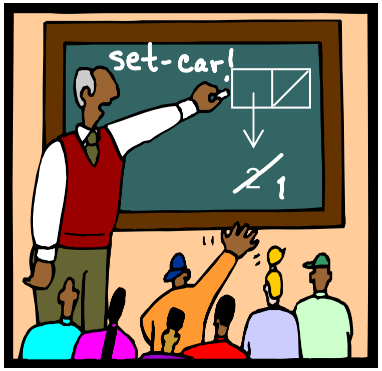
6.001 recitation 3/23/07

- from last time: set-car!, set-cdr!
- trees



Dr. Kimberle Koile

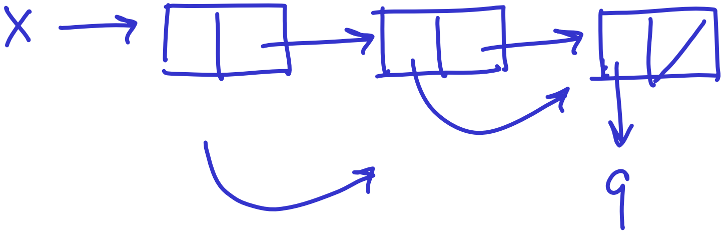
more set-car! and set-cdr! problems

For the box & pointer diagram:

(a) Write what Scheme prints out for the structure (if it can)

(b) Write a Scheme expression that makes the structure(if an error, describe it)

(c) Draw the structure that results from the mutation, and its printed representation.

1. 

a. x =>

b. Scheme expression:

c. mutation: (set-cdr! (car x) '(8))

x =>

more set-car! and set-cdr! problems

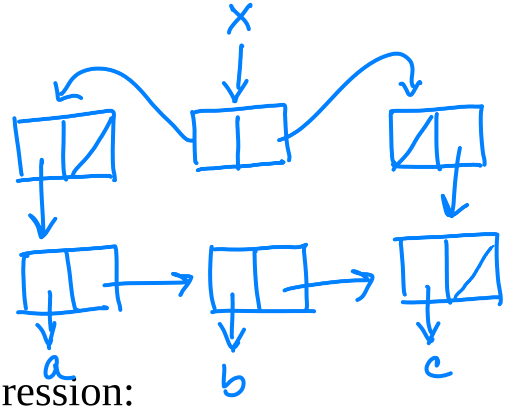
For the box & pointer diagram:

(a) Write what Scheme prints out for the structure (if it can)

(b) Write a Scheme expression that makes the structure (if an error, describe it)

(c) Draw the structure that results from the mutation, and its printed representation.

2.



a. x =>

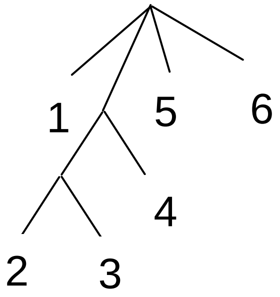
b. Scheme expression:

c. mutation: (set-cdr! (cddr x) (caaar x))

x =>

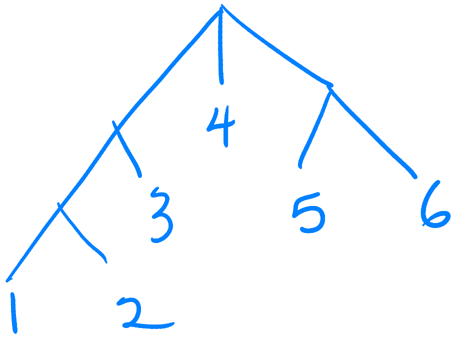
trees

- **A tree is a nested list; each node is a list of the children of that node**
- **A child is either another tree or a leaf node**
  - A child that is a tree is called a *subtree*
  - A leaf node is anything that is not a pair (i.e., a symbol or a self-evaluating value).



tree representation

1. Draw a box-and-pointer structure for the following tree. How does the interpreter print this structure?



box&pointer

printed representation

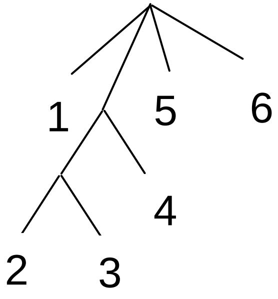
tree representation

2a. Draw the interpretation of this list as a tree structure: (((1 2) 3) (4 (5 6) 7 (8 9 10))

2b. Draw the box-and-pointer diagram.

counting leaves

```
(define (countleaves tree)
    (cond ((null? tree) 0)
              ((leaf? tree) 1)
              (else (+ (countleaves (car tree))
                          (countleaves (cdr tree))))))

(define (leaf? x)
    (not (pair? x)))
```

