
**sequencep** function 1174  
**set-approaching-memory-**  
  limit-callback function 1845  
**set-code-coverage-snapshot**  
  function 940  
**setCurrentActivity** Java  
  method 1356  
**setErrorReporter** Java  
  method 1347  
**set-funcall-async-limit**  
  function 1500  
**setGuiErrorReporter** Java  
  method 1347  
**set-java-field** function 1302  
**setMessageHandler** Java  
  method 1354  
**set-primitive-array-region**  
  function 1248  
**setTextView** Java method 1354  
**setup-field-accessor**  
  function 1312  
**setup-java-caller** function 1313  
**setup-java-constructor**  
  function 1313  
**setup-lisp-proxy** function 1315  
**showBugFormLogs** Java  
  method 1351  
**simple-bmp-string** type 1088  
**simple-bmp-string-p**  
  function 1089  
**simple-int64-vector** type 1880  
**socket-stream-shutdown**  
  function 620  
**standard-java-object**  
  class 1315  
**start-gc-timing** function 1031  
**status** Java method 1343  
**stop-gc-timing** function 1031  
**string-append\*** function 1183  
**structurep** function 1184  
**subtract-code-coverage-data**  
  function 839  
**suspend** argument to **stop-**  
  **profiling** 1036  
**switch-open-tcp-stream-**  
  **with-ssl-to-java**  
  function 634  
**symbol-dynamically-bound-p**  
  function 1039  
Test for dynamic bindings 476  
The HTML version of the CLOS Metaob-  
  ject protocol is available via the  
**Help** menu. 249  
**throw-an-exception**  
  function 1317  
**throw-if-tag-found** macro 1040  
**unlocked-queue** type 1055  
**unlocked-queue-read**  
  function 964  
**unlocked-queue-ready**  
  function 964  
**unlocked-queue-send**  
  function 964  
User Guide chapter "Code  
  Coverage" 119  
User Guide section "Code signing in  
  saved images" 181  
User Guide section "Specifying the target  
  for connecting and binding a  
  socket" 408  
**value :delete** for keyword argument  
  **:load-of-compile-file** 645  
**value :none** for *direction* argument to  
  **open-pipe** 1823  
**verify-java-caller**

function 1320  
**verify-java-callers**  
 function 1321  
**verify-lisp-proxies**  
 function 1324  
**verify-lisp-proxy** function 1324  
**wait-for-wait-state-collection**  
 function 635  
**wait-state-collection**  
 class 636  
**wait-state-collection-stop-loop**  
 function 636  
**with-code-coverage-generation**  
 macro 1062  
**with-ensuring-gethash**  
 macro 1063  
**without-code-coverage**  
 macro 1071  
**with-output-to-fasl-file**  
 additional arguments and improved  
 documentation 1067  
**with-ring-locked** macro 1071  
**with-windows-event-log-event-source**  
 macro 1921  
**write-java-class-definitions-to-file**  
 function 1326  
**write-java-class-definitions-to-stream**  
 function 1326  
 New in LispWorks 7.1  
**accepts-n-syntax** function 1527  
 AIX uses native threads and SMP 296  
**allocated-in-its-own-segment-p**  
 function 1715  
**android-build-value**  
 function 848  
 ARM Linux/64-bit LispWorks 649  
**:arm64** feature 671  
**async-io-state-attach-ssl**  
 function 526  
**async-io-state-ctx** function 529  
**async-io-state-detach-ssl**  
 function 529  
**async-io-state-handshake**  
 function 534  
**async-io-state-ssl** function 551  
**async-io-state-ssl-side**  
 function 551  
**client-remote-debugging-system**  
 class 765  
**close-remote-debugging-connection**  
 function 729  
**configure-remote-debugging-spec**  
 function 730  
**copy-from-sqlite-raw-blob**  
 function 1655  
**count-regexp-occurrences**  
 function 1097  
**create-client-remote-debugging-connection**  
 function 734  
**create-ide-remote-debugging-connection**  
 function 734  
**current-function-name**  
 function 897  
**\*default-client-remote-debugging-server-port\***  
 variable 739  
**\*default-ide-remote-debugging-server-port\***  
 variable 740  
**define-declaration** macro 905  
**ensure-remote-debugging-connection**  
 function 741  
**get-host-java-virtual-machine**  
 function 1245  
**get-maximum-allocated-in-generation-2-after-gc**  
 function 1765  
**globally-accessible**  
 macro 1768  
**ide-attach-remote-output-stream**  
 function 744  
**ide-connect-remote-debugging**  
 function 745  
**ide-eval-form-in-remote**  
 function 747  
**ide-find-remote-debugging-connection**  
 function 750  
**ide-funcall-in-remote**  
 function 747  
**ide-list-remote-debugging-connections**  
 function 750  
**ide-open-a-listener**  
 function 753  
**ide-remote-debugging** system  
 class 765  
**ide-set-default-remote-debugging-connection**  
 function 750  
**ide-set-remote-symbol-value**  
 function 747  
**\*java-null\*** constant 1274  
**mailbox-full-p** function 1413  
**mailbox-send-limited**

function 1418  
**mailbox-size** function 1420  
**make-current-allocation-permanent** function 1798  
**make-object-permanent** function 1805  
**make-permanent-simple-vector** function 1807  
**map-code-coverage-data** function 966  
**mobile-gc-p** function 1817  
**mobile-gc-sweep-objects** function 1818  
**object-dspec** function 816  
**pipe-close-connection** function 1828  
**release-object-and-nullify** macro 1837  
**remote-debugging-connection** system class 765  
**remote-debugging-connection-add-close-cleanup** function 765  
**remote-debugging-connection-name** function 767  
**remote-debugging-connection-peer-address** function 768  
**remote-debugging-connection-remove-close-cleanup** function 765  
**remote-debugging-stream-peer-address** generic function 769  
**remote-inspect** function 770  
**remote-object-connection** function 772  
**remote-object-p** function 772  
**replace-from-sqlite-blob** function 1650  
**replace-from-sqlite-raw-blob** function 1655  
**replace-into-sqlite-blob** function 1650  
**rotate-byte** function 1172  
**safe-format-to-limited-string** function 996  
**safe-format-to-string** function 996  
**safe-prin1-to-string** function 996  
**safe-princ-to-string** function 996  
**save-current-profiler-tree** function 998  
**set-default-remote-debugging-connection** function 774  
**set-expected-allocation-in-generation-2-after-gc** function 1853  
**set-generation-2-gc-options** function 1858  
**set-process-profiling-processes** value:*new* 1021  
**set-promote-generation-1** function 1868  
**set-remote-debugging-connection** function 775  
**set-reserved-memory-policy** function 1869  
**set-split-promotion** function 1872  
**set-static-segment-size** function 1874  
**setup-deliver-dynamic-library-for-java** function 1308  
**setup-java-interface-callbacks** function 1253  
**simple-int32-vector-length** function 1879  
**simple-int32-vector-p** function 1879  
**simple-int64-vector-length** function 1880  
**simple-int64-vector-p** function 1881  
**socket-stream-handshake** function 618  
**software-version** detects Windows 10 correctly 704  
**specific-valid-file-encoding** function 1882  
**\*specific-valid-file-encodings\*** variable 1881  
**sql-expression-object** system class 1647  
**sqlite-blob** system class 1648  
**sqlite-blob-length** function 1650  
**sqlite-blob-p** function 1650  
**sqlite-close-blob** function 1650  
**sqlite-last-insert-rowid** function 1649

