Mu Runtime Reference

***mu namespace*, version 0.2.4**

type keywords and aliases

supertype	*T*	
bool	`()`, `:nil` are false, otherwise true	
condition	*keyword,* see ***Exception***	
list	`:cons` or `()`, `:nil`	
`:null`	`()`, `:nil`	
`:char`	*char*	
`:cons`	*cons*	
`:fixnum`	*fixnum, fix*	56 bit signed integer
`:float`	*float, fl*	32 bit IEEE float
`:func`	*function, fn*	function
`:keyword`	*keyword, key*	symbol
`:ns`	*namespace, ns*	namespace
`:stream`	*stream*	file or string type
`:struct`	*struct*	typed vector
`:symbol`	*symbol, sym*	LISP-1 symbol
`:vector`	*vector, string, str* `:char :t :byte :fixnum :float`	

Features

```
[dependencies]
 default = [ “env”, “procinfo”, “std”, “nix”, "sysinfo" ]
```

env	**heap-room**	*vector*	allocations
	`#(:t :`*`type size total free …`*`)`		
	heap-info	*list*	heap info
	`(`*`type page-size npages`*`)`		
	heap-size *keyword*	*fixnum*	type size
	heap-free	*fixnum*	bytes free
	env	*list*	env state
	core	*list*	core state
nix	**uname**		
std	**command**, **exit**		
sysinfo	**sysinfo** (disabled on macOS)		
procinfo	**process-mem-virt**	*fixnum*	virtual memory in bytes
	process-mem-res	*fixnum*	reserve in bytes
	process-time	*fixnum*	microseconds
	time-units-per-sec	*fixnum*	
prof	**prof-control**		enable
semispace			semispace heap

configuration API

```
config string format:

“npages:N, gc-mode:GCMODE, page-size:N, heap-type:HEAPTYPE”

  N: unsigned integer
  GCMODE: none | auto | demand
  HEAPTYPE: semispace | bump    // needs semispace feature
```

Special Forms

:lambda *list* . *list’*	*function*	anonymous *function*
:quote *form*	*list*	quoted form
:if *form T T’*	*T*	conditional

Reader/Printer

read *stream bool T*	*T*	read stream object
write *T bool stream*	*T*	write escaped object

Core

null/	*ns*	null namespace
apply *fn list*	*T*	apply *fn* to *list*
eval *form*	*T*	evaluate *form*
eq *T T’*	*bool*	*T* and *T’* identical?
type-of *T*	*key*	type keyword
compile *form*	*T*	*mu* form compiler
view *form*	*vector*	vector of object
%if *fn fn’ fn”*	*bool*	**:if** implementation
repr *T*	*vector*	tag representation
unrepr *vector*	*T*	tag representation

vector is an 8 element :`byte` vector of little-endian argument tag bits.

fix *fn T*	*T*	fixpoint of *fn*
gc	*bool*	garbage collection

Frames

%frame-stack	*list*	active *frames*
%frame-pop *fn*	*fn*	pop *function’s* top frame binding

frame binding: `(`*`fn`*` . #(:t …))`

%frame-push *frame*	*cons*	push frame
%frame-ref *fn fix*	*T*	*function*, offset

Symbols

boundp *symbol*	*bool*	is *symbol* bound?
make-symbol *string*	*symbol*	uninterned *symbol*
symbol-namespace *symbol*	*ns*	*namespace*
symbol-name *symbol*	*string*	name binding
symbol-value *symbol*	*T*	value binding

Fixnums

mul *fix fix’*	*fixnum*	product
add *fix fix’*	*fixnum*	sum
sub *fix fix’*	*fixnum*	difference
less-than *fix fix’*	*bool*	*fix* < *fix’?*
div *fix fix’*	*fixnum*	quotient
ash *fix fix’*	*fixnum*	arithmetic shift
logand *fix fix’*	*fixnum*	bitwise and
logor *fix fix’*	*fixnum*	bitwise or
lognot *fix*	*fixnum*	bitwise complement

Floats

fmul *fl fl’*	*float*	product
fadd *fl fl’*	*float*	sum
fsub *fl fl’*	*float*	difference
fless-than *fl fl’*	*bool*	*fl* < *fl’?*
fdiv *fl fl’*	*float*	quotient

Conses/Lists

append *list*	*list*	append lists
car *list*	*T*	head of *list*
cdr *list*	*T*	tail of *list*
cons *T T’*	*cons*	(*T* . *T’*)
length *list*	*fixnum*	length of *list*
nth *fix list*	*T*	*n*th *car* of *list*
nthcdr *fix list*	*T*	*n*th *cdr* of *list*

