Outline

• Sorting
• Searching

Sorting

• Classing Computer Science Problem
• Put the list (3 4 5 1 3 2 1) in order
  – (1 1 2 3 3 4 5)
• Break down into several steps

insert

• Write a procedure (insert itm lst) that
takes an already sorted list and inserts
itm into it
• Example:
  – (insert 1 (list 3 4 5)) → (1 3 4 5)
  – (insert 3 (list 1 2 4 5)) → (1 2 3 4 5)

New Special form: cond

• Cond can replace a set of nested if expressions:
  • (cond (test1 result1)
  •    (test2 result2)
  •    ....
  •    (else value))

insert

(define (insert itm lst)
  (cond ((null? lst) (list itm))
    ((< itm (car lst))
     (cons itm lst))
    (else
     (cons (car lst)
          (insert itm (cdr lst)))))  )}
Sorting

• Can we use insert to sort an unsorted list?
• (define (insert-sort lst)

Insert-sort

(define (insert-sort lst)
  (if (null? lst) lst
      (insert (car lst)
              (insert-sort (cdr lst)))))

Searching

• Another classic problem
• Is 5 in the list (1 2 3 6 7)
• What’s the simple way of solving this?
• (define (contains? elm lst) ....

Contains?

(define (contains? elm lst)
  (cond ((null? lst) #f)
        ((= (car lst) elm) #t)
        (else (contains? elm (cdr lst)))))

Searching for words

• What if we want to see if a list contains a certain word?
• Scheme has two options:
  – Strings: (“foo” “bar” “baz”)
  – Symbols: (foo bar baz)

What’s a symbol?

Read

Eval

print
What’s a symbol?

Create Symbols

• New special form: `(quote expr)
• Examples:
  • `(quote a) → a
  • `(quote 5) → 5
  • `(quote (+ a 5)) → (+ a 5)
• Shortcut for writing:
  • `'(+ a 5) → `(quote (+ a 5))
  • `'a → `(quote a)
  • Use ‘not’ (backquote)

Operations on symbols

• Test if two symbols are equal:
  • `(eq? 'a 'b) → #f
  • `(eq? 'a 'a) → #t
• eq? works on small integers, but not other numbers
  • Use = for other numbers

Searching for words

• Is the word bar in the list `(foo bar baz)
```scheme
(define (contains? elm lst)  
  (cond ((null? lst) #f)  
        ((eq? (car lst) elm) #t)  
        (else (contains? elm (cdr lst))))))
```
(contains? 'bar '(foo bar baz)) → #t

How many times?

• How many times does foo appear in a list `(foo bar foo baz quux)?
• Use higher order procedures
  • (define (how-many elm lst) …

Filter

• Like map, filter is a common HOP
• Remove all elements from lst where pred is false
  • (define (filter pred lst) …)
Filter

(define (filter pred lst)
  (cond ((null? lst) null)
        ((pred (car lst))
         (cons (car lst)
                (filter pred (cdr lst))))
        (else (filter pred (cdr lst))))

Back to how-many

• (how-many 'a '(a b a b c d a)) → 3

If we use filter, we can get just the a’s:

(filter (lambda (x) (eq? x 'a))
         '(a b a b c d a))

;Value: (a a a)

All together

(define (how-many e lst)
  (length (filter
            (lambda (x) (eq? x e))
            lst)))

Quiz

• Quiz Tomorrow (Friday)
  – Intended to be like 6.001 quiz 1
  – Open notes (but no computers)
  – Graded like problem sets
    • Feedback provided, but not used for 6.090 grade