**sqlite-open-blob** function 1650  
**sqlite-raw-blob** system  
  class 1654  
**sqlite-raw-blob-length**  
  function 1655  
**sqlite-raw-blob-p** function 1655  
**sqlite-raw-blob-ref**  
  function 1655  
**sqlite-raw-blob-valid-p**  
  function 1655  
**sqlite-reopen-blob**  
  function 1650  
**start-client-remote-debugging-server** function 776  
**start-ide-remote-debugging-server** function 779  
**start-remote-listener**  
  function 781  
**string-needs-n-prefix**  
  function 1668  
**string-prefix-with-n-if-needed** function 1669  
**string-trim-whitespace**  
  function 1035  
**\*to-java-host-stream\***  
  variable 1318  
**\*to-java-host-stream-no-scroll\*** variable 1319  
**undefine-declaration**  
  function 1054  
**unlocked-queue-count**  
  function 964  
**unlocked-queue-peek**  
  function 964  
**unlocked-queue-size**  
  function 964  
**\*use-n-syntax-for-non-ascii-strings\*** variable 1676  
Using Asynchronous I/O with SSL 421, 425  
**waitForInitialization**  
  method 1336  
**with-remote-debugging-connection** macro 788  
**with-remote-debugging-spec** macro 789  
**with-sqlite-blob** macro 1677  
**write-string-with-properties** macro 1072  
**:new-generation-size**  
  keyword 144  
Newly documented in LispWorks 7.0

**sort-inspector-p** generic  
  function 1138  
Newly documented in LispWorks 7.1  
**prepared-statement** type 1629  
**push-end** macro 1164  
**push-end-new** macro 1164  
non-terminal in grammar 314  
**normal-gc** function 146, 972  
**notice-fd** function 1436

## O

**object**  
  object-oriented interface in Common SQL 354  
  static 137  
**object finalization** 164  
Object Oriented DDL in Common SQL 355  
Object Oriented DML in Common SQL 357  
**object-address** function 1819  
**object-dspec** function 816  
**object-pointer** function 1820  
**octet-ref** function 1821  
**ODBC**  
  connecting 339  
**OODDL** 355  
**OODML** 357  
**open** function 689  
opening a URL 1827  
**open-named-pipe-stream**  
  function 1905  
**open-pipe** function 1823  
**open-registry-key** function 468, 1932  
**open-serial-port** function 1517  
OpenSSL 418  
OpenSSL DLLs  
  **libcrypto-1\_1.dll** 420  
  **libcrypto-1\_1-x64.dll** 420  
  **libeay32.dll** 420  
  **libssl-1\_1.dll** 420  
  **libssl-1\_1-x64.dll** 420  
  **libssl32.dll** 420  
**openssl-version** function 599  
**open-stream-p** generic function 691  
**open-tcp-stream** function 420, 422, 591  
**open-tcp-stream-using-java**  
  function 595  
**open-temp-file** function 467, 895  
**open-url** function 1827  
operating system 453  
optimization

fast 32-bit arithmetic 472  
 fast 64-bit arithmetic 474  
 floating point 112  
 foreign slot access 116  
 of compiler 104  
 tail call 113, 173  
 optimization declarations 105  
 optimization hints 111, 651  
 optimize 105  
 optimize qualities 105–108  
**:optimize-slot-access** class  
     option 250, 253, 504, 658  
**Oracle**  
     connecting 338  
**Oracle Call Interface**  
     in Common SQL 338  
**Oracle large objects** 380  
**Oracle LOB interface** 380  
**Oracle locator objects** 380  
**ora-lob-append** function 388, 1586  
**ora-lob-assign** function 387, 1587  
**ora-lob-char-set-form**  
     function 386, 1587  
**ora-lob-char-set-id**  
     function 1588  
**ora-lob-close** function 388, 1589  
**ora-lob-copy** function 388, 1590  
**ora-lob-create-empty**  
     function 381, 387, 1591  
**ora-lob-create-temporary**  
     function 389, 1592  
**ora-lob-disable-buffering**  
     function 389, 1593  
**ora-lob-element-type**  
     function 386, 1594  
**ora-lob-enable-buffering**  
     function 389, 1595  
**ora-lob-env-handle** function 384,  
     1596  
**ora-lob-erase** function 388, 1596  
**ora-lob-file-close** function 388,  
     1597  
**ora-lob-file-close-all**  
     function 388, 1598  
**ora-lob-file-exists**  
     function 1599  
**ora-lob-file-get-name**  
     function 1600  
**ora-lob-file-is-open**  
     function 1600  
**ora-lob-file-open** function 388,  
     1601

**ora-lob-file-set-name**  
     function 388, 1602  
**ora-lob-flush-buffer**  
     function 389, 1603  
**ora-lob-free** function 387, 1604  
**ora-lob-free-temporary**  
     function 389, 1605  
**ora-lob-get-buffer** function 384,  
     389, 1605  
**ora-lob-get-chunk-size**  
     function 387, 1608  
**ora-lob-get-length** function 387,  
     1608  
**ora-lob-internal-lob-p**  
     function 386, 387, 1609  
**ora-lob-is-equal** function 387, 1610  
**ora-lob-is-open** function 387, 1610  
**ora-lob-is-temporary**  
     function 387, 389, 1611  
**ora-lob-load-from-file**  
     function 388, 1612  
**ora-lob-lob-locator** function 384,  
     1613  
**ora-lob-locator-is-init**  
     function 387, 1614  
**ora-lob-open** function 388, 1614  
**ora-lob-read-buffer** function 386,  
     389, 1615  
**ora-lob-read-foreign-buffer**  
     function 384, 386, 389, 1619  
**ora-lob-read-into-plain-file**  
     function 389, 1618  
**ora-lob-svc-ctx-handle**  
     function 384, 1620  
**ora-lob-trim** function 388, 1620  
**ora-lob-write-buffer**  
     function 386, 389, 1621, 1624  
**ora-lob-write-foreign-buffer**  
     function 384, 386, 389  
**ora-lob-write-from-plain-**  
     file function 389  
**ora-lob-write-from-plain-**  
     file function 1623  
**output**  
     trace 54  
**output-backtrace** function 756  
**output-stream-p** generic  
     function 692

**P**

**:p** debugger command 15  
**package**

hiding 24  
`:package` keyword 307  
`package-flagged-p` function 1827  
 packages  
   allocation of 164  
`*packages-for-warn-on-redef-init*` variable 187, 973  
 parameters  
   command line 454  
`*default-character-element-type*` 438, 440, 441, 442, 449, 1104  
`parse-float` function 975  
`parse-form-dspec` function 817  
 parser generator main chapter 313  
 parser, error handling 316  
 passing run time parameters 454  
 patches  
   saving an image with 4  
 pathname comparison  
   case-sensitivity on Mac OS X 469  
 pathname of deliverable 454, 1149  
 pathname of DLL 454, 1149  
 pathname of dynamic library 1149  
 pathname of executable 454, 1149  
 pathname of lisp image 454, 1149  
`pathname-location` function 1159  
`pem-read` function 426  
`pem-read` function 602  
 pipe  
   open 1823  
`pipe-close-connection`  
   function 1828  
`pipe-exit-status` function 1829  
`pipe-kill-process` function 1830  
 PL/SQL 1567  
 platform 453  
   `*features*` 670  
   `software-type` 703  
   `software-version` 704  
`p-oci-env` FLI type 385, 1625  
`p-oci-file` FLI type 385, 1626  
`p-oci-lob-locator` FLI type 385,  
   1626  
`p-oci-lob-or-file` FLI type 1626  
`p-oci-svc-ctx` FLI type 385, 1626  
`pointer-from-address`  
   function 1832  
 pointers  
   weak 1012  
`position-in-ring` function 976  
`position-in-ring-forward`  
   function 976