Vectors

make-vector *key list*	*vector*	specialized vector from list
vector-length *vector*	*fixnum*	length of *vector*
vector-type *vector*	*key*	type of *vector*
svref *vector fix*	*T*	*n*th element

Streams

standard-input	*stream*	std input *stream*
standard-output	*stream*	std output *stream*
error-output	*stream*	std error *stream*
open `type dir` *string bool*	*stream*	open *stream* raise error if *bool*
close *stream*	*bool*	close *stream*
openp *stream*	*bool*	is *stream* open?
flush *stream*	*bool*	flush output *steam*
get-string *stream*	*string*	from *string stream*
read-byte *stream bool T*	*byte*	read *byte* from *stream*, error on eof, *T:* eof value
read-char *stream bool T*	*char*	read *char* from *stream*, error on `eof`, *T:* `eof` value
unread-char *char stream*	*char*	push *char* onto *stream*
write-byte *byte stream*	*byte*	write *byte* to *stream*
write-char *char stream*	*char*	write *byte* to *stream*

```
type   :file  :string
dir    :input :output :bidir
```

Namespaces

make-namespace *str*	*ns*	make *namespace*
namespace-map	*list*	list of mapped *namespaces*
namespace-name *ns*	*string*	*namespace* name
intern *ns str value*	*symbol*	intern bound symbol
find-namespace *str*	*ns*	map *string* to *namespace*
find *ns string*	*symbol*	map *string* to *symbol*
namespace-symbols *ns list*		*namespace symbols*

Exceptions

with-exception *fn fn'*	*T*	catch exception

fn - `(:lambda (`*`obj cond src`*`) . `*`body`*`)`
fn' - `(:lambda () . `*`body`*`)`

raise *T keyword*	raise exception on *T* with condition:

```
:arity   :div0    :eof     :error   :except
:future  :ns      :open    :over    :quasi
:range   :read    :exit    :signal  :stream
:syntax  :syscall :type    :unbound :under
:write   :storage
```

Structs

make-struct *key list*	*struct*	of type *key* from *list*
struct-type *struct*	*key*	*struct* type *keyword*
struct-vec *struct*	*vector*	of *struct* members

mu library API

```
[dependencies]
mu_runtime = {
   git = "https://github.com/Software-Knife-and-Tool/mu.git",
   branch=main
}

use mu_runtime::{ Condition, Config, Env, Exception, Result,
Tag };

impl Env {
  const VERSION: &str

  fn config(config: Option<String>) → Option<Config>
  fn new(config: &Config, Option<(Vec<u8>, Vec<u8>)> → Env
  fn apply(&self, func: Tag, args: Tag) → Result<Tag>
  fn compile(&self, form: Tag) → Result<Tag>
  fn eq(&self, func: Tag, args: Tag) → bool;
  fn exception_string(&self, ex: Exception) → String
  fn eval(&self, exp: Tag) → Result<Tag>
  fn eval_str(&self, exp: &str) → Result<Tag>
  fn load(&self, file_path: &str) → Result<bool>
  fn read(&self, st: Tag, eofp: bool, eof: Tag) → Result<Tag>
  fn read_str(&self, str: &str) → Result<Tag>
  fn image(&self) → Result<(Vec<u8>, Vec<u8>)>
  fn err_out(&self) → Tag
  fn std_in(&self) → Tag
  fn std_out(&self) → Tag
  fn write(&self, exp: Tag, esc: bool, st: Tag) → Result<()>
  fn write_str(&self, str: &str, st: Tag) → Result<()>
  fn write_to_string(&self, exp: Tag, esc: bool) → String
```

Reader Syntax

`;`	comment to end of line
`#|...|#`	block comment
'*form*	quoted form
`` ` ``*form*	backquoted form
`` ` ``(…)	backquoted list (proper lists)
,*form*	eval backquoted form
,@*form*	eval-splice backquoted form
(…)	constant *list*
()	empty *list*, prints as `:nil`
(… . .)	dotted *list*
"…"	*string, char vector*
`\`	single escape in strings
#*…	bit vector
`#x...`	hexadecimal *fixnum*
`#.`	read-time eval
`#\.`	*char*
`#(:type …)`	*vector*
`#s(:type …)`	*struct*
`#:symbol`	uninterned *symbol*
" ` , ;	terminating macro char
#	non-terminating macro char
`!$%&*+-.` `<>=?@[]|` `:^_{}~/` `A..Za..z` `0..9`	symbol constituents
`0x09 #\tab` `0x0a #\linefeed` `0x0c #\page` `0x0d #\return` `0x20 #\space`	whitespace

mu-sys

```
mu-sys: 0.0.2: [celq] [file…]

c: name:value,…        runtime configuration
e: form                eval and print result
l: path                load from path
q: form                eval quietly
```