

Problem Set 3

Out: Tuesday, 12 February 2008

Due: Thursday, 21 February 2008

Reading: Sections 2.1 and 2.2

Overview

This problem set covers data abstractions and lists as data structures.

Scheme Settings

- Use the Standard (R5RS) language in DrScheme
- You should define nil as follows in your evaluation buffer:

```
(define nil '())
```

What to turn in

Keep your answers in a file named ps3-ans.scm. Put the code for each problem sequentially in the definitions buffer. Put the problem number in a comment before the code for that problem (use a semi-colon to make a line a comment). Underneath the code for each problem, cut and paste the appropriate sample runs. You can put semi-colons in front of the sample runs, which will comment them out and allow you to load the entire buffer in another session.

Print the answers buffer and turn it in at the beginning of class on the due date. Staple any handwritten portions of the assignment to your code file that you turn in. Also submit your answer buffer using the submit command on mercury:

```
submit holly 301-ps3 ps3-ans.scm
```

Exercises

Problem 1: Exercise 2.2 on p. 89-90.

Problem 2: Exercise 2.3 on p. 90.

Problem 3: For each of the following definitions,

- a. Draw the box and pointer diagram
- b. Give the sequence of cars and cdrs needed to return the number 4

```
(define a (list 1 2 3 4))  
(define b (cons (cons 3 4) (cons 5 6)))  
(define c (list 1 (list 2 3) 4))
```

Problem 4: Draw a box and pointer diagram for each of the lists `d`, `e` and `f` defined as follows:

```
(define d (list 1 2))  
  
(define e (cons d d))  
  
(define f (append d d))
```

What would be printed by Scheme when asked for the values of `d`, `e` and `f` sequentially?

Problem 5: Consider the following recursive procedure:

```
(define (list-prod lst)  
  (if (null? lst)  
      1  
      (* (car lst)  
         (list-prod (cdr lst)))))
```

- How many times is `list-prod` called when evaluating the expression `(list-prod '(1 2 3 4))`?
- What is the order of growth in space and time for the `list-prod` procedure above?
- Write an iterative version of the procedure `list-prod`.
- What is the order of growth in space and time for your iterative `list-prod` procedure from part c)?

Problem 6: Write a procedure called `double-list` in three different ways:

- Write a list manipulation procedure of your own to do this.
- Use the `scale-list` procedure on p. 105 in your definition.
- Use the `map` procedure on p. 105 in your definition.

Problem 7: Exercise 2.20 on p. 104.

Problem 8: Exercise 2.21 on p. 106.

Problem 9: Exercise 2.33 on p. 119.

Problem 10: Exercise 2.35 on p. 120.