PostgreSQL  
   connecting 342  
 PostScript Printer Description files 189  
 PPD files 189–190  
`precompile-regexp` function 1160  
`prepared-statement` type 1629  
`prepare-statement` function 1627  
`:previous` keyword 309  
`primitive-array-to-lisp-array` function 1299  
`print-action-lists` function 97,  
   1161  
`print-actions` function 97, 1161  
`*print-binding-frames*`  
   variable 24, 757  
`*print-catch-frames*` variable 24,  
   759  
`*print-command*` variable 1162  
 printer  
   configuring 189  
`*print-handler-frames*`  
   variable 24, 760  
`*print-invisible-frames*`  
   variable 762  
`*print-nickname*` variable 1162  
`print-object` generic function 189  
`*print-open-frames*` variable 763  
`print-pretty-gesture-spec`  
   function 1833  
`print-profile-list` function 171,  
   977  
`print-query` function 348, 1629  
`*print-restart-frames*`  
   variable 24, 764  
`*print-string*` variable 981  
`*print-symbols-using-bars*`  
   variable 1834  
 process  
   creation 262  
   current 262  
   in LispWorks 261  
   scheduling 295  
 process exit status 463  
`:process` keyword 54  
 process plist 294  
 process properties 294  
 process waiting 280  
`process-a-class-option` generic  
   function 495  
`process-alive-p` function 1436  
`process-all-events` function 1437  
`process-allow-scheduling`

**function** 262, 1438  
**process-arrest-reasons**  
     function 1438  
**process-a-slot-option** generic  
     function 497  
**process-break** function 1439  
**process-continue** function 1439  
**processes**  
     allocation of 164  
**processes-count** function 263, 1482  
**process-exclusive-lock**  
     function 1440  
**process-exclusive-unlock**  
     function 1441  
**process-idle-time** function 1442  
**\*process-initial-bindings\***  
     variable 263, 1442  
**process-internal-server-p**  
     function 1444  
**process-interrupt** function 290,  
     1445  
**process-interrupt-list**  
     function 1446  
**process-join** function 1447  
**process-kill** function 1448  
**process-lock** function 277, 1449  
**process-mailbox** function 1450  
**process-name** function 263, 1450  
**process-p** function 1451  
**process-plist** function 294, 1451  
**process-poke** function 1452  
**process-priority** function 295, 1454  
**process-private-property**  
     function 1455  
**process-property** function 294, 1456  
**process-reset** function 1457  
**process-run-function**  
     function 262, 1458  
**process-run-reasons**  
     function 1461  
**process-run-time** function 1462  
**process-send** function 1463  
**process-sharing-lock**  
     function 1465  
**process-sharing-unlock**  
     function 1466  
**process-stop** function 296, 1467  
**process-stopped** function 296  
**process-stopped-p** function 1468  
**process-terminate** function 1468  
**process-unlock** function 1470  
**process-unstop** function 296, 1471  
**process-wait** function 285, 1472  
**process-wait-for-event**  
     function 1473  
**process-wait-function**  
     function 1474  
**process-wait-local** function 1474  
**process-wait-local-with-periodic-checks**  
     function 1477  
**process-wait-local-with-tim-eout** function 1478  
**process-wait-local-with-tim-eout-and-periodic-checks** function 1479  
**process-wait-with-timeout**  
     function 281, 285, 1480  
**process-whostate** function 1482  
**proclaim** function 104, 109, 693  
**product-registry-path**  
     function 464, 1835  
**profile** macro 169, 981  
**profile time** 169  
**profiler**  
     interpretation of results 172  
     main chapter 167  
     pitfalls 172  
     setting up 168  
**\*profiler-print-out-all\***  
     variable 980  
**\*profiler-threshold\***  
     variable 982  
**profiler-tree-from-function**  
     function 983  
**profiler-tree-to-function**  
     function 984  
**\*profile-symbol-list\***  
     variable 983  
**profiling**  
     execution 167  
     KnowledgeWorks 1028  
     program 167  
     program profiling 167  
     promotion 138  
**\*prompt\*** variable 1163  
**prompt**  
     in listener 1163  
**\*prompt\*** variable 8  
**ps** function 263, 1485  
**push** macro 267  
**push-end** macro 1164  
**push-end-new** macro 1164  
**pushnew-to-process-private-**

**property** function 294, 1483  
**pushnew-to-process-property** function 294, 1484

**Q**

**:q** inspector command 39  
**query** function 352, 380, 1631  
**\*query-io\*** variable 705  
**query-registry-key-info** function 468, 1933  
**query-registry-value** function 468, 1934  
**quick** backtrace 14  
**quit** function 4, 463, 1165  
**QuitLispWorks** C function 195, 1991  
quitting LispWorks 4, 99  
**:quit-when-no-windows** delivery keyword 1176

**R**

raw 32-bit arithmetic 472  
raw 64-bit arithmetic 474  
**read-dhparams** function 426, 603  
**read-eval-print loop** 5, 1181  
**read-foreign-modules** function 1078  
**read-java-field** function 1302  
**read-serial-port-char** function 1521  
**read-serial-port-string** function 1521  
**:read-timeout** initarg 613  
real time 169  
**rebinding** macro 1167  
**reconnect** function 338, 1632  
**record-definition** function 817  
**record-java-class-lisp-symbol** function 1304  
**record-message-in-windows-event-log** function 1909  
**\*record-source-files\*** variable 818  
**\*redefinition-action\*** variable 187, 819  
redo 188  
**:redo** listener command 6  
**reduce-memory** function 164, 985  
**references-who** function 987  
**regexp** 1135, 1168  
**regexp-find-symbols** function 1168

**registry**  
API on Windows 468, 1923  
**registry-key-exists-p** function 468, 1935  
**registry-value** function 468, 1935  
regular expression 1135, 1168  
regular expression matching 1116, 1135, 1168  
**release-object-and-nullify** macro 1837  
**relocating** 459  
remote debugging 25  
**remote-debugging-connection** system class 765  
**remote-debugging-connection-add-close-cleanup** function 36, 765  
**remote-debugging-connection-name** function 36, 767  
**remote-debugging-connection-peer-address** function 36, 768  
**remote-debugging-connection-remove-close-cleanup** function 36, 765  
**remote-debugging-stream-peer-address** generic function 769  
**remote-inspect** function 25, 27, 28, 34, 770  
**remote-object-connection** function 29, 35, 772  
**remote-object-p** function 29, 772  
**remove-advice** function 66, 73, 1169  
**remove-duplicates** function 116  
**removef** macro 1171  
**remove-from-process-private-property** function 294, 1486  
**remove-from-process-property** function 294, 1486  
**remove-process-private-property** function 294, 1487  
**remove-process-property** function 294, 1488  
**remove-special-free-action** function 165, 988  
**remove-symbol-profiler** function 989  
REPL 5, 1181  
REPL inspector 37  
**replace-from-sqlite-blob** function 395, 1650

```

replace-from-sqlite-raw-blob
    function 395, 1655
replace-into-sqlite-blob
    function 395, 1650
replacement-source-form
    macro 820
replace-socket-stream-socket
    function 604
replace-standard-object
    function 499
report-error-to-java-host
    function 1305
:requires keyword 309, 310
*require-verbose* variable 1171
:res debugger command 21
reserved words 973
reset-code-coverage function 869
reset-code-coverage-snapshot
    function 940
reset-java-interface-for-
    new-jvm function 1306
reset-profiler function 989
reset-ring function 990
restart 12
restart frame, examining 12
restart-case macro 694
:restarts keyword 764
restore-code-coverage-data
    function 869
restore-sql-reader-syntax-
    state function 370, 1633
:ret debugger command 21
reverse-subtract-code-cover-
    age-data function 839
ring-length function 991
ring-name function 992
ringp function 991
ring-pop function 992
ring-push function 993
ring-ref function 994
rollback function 348, 350, 382, 1634
room function 145, 146, 149, 458, 695
room-values function 458, 1838
Rotate Active Finders Editor
    command 792
rotate-byte function 1172
rotate-ring function 995
round-to-single-precision
    function 1172
rules
    grammar 313
:rules keyword 308
run time parameters 454
run-shell-command function 1839

