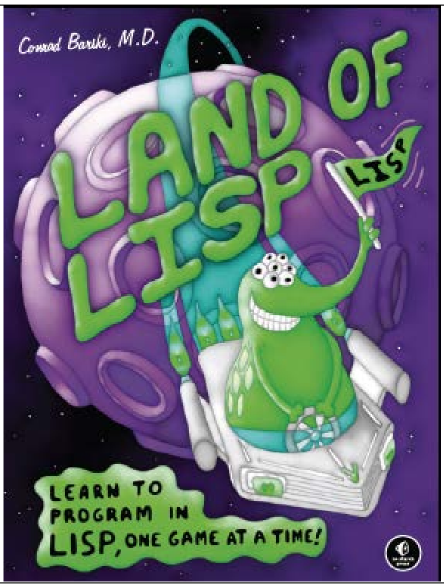


Ch 3

Exploring the Syntax of Lisp Code – Ch 3

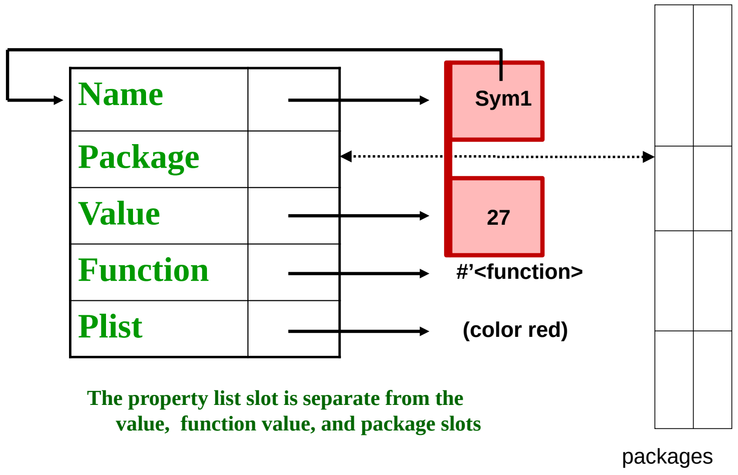
- Parentheses – take the place of many keywords in other languages. Fewer words to memorize and less typing.
- Built in types: lists, symbols, numbers, and strings
- Command mode and data mode
- Building blocks - cons cells

A List – Stuff Enclosed in Parentheses

Symbols

- Symbols - the fundamental data type in Lisp
- A symbol's name is a stand-alone word
- CL symbol names may contain
  - letters,
  - numbers, and
  - characters like + - / * = < > ? ! _.

A Lisp Symbol is More than a Variable



The property list slot is separate from the value, function value, and package slots

Numbers

- Integers e.g. 1, 1234567890, #xDADA
- Rational numbers e.g. 2/3, 543/13
- Floating point e.g. 1.23 456.789
- Exponential notation e.g. 123e0, 123E-3, 0.123e20
- Complex e.g. #c(2 1), #c(2/3 3/4)

Base 2 – 36!!! b = binary, o = octal, x = hexadecimal

s, f, d, l - short, single, double, long double

Strings

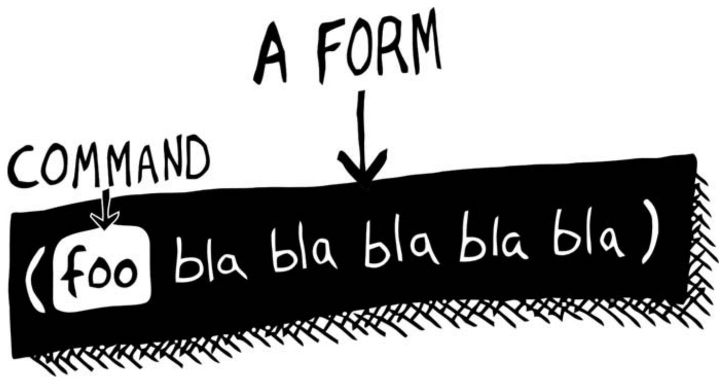
- To indicate a string in Lisp, surround characters with double quotes.
- `"Tutti Frutti"`
- Strings evaluate to themselves
- "Silly string " → "Silly string "
- To display a string without the quote marks use the function `princ`

```
(princ "Silly string") ➔
Silly string
```

Command Mode

- Whenever you type something in to the Lisp REPL, the interpreter assumes that you are entering a command that you want to execute.
- I.e. Lisp always defaults to code mode.

