CS 61A Fall 2007 Midterm 2

1. What will Scheme print in response to the following expressions? If an expression produces an error message, you may just write "error"; you don't have to provide the exact text of the message. **Also, draw a box and pointer diagram for the value produced by each expression.**

```
> (append (cons (list 1 2) (list 2 3)) '(5 6))
```

```
> (let ((y (list '(1) 2 3)))
    (cons '(7 . 8) (cdr y)))
```

2. Draw a box and pointer diagram for the following list.

```
(3 (9 (2 7) 8) ())
 - ----------- --
```

3. We're going to make a new ADT called a hider. A hider provides procedures for encoding and decoding a value, along with a description.

```
(define (make-hider description encoder decoder)
        (list description (cons encoder decoder)))
```

(a) Write selectors hider-description, encoder, and decoder. Given a hider, they should return the appropriate value.

```
(define (hider-description hider)
  _____________________________________)

(define (encoder hider)
  _____________________________________)

(define (decoder hider)
  _____________________________________)
```

(b) Now, we want to test if our hiders work properly. Given a hider and a value, we say that the hider works properly if encoding and then decoding gives us back what we had originally. Write **works?** That takes a hider and a value and tests the hider on the value.

```
(define (works? hider val)
```

4. Louis Reasoner has been looking over the **Scheme-1** code and decides that apply-1 is doing unnecessary work. He argues that we can type **(apply (lambda (x) (* x x)) '(3))** in STk, so why not take advantage of that in Scheme-1.

For reference, here is **apply-1** before Louis makes his proposed change:

```
(define (apply-1 proc args)
        (cond ((procedure? proc)
               (apply proc args))
              ((lambda-exp? proc)
               (eval-1 (substitute (caddr proc)
                                   (cadr proc)
                                   args
                                   '()))))
```

He says we can change apply-1's body to:

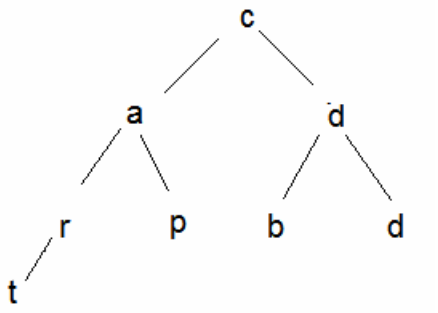
```
(define (apply-1 proc args)
        (cond ((or (procedure? proc) (lambda-exp? proc))
               (apply proc args))
              (else (error "bad proc: " proc))))
```

Using Louis' new apply-1, show what Scheme-1 would print given the following inputs. If an expression produces an error message, you may just write "error"; you don't have to provide the exact text of the message.

```
Scheme-1> car                        =>

Scheme-1> (* 3 7)                    =>

Scheme-1> (lambda (x) (+ x 1))       =>

Scheme-1> ((lambda (x) (+ x 1)) 3)   =>
```

5. This question concerns the Tree abstract data type (with datum and children) discussed in lecture.

We're going to use Trees to store words. Each datum in the tree is a letter, and each path from the root node to a leaf represents a word. For example, the tree




represents the words cart, cap, cob, and cod. Note that this tree does not contain the word car or the word art, because a word must extend

from the root to a leaf.

Write a procedure contains-word? That takes such a Tree and a word, and returns #t if the tree contains the word, or #f if not.

6. Write a procedure list-split that takes in a list and a length, and breaks up the original list into sublists of that length. For example,

```
STk> (list-split '(a b c d e f g h) 2)
((a b) (c d) (e f) (g h))

STk> (list-split '(a b c d e f) 4)
((a b c d) (d e))

STk> (list-split '() 5)
()
```

Note that the last element of the returned value (but only the last one) may be shorter than the specified length.

**Hint: This will be much, much, much easier if you do not try to write it iteratively!** Think about meaningful *helper* procedures, e.g. nth-cdr.