```

## S

```

:s inspector command 39
safe-format-to-limited-
    string function 996
safe-format-to-string
    function 996
safe-locale-file-encoding
    function 1844
safe-print-to-string
    function 996
safe-princ-to-string
    function 996
safety 105
save-argument-real-p
    function 997
save-code-coverage-data
    function 889
save-current-code-coverage
    function 889
save-current-profiler-tree
    function 174, 998
save-current-session
    function 1000
save-image function 179, 191, 454, 460,
    464, 1001
save-image-with-bundle
    function 1010
save-tags-database function 821
save-universal-from-script
    function 1011
saving images 179
sbchar accessor 440
sbchar function 1173
schar accessor 440
schedule-timer function 293, 1489
schedule-timer-milliseconds
    function 1491
schedule-timer-relative
    function 1493
schedule-timer-relative-mil-
    liseconds function 1494
scheduling of processes 295
security-description-string-
    for-open-named-pipe
    function 1910
segmentation violation in compiled
    code 108
select function 346, 357, 1634
select SQL operator 363

```

**Self-contained examples**  
 Asynchronous I/O 482  
 COMM package 481  
 DDE 482  
 miscellaneous examples 483  
 parser generator 482  
**save-image** in a Mac OS X application  
     bundle 482  
     socket streams 481  
 SSL 481  
     streams 482  
     TCP sockets 481  
**semaphore** system class 1496  
**semaphore-acquire** function 288,  
     1496  
**semaphore-count** function 288, 1498  
**semaphore-name** function 288, 1498  
**semaphore-release** function 288,  
     1499  
**semaphore-wait-count**  
     function 288, 1500  
**send-message-to-java-host**  
     function 1307  
**sequencep** function 1174  
**serial-port** function 1520  
**serial-port-input-available-p** function 1522  
**server-terminate** function 605  
**Set Default Remote Debugging**  
     Editor command 752  
**set-application-themed**  
     function 1914  
**set-approaching-memory-limit-callback**  
     function 1845  
**set-array-single-thread-p**  
     function 1012  
**set-array-weak** function 165, 1012  
**set-automatic-gc-callback**  
     function 150, 1846  
**set-blocking-gen-num**  
     function 150, 1848  
**set-clos-initarg-checking**  
     function 501  
**set-code-coverage-snapshot**  
     function 940  
**setCurrentActivity** Java  
     method 1356  
**set-debugger-options**  
     function 773  
**set-default-character-element-type** function 439, 442,  
     443, 1174  
**set-default-generation**  
     function 137, 146, 1014  
**set-default-remote-debugging-connection**  
     function 34, 774  
**set-default-segment-size**  
     function 151, 1851  
**set-delay-promotion** function 151,  
     1852  
**setErrorReporter** Java method 1347  
**set-expected-allocation-in-generation-2-after-gc**  
     function 1853  
**setf cdr-assoc** function 1730  
**setf timer-name** function 1503  
**set-file-dates** function 1857  
**set-funcall-async-limit**  
     function 1500  
**set-gc-parameters** function 139,  
     146, 1015  
**set-generation-2-gc-options**  
     function 1858  
**set-gen-num-gc-threshold**  
     function 150, 1860  
**setGuiErrorReporter** Java  
     method 1347  
**set-hash-table-weak** function 165,  
     1017  
**set-java-field** function 1302  
**set-make-instance-argument-checking** function 502  
**set-maximum-memory** function 146,  
     1862  
**set-maximum-segment-size**  
     function 148, 150, 1863  
**set-memory-check** function 1865  
**set-memory-exhausted-call-back** function 1866  
**setMessageHandler** Java  
     method 1354  
**set-minimum-free-space**  
     function 139, 146, 1019  
**set-prepared-statement-variables** function 1639  
**set-primitive-array-region**  
     function 1248  
**set-process-profiling**  
     function 169, 170, 1020  
**set-profiler-threshold**  
     function 1022  
**set-promote-generation-1**

**function** 1868  
**set-promotion-count**  
  function 1023  
**set-quit-when-no-windows**  
  function 1176  
**set-registry-value** function 468,  
  1937  
**set-remote-debugging-connection** function 33, 775  
**set-reserved-memory-policy**  
  function 1869  
**set-serial-port-state**  
  function 1523  
**set-signal-handler** function 1870  
**set-spare-keeping-policy**  
  function 151, 1871  
**set-split-promotion**  
  function 1872  
**set-ssl-ctx-dh** function 426, 608  
**set-ssl-ctx-options**  
  function 426  
**set-ssl-ctx-options** function 610  
**set-ssl-ctx-password-call-back** function 426  
**set-ssl-ctx-password-call-back** function 610  
**set-ssl-library-path**  
  function 420, 611  
**set-static-segment-size**  
  function 1874  
**sets-who** function 1030  
**set-system-message-log**  
  function 1024  
**set-temp-directory** function 468,  
  1875  
**setTextView** Java method 1354  
**setup-atomic-funcall**  
  function 1876  
**setup-deliver-dynamic-library-for-java**  
  function 217, 1308  
**setup-field-accessor**  
  function 1312  
**setup-java-caller** function 1313  
**setup-java-constructor**  
  function 1313  
**setup-java-interface-call-backs** function 1253  
**setup-lisp-proxy** function 1315  
**set-up-profiler** function 168, 1025  
**set-verification-mode**  
  function 606  
  
**\*sg-default-size\*** variable 1877  
**:sh** inspector command 39  
**shared libraries** 191, 459  
**shared library** 191  
**shared object file** 191  
**Shift JIS** 444  
**short-float** type 480, 700  
**short-namestring** function 454  
**short-site-name** function 453, 701  
**Show Paths From Editor**  
  command 116, 863  
**Show Paths To Editor** command 1060  
**showBugFormLogs** Java method 1351  
**shutdown** 99  
**sid-string-to-user-name**  
  function 1916  
**simple-augmented-string**  
  type 1722  
**simple-augmented-string-p**  
  function 1722  
**simple-base-string** type 439, 440,  
  641  
**simple-base-string-p**  
  function 1086  
**simple-bmp-string** type 439, 1088  
**simple-bmp-string-p**  
  function 1089  
**simple-char** type 1176  
**simple-char-p** function 1177  
**simple-do-query** macro 351, 381,  
  1640  
**SimpleInitLispWorks C**  
  function 1990  
**simple-int32-vector** type 473,  
  1878  
**simple-int32-vector-length**  
  function 1879  
**simple-int32-vector-p**  
  function 1879  
**simple-int64-vector** type 474,  
  1880  
**simple-int64-vector-length**  
  function 1880  
**simple-int64-vector-p**  
  function 1881  
**simple-lock-and-condition-variable-wait**  
  function 1501  
**simple-string** type 439, 440, 702  
**simple-text-string** type 439, 440,  
  1185  
**simple-text-string-p**

