List Recap

- A List is either:
  1. A Pair whose second part is a List
  2. null

- Pair primitives:
  - (cons a b) Construct a pair <a, b>
  - (car pair) First part of a pair
  - (cdr pair) Second part of a pair

List Examples

> null
()  
> (cons 1 null)
(1)
> (list? null)
#t
> (list? (cons 1 2))
#f
> (list? (cons 1 null))
#t

More List Examples

> (list? (cons 1 (cons 2 null)))
#t
> (car (cons 1 (cons 2 null)))
1
> (cdr (cons 1 (cons 2 null)))
(2)

List Procedures

- Be very optimistic! Since lists themselves are recursive data structures, most problems involving lists can be solved with recursive procedures.
- Think of the simplest version of the problem, something you can already solve. This is the base case. For lists, this is usually when the list is null.
- Consider how you would solve the problem using the result for a slightly smaller version of the problem. This is the recursive case. For lists, the smaller version of the problem is usually the cdr of the list.

list-trues

Define a procedure that takes as input a list, and produces as output the number of non-false values in the list.

(list-trues null) → 0
(list-trues (list 1 2 3)) → 3
(list-trues (list false (list 2 3 4))) → 1
list-trues

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(define (list-trues p)
  (if (null? p)
      0
      (+ (if (car p) 1 0)
          (list-trues (cdr p)))))

Quiz

Define a procedure, list-sum, that takes a list of numbers as input and outputs the sum of the numbers in the input list.

(list-sum (list 1 2 3)) \rightarrow 6
(list-sum null) \rightarrow 0

Define a procedure, list-length, that takes a list as input and outputs the number of elements in the input list.

(list-length (list 1 2 3)) \rightarrow 3
(list-length (list 1 (list 2 3))) \rightarrow 2
(list-length null) \rightarrow 0
Charge

• We’ll repeat the Quiz on Friday if it seems too few people have done the readings well
• Problem Set 2: Due Monday
  – It is much longer than PS1, don’t wait to get started
  – Help hours tonight in Olsson 001
• Friday: Recursive Procedures Practice