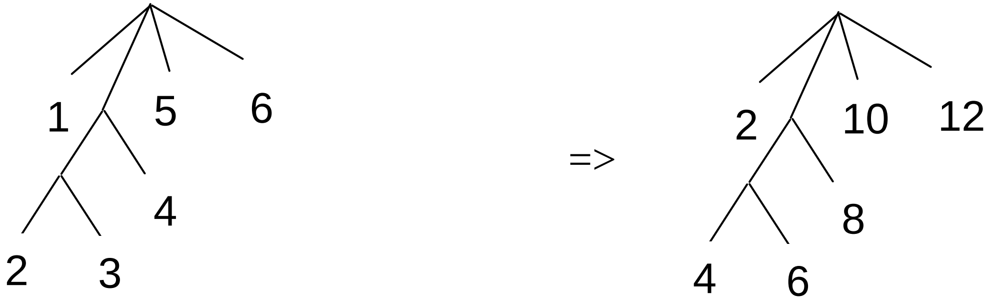


(1 ((2 3) 4) 5 6)

doubling a tree: version 1

```
(define (countleaves tree)
   (cond ((null? tree) 0)
         ((leaf? tree) 1)
         (else (+ (countleaves (car tree))
                  (countleaves (cdr tree))))))

(define (leaf? x)
   (not (pair? x)))
```

```
(define (double-tree tree)
   (cond ((null? tree) ‘())
         ((leaf? tree) □ )

         (else (□ (□ (car tree))
                  (□ (cdr tree))))))
```

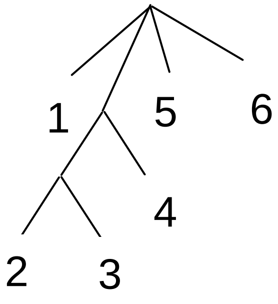


(1 ((2 3) 4) 5 6)   (2 ((4 6) 8) 10 12)

doubling a tree: version 2, map

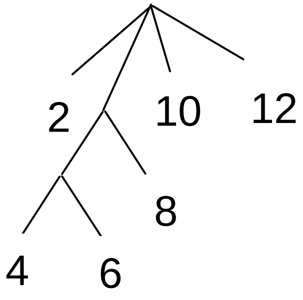
```
v. 1 (define (double-tree tree)
        (cond ((null? tree) '())
              ((leaf? tree)                      )

              (else (          (                    (car tree))

                          (                        (cdr tree))))))
```

```
v. 2 (define (double-tree tree)
        (if  (leaf? tree)

             (                              )

             (                              )))
```



(1 ((2 3) 4) 5 6)

=>



(2 ((4 6) 8) 10 12)

doubling a tree: version 3, map-tree

```
v. 1 (define (double-tree tree)
        (cond ((null? tree) '())
              ((leaf? tree)                        )

              (else (              (                        (car tree))

                               (                        (cdr tree))))))
```

```
v. 2 (define (double-tree tree)
        (if  (leaf? tree)

             (                              )

             (                                            )))
```

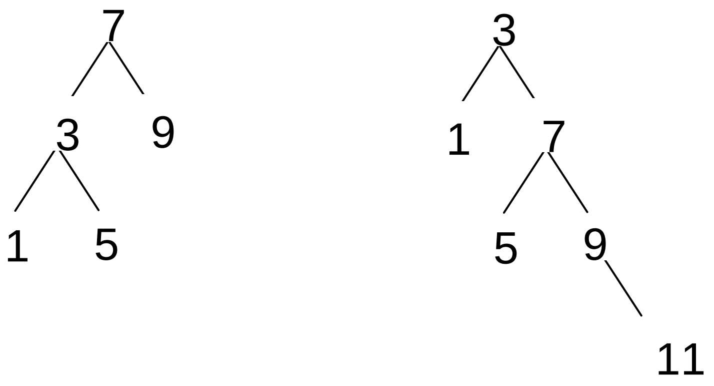
```
(define (map-tree proc tree)
    (if  (leaf? tree)
         (proc tree)
         (map-tree proc  tree )))
```

```
(define (double x)
   (*  2  x))

(define (double-tree tree)

)
```

binary trees

- **A *binary tree* is one in which each node is represented by an *entry* and a *link***
- **The “left” link points to elements smaller than node entry**
- **The “right” link points to elements larger than node entry**
- **To check where an element is in a set:**
  - compare x with an entry
  - if x is less than entry, search left subtree; if greater, search right subtree

- **Two trees that represent the set {1, 3, 5, 7, 9, 11}:**


7
3
9
1
5
3
1
7
5
9
11