**function** 1186  
**single-float** type 480, 703  
**single-form-form-parser**  
  function 822  
**single-form-with-options-form-parser** function 822  
**single-threaded**  
  arrays 276  
  hash tables 276  
**:size** initarg 1884  
**:sjis** external format 444  
**SLIME** 3  
**slot-boundp-using-class** generic  
  function 249, 502  
**slot-makunbound-using-class**  
  generic function 249, 503  
**slot-value**  
  atomic operations 299  
**slot-value-using-class** generic  
  function 249, 504  
**:socket** initarg 612  
**socket-error** class 612  
**socket-stream** class 418, 422, 612  
**socket-stream-address**  
  function 617  
**socket-stream-ctx** function 431, 618  
**socket-stream-handshake**  
  function 618  
**socket-stream-peer-address**  
  function 619  
**socket-stream-shutdown**  
  function 620  
**socket-stream-socket**  
  accessor 613  
**socket-stream-ssl** function 431, 621  
**socket-stream-ssl-side**  
  function 431, 622  
**software-type** function 453, 703  
**software-version** function 453, 704  
**sort-inspector-p** generic  
  function 1138  
**source level debugging** 88, 116, 1040  
**source-debugging-on-p**  
  function 1031  
**\*source-found-action\***  
  variable 185  
**:source-only** keyword 308  
**space** 105  
**special actions** 164  
**special forms**  
**declare** 104, 109, 651  
**specific-valid-file-encoding**  
  function 1882  
**\*specific-valid-file-encodings\*** variable 1881  
**speed** 105  
**splash screen** 1898  
**split-sequence** function 1177  
**split-sequence-if** function 1178  
**split-sequence-if-not**  
  function 1179  
**SQL**  
  database functions 365  
  database operators 365  
  direct specification 352  
  mode 375  
  stored procedure 352, 1567  
**sql** function 368, 1642  
**SQL pseudo operators**  
  **sql-boolean-operator** 366, 368, 1660  
  **sql-function** 365, 368, 1660  
  **sql-operator** 366, 368, 1660  
**sql-boolean-operator** SQL pseudo  
  operator 366, 368, 1660  
**sql-connection-error**  
  condition 1643  
**sql-connection-error** error 373  
**sql-database-data-error**  
  accessor 1644  
**sql-database-data-error**  
  condition 1643  
**sql-database-data-error**  
  error 372  
**sql-database-error** condition 1643  
**sql-database-error** error 372  
**\*sql-enlarge-static\***  
  variable 1644  
**sql-error-database-message**  
  accessor 1644  
**sql-error-secondary-error-id**  
  accessor 1644  
**sql-expression** function 368, 1645  
**sql-expression-object** system  
  class 1647  
**sql-fatal-error** condition 1648  
**sql-fatal-error** error 373  
**sql-function** SQL pseudo  
  operator 365, 368, 1660  
**sqlite-blob** system class 395, 1648  
**sqlite-blob-length** function 1650  
**sqlite-blob-p** function 1650

**sqlite-close-blob** function 395, 1650  
**sqlite-last-insert-rowid** function 1649  
**sqlite-open-blob** function 395, 1650  
**sqlite-raw-blob** system class 394, 1654  
**sqlite-raw-blob-length** function 395, 1655  
**sqlite-raw-blob-p** function 1655  
**sqlite-raw-blob-ref** function 395, 1655  
**sqlite-raw-blob-valid-p** function 395, 1655  
**sqlite-reopen-blob** function 1650  
**\*sql-libraries\*** variable 337, 1659  
**\*sql-loading-verbose\*** variable 337, 349, 1660  
**sql-operation** function 368, 1660  
**sql-operator** function 368, 1662  
**sql-operator** SQL pseudo operator 366, 368, 1660  
**sql-recording-p** function 372, 1663  
**sql-stream** function 372, 1664  
**sql-temporary-error** condition 1665  
**sql-temporary-error** error 372  
**sql-timeout-error** condition 1665  
**sql-timeout-error** error 373  
**sql-user-error** condition 395, 396, 1653, 1659, 1665  
**sql-user-error** error 372  
square bracket syntax 359  
**ssl-add-client-ca** function 427  
**ssl-cipher-get-bits** function 427  
**ssl-cipher-get-name** function 427  
**ssl-cipher-get-version** function 427  
**ssl-cipher-pointer** FLI type 427, 622  
**ssl-cipher-pointer-stack** FLI type 622  
**ssl-clear-num-renegotiations** function 427  
**ssl-closed** class 431, 623  
**ssl-condition** class 431, 623  
**:ssl-configure-callback** initarg 515, 565, 592, 613  
**ssl-ctrl** function 428  
**:ssl-ctx** initarg 613  
**ssl-ctx-add-client-ca** function 428  
**ssl-ctx-add-extra-chain-cert** function 428  
**ssl-ctx-ctrl** function 428  
**ssl-ctx-get-max-cert-list** function 428  
**ssl-ctx-get-mode** function 428  
**ssl-ctx-get-options** function 428  
**ssl-ctx-get-read-ahead** function 428  
**ssl-ctx-get-verify-mode** function 428  
**ssl-ctx-load-verify-locations** function 428  
**ssl-ctx-need-tmp-rsa** function 428  
**ssl-ctx-pointer** FLI type 427, 624  
**ssl-ctx-sess-get-cache-mode** function 428  
**ssl-ctx-sess-get-cache-size** function 428  
**ssl-ctx-sess-set-cache-mode** function 428  
**ssl-ctx-sess-set-cache-size** function 428  
**ssl-ctx-set-client-ca-list** function 428  
**ssl-ctx-set-max-cert-list** function 428  
**ssl-ctx-set-mode** function 428  
**ssl-ctx-set-options** function 428  
**ssl-ctx-set-read-ahead** function 428  
**ssl-ctx-set-tmp-dh** function 428  
**ssl-ctx-set-tmp-rsa** function 428  
**ssl-ctx-use-certificate-chain-file** function 428  
**ssl-ctx-use-certificate-file** function 429  
**ssl-ctx-use-privatekey-file** function 429  
**ssl-ctx-use-rsaprivatekey-file** function 429  
**ssl-error** class 431, 624  
**:ssl-error-callback** initarg 515  
**ssl-failure** class 431, 624  
**ssl-get-current-cipher** function 429  
**ssl-get-max-cert-list** function 429  
**ssl-get-mode** function 429  
**ssl-get-options** function 429  
**ssl-get-verify-mode** function 429