How Lisp Distinguishes between Code and Data



Data Mode

- Switch into data mode with **QUOTE '**

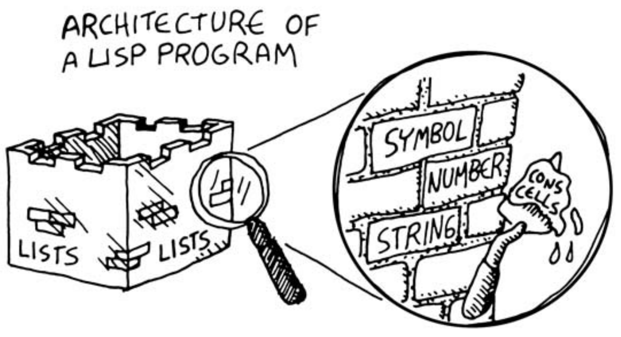
```
'(some data)
```

- Is equivalent to

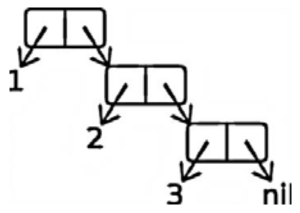
```
(quote (some data))
```

The quote **prevents evaluation**

Building Blocks of Lisp Programs

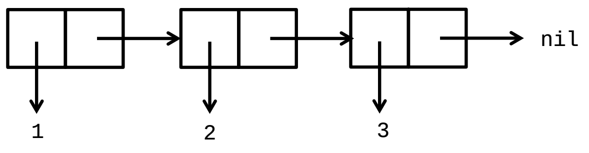


Lists are Built of Cons Cells



Represents the list
`(1 2 3)`

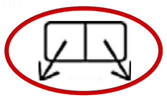
As seen in LoL



Cons cells may also be drawn with down and right arrows.
The figure above represents the same list: `(1 2 3)`

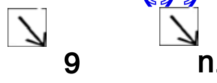
Lisp Functions to Build Lists

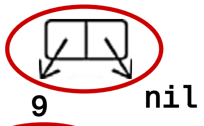
cons – create a new cons cell



Create a new cc with arg1 as car

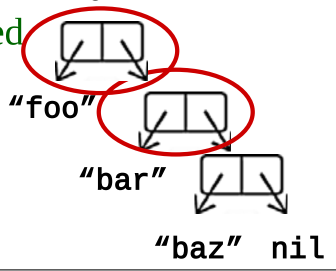
(cons 9 ()) ➔





Functions can be nested

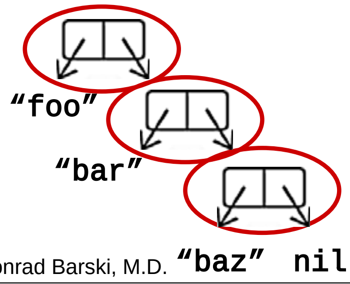
```
(cons "foo"
   (cons "bar"
      '("baz")))
```



List Functions to Build Lists

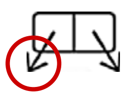
- **list** – create a new list with a new cons cell pointing to each parameter

(list "foo" "bar" "baz") ➔ **("foo" "bar" "baz")**



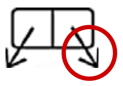
List Functions to Access Data

- **car** – return the first item in the first cons cell



(car '(9 10)) ➔ 9

- **cdr** – return a reference to the second item in the list



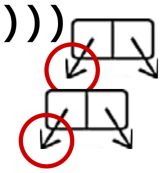
(cdr '(9 10)) ➔ (10)

Shortcuts with **car** & **cdr**

- **(car (car '((1) 2 3)))**

Is equivalent to

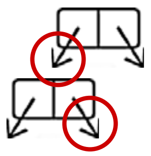
(caar '((1) 2 3)))



- **(car (cdr '((1) 2 3)))**

Is equivalent to

(cadr '((1) 2 3))



Shortcuts with **car** & **cdr**

- **(caddr '((1) 2 3))**

Is equivalent to

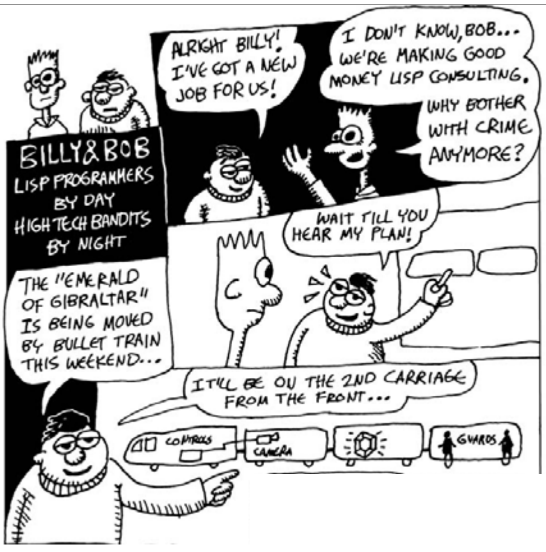
???????

