## Structure and Interpretation of Computer Programs October 2000

## $\begin{array}{c} {\rm Quiz} \ 1 \\ {\bf Scheme} \ {\bf Basics} \end{array}$

Before starting, please write your name in the first blank below, and optionally a guess as to how well you think you will do in the second. Start the quiz only when instructed to do so. You may use any written resources you wish, but you may not consult another student, nor use a computer, nor a calculator. You will have one hour to finish this quiz, at which point please close the document, and optionally re-assess your anticipated grade in the third blank below. Please give your tests to the staff as you leave. Your actual grade will not be affected by your self-assessment, nor by opting out of self-assessment.

Name:								
Optional,	expected	grade (percen	t correct	) before tak	king quiz:			
Optional,	expected	grade (percen	t correct	) after takir	ng quiz:			
P1:		P2:		P3:		P4:	 Total: _	

**Problem 1** What will Scheme print in response to the following statements? Assume that they are each evaluated in order in a single Scheme buffer. Write your answer below each statement. You may write "procedure" if a procedure would be returned, or "error" if an error message would be returned. (This problem spans two pages.)

(define x 2)

х

(x)

(define (y) (\* x 2))

у

(y)

```
(define (a) (lambda (x) (+ x 1)))
```

a

(a)

(define (if a b c) (+ a b c))

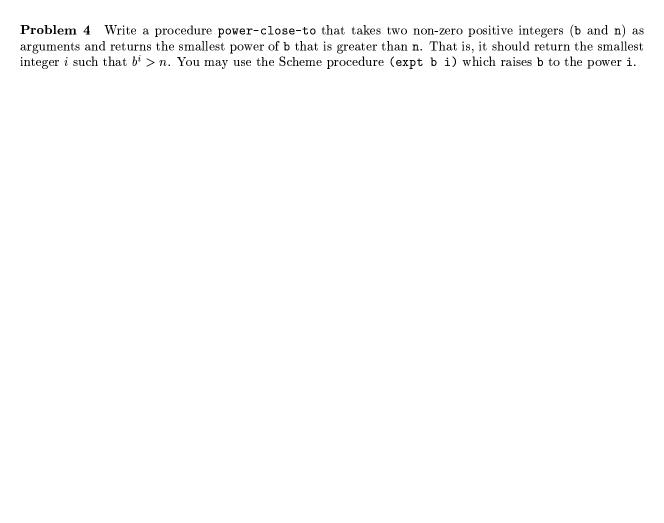
(if 2 3 4)

<b>Problem 2</b> Write a function called new-add which returns the sum of two nu functions $+$ and $-$ , but instead, use inc (an already defined Scheme procedu and returns the sum of that argument and 1) and dec (a similar procedure argument and $-1$ ).	ure which takes one argumen
Is your procedure recursive?	
Is your procedure tail-recursive?	
Is the process it generates recursive or iterative?	

Problem 3 Assume that we have defined sum and square as follows:

Determine the order of growth in time for the following functions using  $\Theta$  notation. (Hint: you will only need to use one or more of the following for your answers:  $\Theta(1)$ ,  $\Theta(\log n)$ ,  $\Theta(n)$ ,  $\Theta(n^2)$  and  $\Theta(2^n)$ . All classes might not be used.) Write your answer in the blanks to the right of each function.

```
(define (integrate a b f dx)
   (sum (lambda (x) (* (f x) dx))
        (lambda (x) (+ x dx))
        b))
(define (number-of-bits-in n)
   (if (< n 2)
       (+ 1 (number-of-bits-in (/ n 2)))))
(define (times-5 x)
   (* x 5))
(define (exp a b)
   (cond ((< b 0) (error "Oops! b cannot be negative"))</pre>
         ((= b 0) 1)
         (else (if (odd? b)
                   (* a (exp a (- b 1)))
                   (square (exp a (/ b 2))))))
(define (sum-of-squares x y)
   (+ (square x)
      (square y)))
(define (triangle-sum n)
   (sum (lambda (m) (sum (lambda (x) x) 1 inc m))
        1
        inc
        n))
```



Does your procedure generate an iterative process or a recursive process?