**ssl-get-version** function 429  
**ssl-load-client-ca-file**  
  function 429  
**ssl-need-tmp-rsa** function 429  
**ssl-new** function 431, 625  
**ssl-num-renegotiations**  
  function 429  
**ssl-pointer** FLI type 427, 625  
**ssl-session-reused** function 429  
**ssl-set-accept-state**  
  function 424, 429  
**ssl-set-client-ca-list**  
  function 429  
**ssl-set-connect-state**  
  function 424, 429  
**ssl-set-max-cert-list**  
  function 429  
**ssl-set-mode** function 429  
**ssl-set-options** function 429  
**ssl-set-tmp-dh** function 429  
**ssl-set-tmp-rsa** function 429  
**:ssl-side** initarg 613  
**ssl-total-renegotiations**  
  function 429  
**ssl-use-certificate-file**  
  function 430  
**ssl-use-privatekey-file**  
  function 430  
**ssl-use-rsaprivatekey-file**  
  function 430  
**ssl-x509-lookup** class 431, 626  
**stack**  
  examining 12  
  extension 925  
**stack size** 164, 898, 1738, 1877  
**\*stack-overflow-behaviour\***  
  variable 1883  
**stacks**  
  allocation of 164  
**standard-accessor-method**  
  class 250  
**standard-class** class 251  
**standard-db-object** class 354, 1666  
**\*standard-input\*** variable 705  
**standard-instance-access**  
  function 250  
**standard-java-object** class 1315  
**standard-object** class 266  
**\*standard-output\*** variable 705  
**standard-reader-method** class 250  
**standard-writer-method** class 250  
**start** 99  
**start LispWorks** 1  
**start-client-remote-debugging-server** function 27, 33, 776  
**start-dde-server** function 327, 1983  
**start-gc-timing** function 1031  
**start-ide-remote-debugging-server** function 26, 27, 779  
**starting LispWorks** 1, 99  
**start-profiling** function 169, 170, 1033  
**start-remote-listener**  
  function 25, 27, 28, 34, 781  
**start-sql-recording** function 372, 1666  
**start-tty-listener** function 1180  
**startup** 99  
**startup image** 1898  
**startup relocation** 459  
**startup screen** 1898  
**startup window** 1898  
**:startup-bitmap-file** delivery keyword 1898  
**start-up-server** function 626  
**start-up-server-and-mp**  
  function 632  
**:static** initarg 1885  
**static object**  
  allocation in memory management 137  
**staticcp** function 1884  
**status** function 338, 1667  
**status** Java method 1343  
**stchar** accessor 440  
**stchar** function 1181  
**stderr** 1810  
**:step** keyword 52  
**step** macro 706  
**\*step-compiled\*** variable 709  
**\*step-filter\*** variable 709  
**stepper**, entering when tracing 52  
**\*step-print-env\*** variable 709  
**stop-gc-timing** function 1031  
**stop-profiling** function 169, 170, 1036  
**stop-sql-recording** function 372, 1668  
**storage-exhausted** class 1884  
**storage-exhausted-gen-num**  
  accessor 1885  
**storage-exhausted-size**  
  accessor 1885  
**storage-exhausted-static**

**accessor** 1885  
**storage-exhausted-type**  
  accessor 1885  
**str** FLI type 1916  
**:stream** initarg 612  
**stream-advance-to-column**  
  generic function 1689  
**stream-check-eof-no-hang**  
  generic function 1690  
**stream-clear-input** generic  
  function 402, 1690  
**stream-clear-output** generic  
  function 403, 1691  
**stream-element-type** generic  
  function 400, 709  
**stream-file-position** generic  
  function 1692  
**stream-fill-buffer** generic  
  function 1692  
**stream-finish-output** generic  
  function 403, 1693  
**stream-flush-buffer** generic  
  function 1694  
**stream-force-output** generic  
  function 403, 1695  
**stream-fresh-line** generic  
  function 1695  
**stream-line-column** generic  
  function 403, 1696  
**stream-listen** generic function 402,  
  1697  
**stream-output-width** generic  
  function 1698  
**stream-peek-char** generic  
  function 1698  
**stream-read-buffer** generic  
  function 1699  
**stream-read-byte** generic  
  function 1700  
**stream-read-char** generic  
  function 401, 1701  
**stream-read-char-no-hang**  
  generic function 1701  
**stream-read-line** generic  
  function 1702  
**stream-read-sequence** generic  
  function 1703  
**stream-read-timeout** accessor 613  
**stream-read-timeout** generic  
  function 1704  
**streams**  
  defining new 400  
**directionality** 400  
**example** 400–405  
**input** 401  
**instantiating** 404  
**output** 402  
**user defined** 399  
**stream-start-line-p** generic  
  function 403, 1704  
**stream-terpri** generic function 1705  
**stream-unread-char** generic  
  function 401, 1706  
**stream-write-buffer** generic  
  function 1706  
**stream-write-byte** generic  
  function 1707  
**stream-write-char** generic  
  function 402, 1708  
**stream-write-sequence** generic  
  function 1708  
**stream-write-string** generic  
  function 1709  
**stream-write-timeout**  
  accessor 613  
**string construction** 441  
**string type** 438, 439, 710  
**string types** 438  
**string-append** function 1182  
**string-append\*** function 1183  
**string-ip-address** function 633  
**string-needs-n-prefix**  
  function 1668  
**string-prefix-with-n-if-needed** function 1669  
**string-trim-whitespace**  
  function 1035  
**structure types**  
  **async-io-state** 412, 523  
**structurep** function 1184  
**subtract-code-coverage-data**  
  function 839  
**superclass**  
  invalid 253  
**sweep** 138  
**sweep-all-objects** function 164,  
  1037  
**sweep-gen-num-objects**  
  function 1885  
**switch-open-tcp-stream-with-ssl-to-java** function 634  
**switch-static-allocation**  
  function 136, 137, 1038  
**symbol macros**

```

+int32-0+ 1774
+int32-1+ 1774
+int64-0+ 1785
+int64-1+ 1785
*symbol-alloc-gen-num*
    variable 146, 164, 1039
symbol-dynamically-bound-p
    function 1039
symbolic query syntax 358
symbolic syntax in Common SQL 358
symbols
    allocation of 164
symeval-in-process function 295,
    1503
Synchronization barriers 287
syntax, in Common SQL 358
system
    compile 1092
    defining 306–311
    introduction to 305–311
    load 1153
    members of 307
    plan 308
    print 1147
    rules 308–310
system classes
    barrier 1362
    client-remote-debugging 765
    condition-variable 1376
    ide-remote-debugging 765
    lock 1401
    mailbox 1411
    remote-debugging-
        connection 765
    semaphore 1496
    sql-expression-object 1647
    sqlite-blob 395, 1648
    sqlite-raw-blob 394, 1654
system commands
    running directly 1725
    running via a shell 1725

T
table-exists-p function 1670
tail call 113
tail call merging 113
tail call optimization 113
tail merge 113
tail recursion 113
tail-call 113
TCP/IP socket
    client side 408
server side 407
SSL interface 418
teletype inspector 37
temp files 467
temporary files 467
*terminal-debugger-block-
    multiprocessing*
    variable 783
text-string type 438, 1185
text-string-p function 1186
threads 261
    allocation of 164
throw-an-exception function 1317
throw-if-tag-found macro 1040
time macro 711
timer-expired-p function 1504
timer-name function 1505
timers 293
    I/O 293
    input and output 293
    multiprocessing 293
    process 293
    threading issues 293
:tlsext-host-name initarg 613
toggle-source-debugging
    function 117, 1040
*to-java-host-stream*
    variable 1318
*to-java-host-stream-no-
    scroll* variable 1319
tools
    inspector 37
:top debugger command 21
top-level loop 5
total-allocation function 145, 1042
trace
    excessive output 60
    main chapter 47
    missing output 60
    not working 60
    troubleshooting 60
trace macro 713
traceable-dspec-p function 823
traced functions
    arguments 50
*traced-arglist* variable 50, 60,
    1043
*traced-results* variable 50, 60,
    714, 1043
*trace-indent-width* variable 59,
    1044
*trace-level* variable 60, 1045