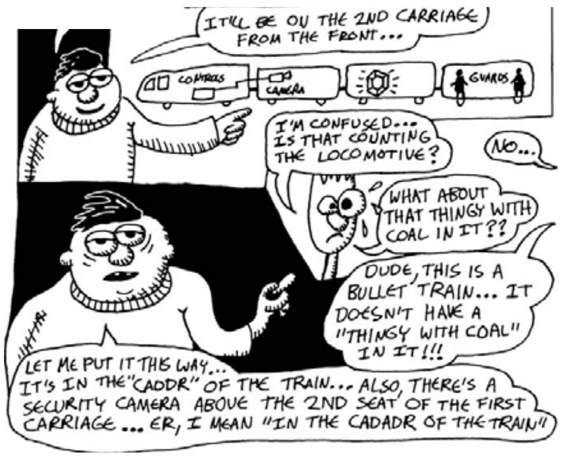
- **(cadddr (cdr '((1) 2 3)))**

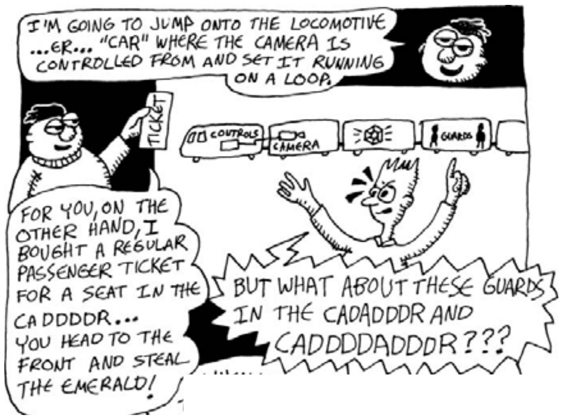
Is equivalent to

??????

C_ _ _ _R is defined *with up to* ***4*** **a**s/**d**s!!


ALRIGHT BILLY! I'VE GOT A NEW JOB FOR US!
I DON'T KNOW, BOB... WE'RE MAKING GOOD MONEY LISP CONSULTING.
WHY BOTHER WITH CRIME ANYMORE?
BILLY & BOB LISP PROGRAMMERS BY DAY HIGH TECH BANDITS BY NIGHT
WAIT TILL YOU HEAR MY PLAN!
THE "EMERALD OF GIBRALTAR" IS BEING MOVED BY BULLET TRAIN THIS WEEKEND...
IT'LL BE ON THE 2ND CARRIAGE FROM THE FRONT...
CONTROLS
CAMERA
GUARDS


IT'LL BE ON THE 2ND CARRIAGE FROM THE FRONT...
CONTROLS
CAMERA
GUARDS
I'M CONFUSED... IS THAT COUNTING THE LOCOMOTIVE?
NO...
WHAT ABOUT THAT THINGY WITH COAL IN IT??
DUDE, THIS IS A BULLET TRAIN... IT DOESN'T HAVE A "THINGY WITH COAL" IN IT!!!
LET ME PUT IT THIS WAY... IT'S IN THE "CADDR" OF THE TRAIN... ALSO, THERE'S A SECURITY CAMERA ABOVE THE 2ND SEAT OF THE FIRST CARRIAGE... ER, I MEAN "IN THE CADADR OF THE TRAIN"


I'M GOING TO JUMP ONTO THE LOCOMOTIVE ...ER... "CAR" WHERE THE CAMERA IS CONTROLLED FROM AND SET IT RUNNING ON A LOOP.
TICKET
CONTROLS
CAMERA
GUARDS
FOR YOU, ON THE OTHER HAND, I BOUGHT A REGULAR PASSENGER TICKET FOR A SEAT IN THE CADDDDR... YOU HEAD TO THE FRONT AND STEAL THE EMERALD!
BUT WHAT ABOUT THESE GUARDS IN THE CADADDDR AND CADDDDADDDR???

YOU HEAD TO THE FRONT AND STEAL THE EMERALD!
CADDDDADDDR???
WHEN YOU GET TO THE CADDDR YOU'LL JUST CLIMB OVER THE ROOF...
BUT THIS IS A 200 MPH BULLET TRAIN - AND WE'RE SUPPOSED TO HAVE RAIN THIS WEEKEND!
THAT'S THE GENIUS OF THIS PLAN... YOU'RE GOING TO BE WEARING THIS WET SUIT, WHICH WILL GIVE YOU THE AERODYNAMIC PROPERTIES NEEDED TO CLING TO THE TRAIN AND AVOID HYPOTHERMIA... ...HEY, WHAT ARE YOU DOING??
CONSING YOUR PLAN TO THE TRASH!!
JERK!!

Summary

- Parentheses for syntax
- Lists, symbols, numbers, and strings
- Cons cells
- Create lists
  - `cons`
  - `list`
- Access lists
  - `car`
  - `cdr`