Computer Science 61A
Midterm 3 - Spring 96

Professor Harvey

Your Name _____

login cs61a-___

Discussion section number ___

TA's name _____

This exam is worth 20 points, or about 13% of your total course grade. It includes two parts: The individual exam (this part) is worth 16 points, and the group exam is worth 4 points. The individual exam contains four substantive questions, plus the following:

Question 0 (1 point): Fill out this front page correctly and put your name and login correctly at the top of each of the following pages.

This booklet contains five numbered pages including the cover page. Put all answers on these pages, please; don't hand in stray pieces of paper. This is an open book exam.

When writing procedures, don't put in error checks. Assume that you will be given arguments of the correct type.

Our expectation is that many of you will not complete one or two of these questions. If you find one question especially difficult, leave it for later; start with the ones you find easier.

Question 1 (3 points):
What will the Scheme interpreter print in response to each of the following expressions? Also, draw a "box and pointer" diagram for the result of each expression. Hint: It'll be a lot easier if you draw the box and pointer diagram *first!*

```
(let ((x (list 1 2 3 4)))
(set-cdr! (cddr x) (car x))
x)
```

```
(let ((x (list 1 2 3 4)))
(set-car! (cddr x) (cddddr x))
x)
```

```
(let ((x (list 1 2 3 4)))
(set-car! (cddr x) x)
x)
```

Question 2 (4 points):
Write **list-rotate!** which takes two arguments, a nonnegative integer **n** and a list **seq**. It returns a mutated version of the argument list, in which the first **n** elements are moved to the end of the list, like this:
> (list-rotate! 3 (list 'a 'b 'c 'd 'e 'f 'g))
(d e f g a b c)
You may assume that 0 <= n < (length seq) without error checking.

Note: **Do not allocate any new pairs** in your solution. Rearrange the existing pairs.

Question 3 (4 points):

(a) What are the first five elements of the stream **S** defined as follows:
(define S (cons-stream 1 (add-stream S S)))

(b) What are the first five elements of the stream **ALT** defined as follows:
(define ALT (cons-stream 0 (interleave integers ALT)))

(c) Suppose we have defined a procedure **multiply-steams** analogous to the **add-streams** procedure in the text. Fill in the blanks in the following definition of the stream of factorials. (The elements should be
0! = 1,
1! = 1,
2! = 2*1 = 2,
3! = 3*2*1 = 6,
4! = 4*3*2*1 = 24,
5! = 5*4*3*2*1 = 120,
etc.)
(define factorials
(cons-stream 1 (multiply-streams _____ _____)))

For parts (d) and (e), we want to know whether or not the following functions can be defined for infinite streams as arguments. "Can be defined" means:
- It is possible to write a procedure to implement this function.
- The procedure always returns in a finite amount of time.
- If the result is a stream, every element that should be in that result stream is reachable by a finite number of **tail** operations.

(d) Can the Boolean function **ordered?** be defined for infinite streams of numbers? It should return **#t** if every element of the argument stream is less than the element following it, **#f** otherwise.

(e) Can the function **pair** be defined for infinite stream? It should return a stream whose elements are all possible two-element lists made up of elements of the argument stream. For example, the result of **(pairs integers)** should be a stream that includes such elements as (1,4), (7,7), (826,94), and so on, for every possible pair of integers.

Question 4 (4 points):

(a) Suppose that **bh** is a person object, in the place **bh-office**. What does each of these do?
(ask (ask bh 'place) 'name)

(ask (ask bh 'name) 'place)

(b) Here are some situations that might be simulated using oop. In each case we want to know whether class **A** should be a **parent** of class **B** (answer Yes or No):
- We're simulating a rock and roll group. Class A: musician. Class B: drummer.

- We're simulating an automobile. Class A: automobile. Class B: wheel.

- We're simulating an office. Class A: file cabinet. Class B: file folder.

(c) For each of the following, should it be a **class** variable ro an **instance** variable?
- In the file cabinet class, the number of files in a file cabinet.

- In the AC Transit local bus class, the price of a bus ticket/

- In the restaurant class in the adventure game, how many people have eaten at this restaurant.