```

```

trace-new-instances-on-access function 505
trace-on-access function 506
:trace-output keyword 54
*trace-output* variable 60, 705
*trace-print-circle* variable 60, 1046
*trace-print-length* variable 38, 60, 1047
*trace-print-level* variable 38, 60, 1048
*trace-print-pretty* variable 60, 1049
tracer
  :after option 50
  :allocation option 55
  :before option 49
  :break option 51
  :break-on-exit option 51
commands available 49–56
definition specs 58
directing output 54
entering the stepper 52
:entrycond option 52
:eval-after option 51
:eval-before option 50
evaluating forms 49–51
example of use 47
:exitcond option 52
functions, tracing inside 55
information displayed 48
:inside option 55
invoking the debugger 51
memory allocation 55
methods, tracing 57
:process option 54
restricting to a process 54
:step option 52
traced function, arguments for 50
traced functions, results for 50
:trace-output option 54
*trace-verbose* variable 1050
tracing functions
  inside other functions 55
tracing-enabled-p function 824
tracing-state function 825
transaction handling
  in Common SQL 339, 350, 377
true function 1186
truename function 720
try-compact-in-generation
  function 144, 146, 1051
try-move-in-generation
  function 144, 146, 1052
tstr FLI type 1917
tty 1002
:type initarg 1885
typed-aref function 1886
types
  16-bit-string 1082
  8-bit-string 1081
  accepting-handle 517
  augmented-string 1722
  base-char 436, 1084
  base-character 1084
  base-string 438, 641
  bmp-char 436, 1086
  bmp-string 438, 1088
  character 436
  code-coverage-data 870
  code-coverage-file-stats 879
  double-float 669
  extended-char 1131
  extended-character 1131
  fixnum 477
  int32 472, 1772
  int64 474, 1783
  java-vm-poi 1280
  jboolean 1280
  jbyte 1280
  jchar 1280
  jdouble 1280
  jfloat 1280
  jint 1280
  jlong 1280
  jni-env-poi 1281
  jobject 1281
  jshort 1280
  long-float 678
  mt-random-state 1158
  prepared-statement 1629
  short-float 480, 700
  simple-augmented-string 1722
  simple-base-string 439, 440, 641
  simple-bmp-string 439, 1088
  simple-char 1176
  simple-int32-vector 473, 1878
  simple-int64-vector 474, 1880
  simple-string 439, 440, 702
  simple-text-string 439, 440, 1185
  single-float 480, 703
  string 438, 439, 710
  text-string 438, 1185

```

**unlocked-queue** 1055

**U**

- :u** inspector command 39
- :ud** inspector command 39, 40
- unbreak-new-instances-on-access** function 509
- unbreak-on-access** function 509
- undefine-action** macro 96, 1187
- undefine-action-list** macro 96, 1188
- undefine-declaration** function 1054
- Unicode** 435
- :unicode** external format 444
- unicode-alpha-char-p** function 451, 1188
- unicode-alphanumericp** function 451, 1189
- unicode-both-case-p** function 451, 1190
- unicode-char-equal** function 451, 1191
- unicode-char-greaterp** function 451, 1192
- unicode-char-lessp** function 451, 1192
- unicode-char-not-equal** function 451, 1191
- unicode-char-not-greaterp** function 451, 1193
- unicode-char-not-lessp** function 451, 1193
- unicode-lower-case-p** function 451, 1194
- unicode-string-equal** function 451, 1194
- unicode-string-greaterp** function 451, 1196
- unicode-string-lessp** function 451, 1196
- unicode-string-not-equal** function 451, 1194
- unicode-string-not-greaterp** function 451, 1197
- unicode-string-not-lessp** function 451, 1197
- unicode-upper-case-p** function 451, 1198
- universal binaries** helper functions 862, 997
- saving**

**advanced** 897

**simply** 1011

**UNIX command**

- call-system** 1724
- call-system-showing-output** 1727
- open-pipe** 1823
- run-shell-command** 1841

**Unix commands**

- calling from Lisp 462

**Unix functions**

- calling from Lisp 462
- unixODBC** 390
- unlocked-queue** type 1055
- unlocked-queue-count** function 964
- unlocked-queue-peek** function 964
- unlocked-queue-read** function 964
- unlocked-queue-ready** function 964
- unlocked-queue-send** function 964
- unlocked-queue-size** function 964
- unnotice-fd** function 1506
- \*unresolved-messages\*** 1080
- unschedule-timer** function 1506
- untrace** macro 721
- untrace-new-instances-on-access** function 510
- untrace-on-access** function 510
- unwind-protect-blocking-interrupts** macro 289, 1055
- unwind-protect-blocking-interrupts-in-cleanups** macro 289, 1057
- update-instance-for-different-class** function 722
- update-instance-for-redefined-class** function 723
- update-instance-from-records** generic function 357, 1671
- update-objects-joins** function 1672
- update-record-from-slot** generic function 357, 1675
- update-records** function 348, 349, 381, 1673
- update-records-from-instance** generic function 357, 1674
- update-slot-from-record** generic function 357, 1675

**URL**

- opening 1827

```

:use listener command 7
*use-n-syntax-for-non-ascii-
    strings* variable 1676
user defined stream 399
user-homedir-pathname
    function 227, 466, 1764
user-name-to-sid-string
    function 1919
user-preference function 464, 1199
UTF-16 444
:utf-16 external format 444
:utf-16be external format 446, 830
:utf-16le external format 446, 830
:utf-16-native external format 446,
    830
:utf-16-reversed external
    format 446, 830
:utf-32 external format 444
UTF-8 444, 449
:utf-8 external format 444
utilities in Common SQL 370

V
:v debugger command 16
validate-superclass generic
    function 251, 252
valid-external-format-p
    function 838
variable-information
    function 1058
variables
    $ (dollar) 38
    $$ 38
    $$$ 38
    *active-finders* 791
    *autoload-asdf-
        integration* 1083
    *background-input* 858
    *background-output* 858
    *background-query-io* 858
    *binary-file-type* 649, 1723
    *binary-file-types* 649, 1723
    *browser-location* 1089
    *cache-table-queries-
        default* 1532
    *check-network-server* 1731
    *compiler-break-on-
        error* 887
    *connect-if-exists* 1541
    *current-process* 262, 1380
    *debug-initialization-
        errors-in-snap-shot* 1736
    *debug-io* 23, 705
    *debug-print-length* 23, 738
    *debug-print-level* 24, 738
    *default-action-list-sort-
        time* 97, 1103
    *default-client-remote-
        debugging-server-
        port* 27, 739
    *default-database* 1549
    *default-database-type* 1550
    *default-ide-remote-debug-
        ging-server-port* 27, 740
    *default-libraries* 1079
    *default-package-use-
        list* 901
    *default-process-
        priority* 1389
    *default-profiler-
        collapse* 901
    *default-profiler-
        cutoff* 902
    *default-profiler-limit* 902
    *default-profiler-sort* 903
    *default-stack-group-list-
        length* 164, 1738
    *default-update-objects-
        max-len* 1550
    *defstruct-generates-print-
        object-method* 189
    *defsystem-verbose* 1115
    *describe-length* 39, 1117
    *describe-level* 38, 1117
    *describe-print-length* 38,
        1119
    *describe-print-level* 38,
        1119
    *directory-link-
        transparency* 664, 1745
    *disable-trace* 914
    *dspec-classes* 804
    *enter-debugger-
        directly* 1124
    *error-output* 705
    *extended-spaces* 1203, 1748
    *external-formats* 1133
    *features* 670
    *file-encoding-detection-
        algorithm* 448, 1749
    *file-eol-style-detection-
        algorithm* 448, 1751
    *filename-pattern-encoding-
        matches* 1752

