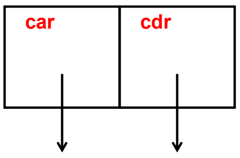
CS61A Lecture 8

2011-06-30

Colleen Lewis

`cons` makes pairs

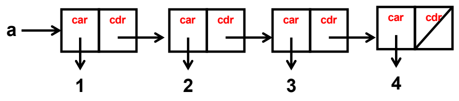
Pairs



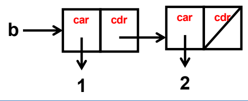
Selectors	Constructors
`car` `cdr`	`cons`

Lists are made with pairs!

```
STk> (define a (list 1 2 3 4))
```

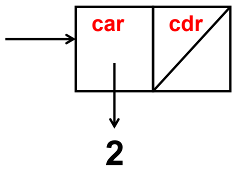


```
STk> (define b (list 1 2))
```



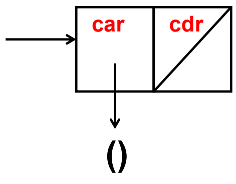
Make the Empty List the `cdr`

```
STk> (cons 2 '())
(2)
```



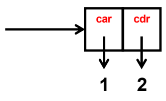
Make the Empty List the `car`

```
STk> (cons '() '())
(())
```

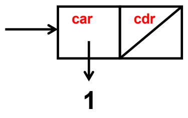


Dots

```
STk> (cons 1 2)
(1 . 2)
```



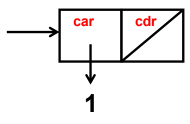
```
STk> (cons 1 '())
(1)
```



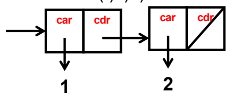
STk> (cons 1 '())

(1 ~~.(~~ ~~)~~)

Dots



```
STk> (cons 1 '())
(1 . ())
(1)
STk> (cons 1 (cons 2 '()))
```
(1 ~~. (~~2 ~~. ( ))~~)



```
(1 2)
```

Practice Removing Dots

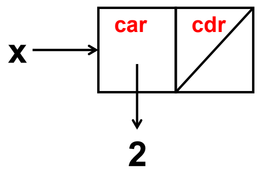
```
(cons
    (cons 1 '())
    (cons
        2
        (cons
            (cons 3 4)
            (cons 5 '()))))
```

Accessing Elements

Using `car` and `cdr`

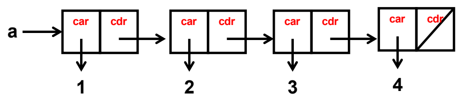
The Empty List w/ `car` & `cdr`

```
STk> (define x (cons 2 '())
x
STk> x
(2)
STk> (car x)
2
STk> (cdr x)
()
```



How do you get the 2?

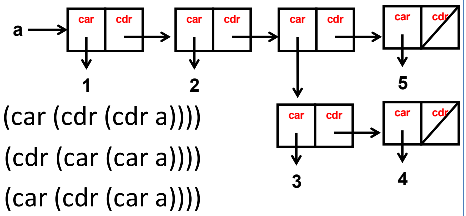
```
STk> (define a (list 1 2 3 4))
```



A) (car (cdr a))
B) (cdr (car a))
C) (cdr (cdr (car a)))
D) (car (cdr (cdr a)))
E) (cdr (car (car a)))

How do you get the 3?

```
STk> (define a (list 1 2 (list 3 4) 5))
```



A) (car (car (cdr (cdr a))))
B) (cdr (cdr (car (car a))))
C) (cdr (car (cdr (car a))))
D) (car (cdr (car (cdr a))))
E) ???

We don't need no stinkin' pairs

```
(define (cons x y)
  (lambda (which)
    (cond
      ((equal? which 'car) x)
      ((equal? which 'cdr) y)
      (else (error "Bad message"
                            which)))))
(define (car pair) (define (cdr pair)
  (pair 'car))        (pair 'cdr))
```

Try It!

- Try to use this new cons!

Does it work the same way as before?

A) Yes

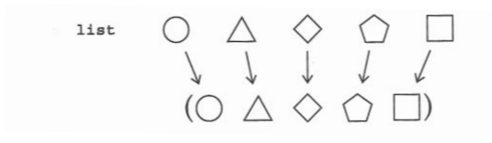
B) No

C) I don't know

List Methods

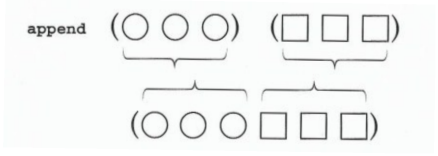
`list`

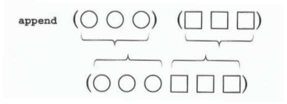
- Takes any number of arguments and puts them in a list



