Basic Lisp Overview

Numeric Functions

*, +,-,/ - returns product, sum, difference, or quotient
(* 2 3 4) ⇒ 24
(/ (+ 2 2) (- 3 1))⇒2

sqrt - square root of number (sqrt 9) ⇒ 3

expt - (expt *Base Exponent*) ⇒ $Base^{Exponent}$
(expt 10 3) ⇒ 1000

min, max - minimum or maximum of numbers
(min -1 2 -3 4 -5 6) ⇒ -5

abs, mod, round - absolute value, mod, nearest int
(round (abs -4.2)) ⇒ 4

sin, cos, tan - trig functions. Arguments in radians, ***not*** degrees.
(sin (/ pi 2)) ⇒ 1.0 ; PI is built-in variable

List Access Functions

first - returns first element of a list. Use instead of CAR.
(first '(A B C D)) ⇒ A

second, third, ..., tenth - analogous to "first": (third '(A B C D)) ⇒ C

nth - (nth *N List*) ⇒ *N*th entry of *List*. Note that *N* starts at 0, not 1.
(nth 2 '(A B C D)) ⇒ C

rest - returns all but 1st element of a list. Use instead of CDR.
(rest '(A B C D)) ⇒ (B C D)

last - returns ***list*** of last element of a list
(last '(A B C D)) ⇒ (D)

length - returns the number of top-level entries in list
(length '(A (B C) (D E))) ⇒ 3

List Construction Functions

cons - (cons *Entry* (*List*)) ⇒ (*Entry List*)
(cons 'A '(B C D)) ⇒ (A B C D)
(cons (first '(A B C)) (rest '(A B C))) ⇒ (A B C)

append - (append (*List1*) (*List2*)) ⇒ (*List1 List2*)
(append (*L1*) (*L2*) (*L3*)...(*LN*)) ⇒ (*L1 L2 L3 ... LN*)
(append '(A B) '(C D)) ⇒ (A B C D)
For CONS and APPEND, if the second arg is not a list, you will get an odd result that looks like a list but has a dot before the last element.

list - (list *Entry1 E2 ... EN*) ⇒ (*Entry1 E2 ... EN*)
(list 'A '(B C) (+ 2 3)) ⇒ (A (B C) 5)

Predicates

Type-checking Predicates: listp, numberp, integerp, stringp, atom test if arg is a list, number, integer, string or atom, respectively.
(numberp 5.78) ⇒ t (integerp 5.78) ⇒ NIL

Numeric Predicates: evenp, oddp, =, <, >, <=, >=
(oddp 7) ⇒ t (> 7 6) ⇒ t
These will all give errors for non-numbers.

General Predicates: null, equal, eql - test if arg is NIL or if two arguments have the same value. EQL does ***not*** work on lists or strings.
(null (rest '(A)) ⇒ t
(equal '(A B) (cons 'A '(B))) ⇒ t
(eql 'A 'A) ⇒ t
(eql '(A B) (cons 'A '(B))) ⇒ NIL

Logical Predicates: and, or, not
(not (and (= 7 (+ 2 5)) (evenp 8))) ⇒ NIL

Special Forms

Special forms are used for side effects, and don't follow the normal Lisp rule of evaluating all the args before applying function to the results.

setq (or setf) - assigns a value to a variable
(setq Foo 'Bar)⇒BAR (list Foo 'Foo)⇒(BAR FOO)

" ' " (or quote) - returns argument literally
'(+ 2 3) ⇒ (+ 2 3) (+ 2 3) ⇒ 5

defun - defines a function.
(defun *Function-Name* (*Arguments*) *Body*) The value the function returns is the value of the last form in the *Body*.
(defun Square (Num) (* Num Num))
(Square 7) ⇒ 49

if - the most basic conditional operator.
(if *Form1* *Form2* *Form3*) usually read as (if *Condition* *Then-Result* *Else-Result*)
Means to evaluate *Form1*. If its value is "true" (non-NIL), then evaluate and return *Form2*, otherwise evaluate and return *Form3* (or NIL if *Form3* is missing).
(if (= 7 (+2 4)) 'yes 'no) ⇒ NO

cond - multiple if-then-else conditional operator.
(cond (*Test1 Result1*)
(*Test2 Result2*)
...
(*TestN ResultN*))
This evaluates each of *Test1* through *TestN* in order. The first one it finds that is "true" (non-NIL), it evaluates and returns the associated *Result*. No further *Tests* or *Results* are evaluated. If you have multiple results associated with a single test, each is evaluated and the value of the last one is returned.

```
(setq Test 7)
(cond ((not (numberp Test))  "Not a number!")
      ((oddp Test)           (+ Test 1))
      (t                     Test))
⇒ 8
```

progn - Group multiple commands into a single block, returning the value of the final one. Some constructs do this implicitly.

loop - The infamous all-in-one iteration construct. See handout.

Miscellaneous

load - loads the indicated file, evaluating all Lisp forms in file.

compile-file - takes the indicated source file (xxx.lisp) and produces a compiled file (xxx.wfasl). Does *not* load this compiled file.

print, format - prints output. See separate handout on FORMAT.

```
(print "Hello")
"Hello"          ; prints on screen, is NOT return value
⇒ "Hello"        ; return value (rarely used)
```

On-line help:
apropos - finds functions/variables containing substring
(apropos 'concat 'user) gives all functions containing "concat" in the default ("user") package, including "concatenate"
documentation - prints the doc-string for a function. E.g.
(documentation 'concatenate 'function)

Debugger options: :A - Abort out of debugger
:B - Backtrace (list previous calls)
:N - Next (earlier) entry on stack
:P - Previous (later) entry on stack
:? - more debugger options

bye - quits Harlequin lisp (Harlequin specific).