```

**gesture-spec-accelerator-** 1584  
     bit 1756  
**gesture-spec-caps-lock-**  
     bit 1756  
**gesture-spec-control-**  
     bit 1756  
**gesture-spec-hyper-bit** 1756  
**gesture-spec-meta-bit** 1756  
**gesture-spec-shift-bit** 1756  
**gesture-spec-super-bit** 1756  
**\*grep-command\*** 1142  
**\*grep-command-format\*** 1143  
**\*grep-fixed-args\*** 1144  
**\*handle-existing-action-in-**  
     action-list\* 96, 1144  
**\*handle-existing-action-**  
     list\* 96, 1145  
**\*handle-existing-**  
     defpackage\* 954  
**\*handle-missing-action-in-**  
     action-list\* 97, 1146  
**\*handle-missing-action-**  
     list\* 97, 1145  
**\*handle-old-in-package\*** 955  
**\*handle-old-in-package-**  
     used-as-make-package\* 956  
**\*handle-warn-on-**  
     redefinition\* 187, 1146  
**\*hidden-packages\*** 24, 742  
**\*init-file-name\*** 1148  
**\*initialized-database-**  
     types\* 1570  
**\*initial-processes\*** 195, 263,  
     1398  
**\*inspect-print-length\*** 39  
**\*inspect-print-level\*** 39  
**\*inspect-through-gui\*** 1149  
**\*latin-1-code-pages\*** 1902  
**\*line-arguments-list\*** 454,  
     1795  
**\*lispworks-directory\*** 1150  
**\*load-fasl-or-lisp-file\*** 961  
**\*main-process\*** 1424  
**\*maximum-ordinary-**  
     windows\* 186  
**\*max-trace-indent\*** 59, 969  
**\*mt-random-state\*** 1157  
**\*multibyte-code-page-**  
     ef\* 391, 1904  
**\*mysql-library-**  
     directories\* 341, 342, 1583  
**\*mysql-library-path\*** 341, 342,

    1584  
**\*mysql-library-sub-**  
     directories\* 341, 1585  
**\*packages-for-warn-on-**  
     redefinition\* 187, 973  
**\*print-binding-frames\*** 24,  
     757  
**\*print-catch-frames\*** 24, 759  
**\*print-command\*** 1162  
**\*print-handler-frames\*** 24,  
     760  
**\*print-invisible-frames\*** 762  
**\*print-nickname\*** 1162  
**\*print-open-frames\*** 763  
**\*print-restart-frames\*** 24,  
     764  
**\*print-string\*** 981  
**\*print-symbols-using-**  
     bars\* 1834  
**\*process-initial-**  
     bindings\* 263, 1442  
**\*profiler-print-out-all\*** 980  
**\*profiler-threshold\*** 982  
**\*profile-symbol-list\*** 983  
**\*prompt\*** 8, 1163  
**\*query-io\*** 705  
**\*record-source-files\*** 818  
**\*redefinition-action\*** 187, 819  
**\*require-verbose\*** 1171  
**\*sg-default-size\*** 1877  
**\*source-found-action\*** 185  
**\*specific-valid-file-**  
     encodings\* 1881  
**\*sql-enlarge-static\*** 1644  
**\*sql-libraries\*** 337, 1659  
**\*sql-loading-verbose\*** 337,  
     349, 1660  
**\*stack-overflow-**  
     behaviour\* 1883  
**\*standard-input\*** 705  
**\*standard-output\*** 705  
**\*step-compiled\*** 709  
**\*step-filter\*** 709  
**\*step-print-env\*** 709  
**\*symbol-alloc-gen-num\*** 146,  
     164, 1039  
**\*terminal-debugger-block-**  
     multiprocessing\* 783  
**\*to-java-host-stream\*** 1318  
**\*to-java-host-stream-no-**  
     scroll\* 1319  
**\*traced-arglist\*** 50, 60, 1043

**\*traced-results\*** 50, 60, 714, 1043  
**\*trace-indent-width\*** 59, 1044  
**\*trace-level\*** 60, 1045  
**\*trace-output\*** 60, 705  
**\*trace-print-circle\*** 60, 1046  
**\*trace-print-length\*** 38, 60,  
 1047  
**\*trace-print-level\*** 38, 60,  
 1048  
**\*trace-print-pretty\*** 60, 1049  
**\*trace-verbose\*** 1050  
**\*use-n-syntax-for-non-**  
 ascii-strings\* 1676  
**vector-pop** function 266, 276  
**vector-push** function 266, 276  
**vector-push-extend** function 266,  
 276  
 verbose backtrace 14  
**verify-java-caller** function 1320  
**verify-java-callers**  
 function 1321  
**verify-lisp-proxies**  
 function 1324  
**verify-lisp-proxy** function 1324  
 virtual (ordinary) slots 355  
 virtual time 169  
**Visit Tags File Editor**  
 command 792

**W**

**wait-for-connection** generic  
 function 1919  
**waitForInitialization**  
 method 1336  
**wait-for-input-streams**  
 function 1888  
**wait-for-input-streams-**  
 returning-first  
 function 1889  
**wait-for-wait-state-collec-**  
 tion function 411, 635  
**wait-processing-events**  
 function 1508  
**wait-serial-port-state**  
 function 1524  
**wait-state-collection** class 411,  
 636  
**wait-state-collection-stop-**  
 loop function 411, 415, 636  
**weak**  
 arrays 1012  
 hash tables 682

weak hash tables 682  
 weak pointers 1012  
 web browser 1827  
**:when** keyword 55  
**when-let** macro 1201  
**when-let\*** macro 1202  
**whitespace-char-p** function 1203  
**who-binds** function 1059  
**who-calls** function 1060  
**who-references** function 1061  
**who-sets** function 1061  
 Windows code page 936 444  
 Windows event log 1909  
 Windows registry  
 API 468, 1923  
 Windows themes 1914  
**windows-cp936** 444  
**:windows-cp936** external format 444  
**with-action-item-error-han-**  
 dling macro 1204  
**with-action-list-mapping**  
 macro 1205  
**with-code-coverage-genera-**  
 tion macro 1062  
**with-dde-conversation**  
 macro 323, 1968  
**with-debugger-wrapper** macro 23,  
 785  
**with-ensuring-gethash**  
 macro 1063  
**with-exclusive-lock** macro 277,  
 1509  
**with-hash-table-locked**  
 macro 266, 267, 1065  
**with-heavy-allocation**  
 macro 146, 1066  
**with-interrupts-blocked**  
 macro 289, 1510  
**with-lock** macro 277, 1510  
**with-modification-change**  
 macro 1890  
**with-modification-check-**  
 macro macro 1891  
**with-noticed-socket-stream**  
 macro 637  
**with-other-threads-disabled**  
 macro 289, 1892  
**without-code-coverage**  
 macro 1071  
**without-interrupts** macro 289,  
 290, 1512  
**without-preemption** macro 289,

290, 1513  
**with-output-to-fasl-file**  
macro 1067  
**with-output-to-string** macro 723  
**with-registry-key** macro 468, 1938  
**with-remote-debugging-connection**  
function 33  
**with-remote-debugging-connection**  
macro 788  
**with-remote-debugging-spec**  
macro 789  
**with-ring-locked** macro 1071  
**with-sharing-lock** macro 277, 1511  
**with-sqlite-blob** macro 395, 1677  
**with-stream-input-buffer**  
macro 1710  
**with-stream-output-buffer**  
macro 1712  
**with-transaction** macro 348, 350,  
1678  
**with-unique-names** macro 1206  
**with-windows-event-log-**  
event-source macro 1921  
**write-java-class-definitions-to-file**  
function 1326  
**write-java-class-definitions-to-stream**  
function 1326  
**write-serial-port-char**  
function 1524  
**write-serial-port-string**  
function 1525  
**write-string-with-properties**  
function 1072  
**:write-timeout** initarg 613  
**wstr** FLI type 1918

## X

xrefs 860, 863, 1040, 1059, 1060

## Y

yellow pages 578  
**yield** function 1514