`append`

- Takes two lists and turns them into one
- Both arguments MUST be lists

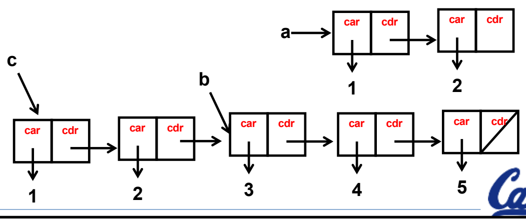




- Examples
  - `(append '(cat) '(dog))` ➔ `'(cat dog)`
  - `(append '(cat) '())` ➔ `'(cat)`
  - `(append '() '(dog))` ➔ `'(dog)`
  - `(append '(cat) '(()))` ➔ `'(cat ())`
  - `(append '(() ()) '(dog))` ➔ `'(() () dog)`

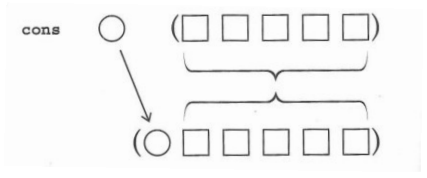
The truth about append

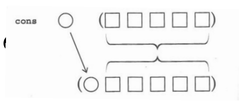
```
STk> (define a (list 1 2))
STk> (define b (list 3 4 5))
STk> (define c (append a b))
```



cons

- Takes two arguments
- If the second arg is a list
  - Makes the first arg the car of the new list
  - Makes the second arg the cdr of the new list





- Examples
  - **(cons 'cat '(dog)) ➔ '(cat dog)**
  - **(cons '(cat) '(dog)) ➔ '((cat) dog)**
  - **(cons 'cat '()) ➔ '(cat)**
  - **(cons '() '(() dog)) ➔ '(() () dog)**
  - **(cons '(cat) 'dog ➔ '((cat) . dog)**

Data Abstraction Goals

- To talk about things using *meaning* not how it is represented in the computer
- To be able to change how it is represented in the computer without people who use our program caring

Very Happy Code ☺

```
(define (total hand)
     (if (empty? hand)
          0
          (+ (rank ( last  hand))
               (total (remaining-cards hand)
                                          ))))
```

Data Abstraction Violation (D.A.V.)

```
(define (rank card)
      (butlast card))
(define (suit card)
      (last card))
(define (one-card hand)
      (last hand))
(define (remaining-cards hand)
      (bl hand))
```

```
(define (make-card rank suit)
      (word rank (first suit)))
(define make-hand se)
```

Use the right one or it is a DAV

sentence & word stuff	list stuff
first	car
butfirst	cdr
last	☹
butlast	☹

Use the right one or it is a DAV

sentence & word stuff	list stuff
empty?	null?
sentence?	list?
item	list-ref
sentence	append, cons, list

Implement se2

```
(define (se2 a b)
  (cond
   ((and (word? a) (word? b))

   ((word? a)

   ((word? b)

   (else
```

Modify this to work with lists (without sub-lists)

```
(define (square-sent sent)
  (if (empty? sent)
      sent
     (sentence
          (square (first sent))
          (butfirst sent))))
```

map2 (like every)

```
(define (map2 fn lst)
   (if (null? lst)
       lst
       (cons (fn (car lst))
             (map2 fn (cdr lst)))))
STk> (map2 square '(1 2 3 4))
(1 4 9 16)
```

The real map

(map *procedure list1 list2…***)**

- *procedure*
  - a procedure that takes in **some # of arguments**
- *Some # of lists*
  - The number of lists MUST match the number of arguments that the procedure takes

map

```
(define (add-2-nums x y)
    (+ x y))

(map add-2-nums '(1  2  3)
                '(4  5  6))
                  ↓  ↓  ↓
             ➔ '(5  7  9)
```

map

```
(define (add-3-nums x y z)
    (+ x y z))

(map add-3-nums '(1  2  3)
                '(4  5  6)
                '(7  8  9))

            ➔ '(12  15  18)
```

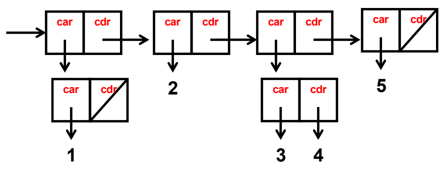
map

```
(map cons  '(1   2   3)
          '((4) (5) (6)))

       ➔ '((1 4) (2 5)  (3 6))
```

Solutions

Solution



```
((1) 2 (3 . 4) 5)
((1.()).(2.((3.4).(5.()))))
```

Implement se2

```
(define (se2 a b)
  (cond
   ((and (word? a) (word? b))
           (list a b))
   ((word? a)
           (cons a  b))
   ((word? b)
           (append a (list b)))
   (else
           (append a b))))
```

Modify this to work with lists (without sub-lists)

```
(define (square-sent sent)
  (if (null? sent)
      sent
     ( CONS
              (square (car sent))
              (cdr sent))))
```