Programming in Lisp

Lecture #5
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Outline

- Symbols
- Packages
- Numbers

Symbols

- We've seen symbols in three contexts so far:
- > (setf sym 3)
  3
- (let ((sym 3)) ...)
- >'Sym
  SYM

Symbols -- Context

- The first of these refers to a *special* (or global) variable.
- The second refers to a *lexical* (or local) variable
- The third refers to a global symbol
- But these are all uses of symbols!

Special Variables

- Also called *dynamic* variables
- Created by *setf*, *defvar*, and others.
- Scope is from when bound to a value until whenever.
- Global...
- Should rarely be used.

Lexical, Perplexical

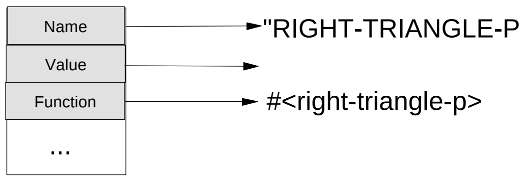
- *lexical* or static variables are created by functions like *let*, *do*, etc.
- Can only be referenced within textual region defined
- However, bindings can be changed at any time... Remember closure.

Back to Symbols...

- A symbol to hold a lexical variable is never really created -- the value is merely substituted as needed.
- Symbols, however, are big structures that include pointers to values and functions
- Special variables are symbols whose value pointers point to the value of the variable
- Named functions are symbol pointers as well

Symbol Structure

- Symbols are represented internally a little like this:



Symbol Names

- Remember Lisp converts symbols to all caps.
- Use (*symbol-name* symbol) to get a string holding the name of the symbol
- Symbol names can have whitespace -- use | | to enclose the symbol when declaring it:
- '|This is a really long symbol name|

Symbol Values (Global Vars)

```
> (setf global-var 3)
3
> (symbol-value 'global-var)
3
```

- This demonstrates that the value of a global variable is held in a symbol

Packages

- Similiar to Java's package management system in some ways
- All symbols are included in some package
- A package is a namespace or context which parameterizes symbol names
- Symbols are by default in *common-lisp-user*

Symbols on Packages

- You can create symbols with *(intern)*
- Reverses process of *(symbol-name)*
- Returns symbol and whether the symbol previously existed
  - nil -- Didn't exist
  - :internal -- Already present in this package
  - :external -- Imported from another package
  - :inherited -- Imported via *use-package*

Intern Examples (Not what you're thinking!)

-
  ```
  > (intern "KENN")
  KENN
  NIL
  ```

-
  ```
  > (intern "KENN" 'common-lisp)
  CL::KENN
  NIL
  ```

-
  ```
  > (intern "CAR" 'common-lisp)
  CAR
  :EXTERNAL
  ```

Packages II

- Create packages with (defpackage)

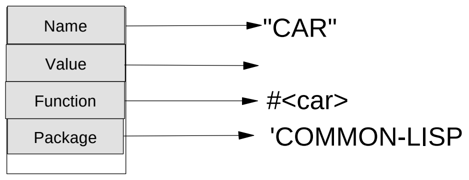
-
  ```
  (defpackage "PACKAGE-NAME"
        (:use "COMMON-LISP" ...)
        (:nicknames "PN")
        (:export "SYM1" "SYM2" ...)
  )
  ```
- (in-package 'PACKAGE-NAME)

Packages...

- Packages allow for source code management
- To use other packages, we can refer to exported symbols as PACKAGE-NAME:SYMBOL, or PN:SYMBOL
- Use-ing a package allows us to not have to have the qualifier
- Most implementations auto use 'Common-Lisp

Symbols Again

- Symbols know their package name and are contained within



Keywords

- Keyword arguments, or symbols beginning with a mere : -- such as :input are in the KEYWORD package
- They are put there silently. They are then accessible anywhere -- :symbol means look in that package, which is auto "used."
- Functions that take symbols as args should use keywords

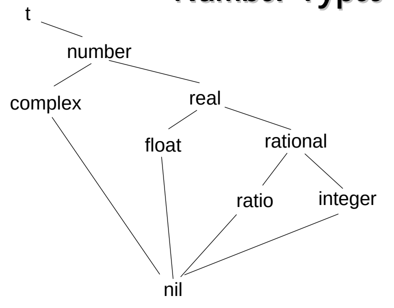
Numbers

- Lisp has many functions to handle numbers
- But first, we need to talk about types:
- Although we never see it, all Lisp variables have a data type.
- These types are not mutally exclusive!
- See Steele, pg. 50 for complete list

Data Types

- Numbers
- Characters
- Symbols
- Lists
- Arrays
- Packages
- Streams
- Structures
- Functions
- Hash-Tables
- ReadTables
- Random-States

Number Types



typep

- (typep 123 'integer)
  T
- (typep 3.3 'float)
  T
- Can be used with any type, even a structure you define
- Also (numberp, integerp, etc...)

More on Numbers

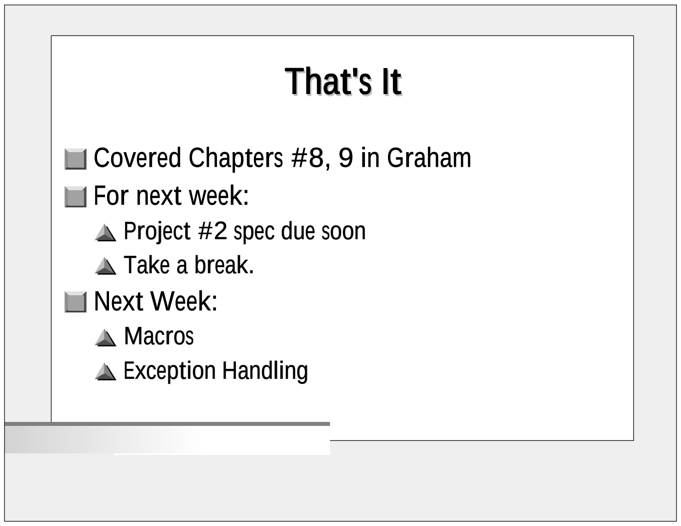
- Conversion
  - (float) (truncate) (floor) (ceiling) (round) ...
  - Take any number of args.
- Comparision
  - = does numeric checking
  - #'eql requires same type and numeric equal

Some Notes On Style

- Lisp is functional
- All functions return at least one value
- Functions do not modify their arguments, instead they return a new value
- This is what we mean by "no variables"
- No *side-effects*
- Use as few *setf's* as possible! This will avoid errors.

House of Lisp Style

- In source files, should only find package definitions, global constants, and functions
- Do not declare global variables unless you have a very, very, very good reason!
- Then use (load) to load your file



That's It

- Covered Chapters #8, 9 in Graham
- For next week:
  - Project #2 spec due soon
  - Take a break.
- Next Week:
  - Macros
  - Exception Handling