Mid-Term Examination for Csci 3316 (Winter 1997)

Due: In 45 minutes.

Instructions:

1. It is an open book examination. You are expected to refer to the Scheme Reference Manual (Appendix B, Mani/Little's textbook). Be careful not to spend too much time looking for other things in the textbook. No book other than the textbook is allowed.
2. You can use all primitives scheme functions in defining various functions, unless instructed otherwise in a question.
3. Budget your time for various questions before working on any. Use the space below the questions to write your answers. If needed, use the back of the printed pages.

Score Table					
Question	Q0	Q1	Q2	Q3	Total
Score					

QUESTION 0 (1 points) Fill out the following table.

NAME:	
UMN Identification Number:	
Account on itlabs.umn.edu :	
Recitation Section:	1 / 2 / 3/ 4/ 5
TA:	Andrew Forester / Catherine Jacobs / Cecil Smith
Classification:	NTU / UNITE / Extension/ Regular

Q1. (5 points)

What would scheme interpreter print in response to the last 4 of scheme expressions listed below. Provide intermediate results to explain your answer. (Hint: Use The Rules of Evaluation from Chapter 1).

```
=> (define a (+ 2 3))
=> (define (loop-for-ever a) (loop-for-ever (+ a 1) ) )
=> (define (new-if predicate then-clause else-clause)
        (if predicate then-clause else-clause))
=> ;;;;;;;;;; Evaluate the following forms ;;;;;;;;;;;;
=> (if (> a 0) (* a a) (+ 2 a))

=> (if (> a 4) (* a a) (loop-for-ever a))

=> (new-if (< a 4) (* a a) loop-for-ever)

=> (new-if (> a 4) (* a a) (loop-for-ever a))
```

Q2a. (5 points)

Which of the following functions are $O(n^2)$? Justify your answer using the definition of Big-Oh notation.

$f(n) = 1 + 2 + 3 + ... + n$
$g(n) = n + n^3 + 1000$

Q2b. (5 points)

A programmer was asked to write a program that can compute shortest paths over a road map with a million road-intersections and road-segments. He designs two different algorithms (A and B). Storage complexity of Algorithm A is O(n). Storage complexity of Algorithm B is $O(n^2)$. Estimate the storage needed by each algorithm for the road map with $n = 10^6$. Which algorithms is suitable for a computer with only 32 Megabytes of memory? If you need to make any assumptions, state them clearly.

Q3a. (4 points)

Given the following procedure silly, Draw the droid diagram for (silly 1234) and calculate the final result of this computation:

```
(define (silly n)
 (if (= (remainder n 2) 1)
    (if (< n 10)
         1
       (+ 1 (silly (quotient n 10)))  )
    (if (< n 10)
         0
       (silly (quotient n 10)) )
  ))
```

Q3b (5 points).

Write a tail-recursive version of function "silly" used in Q. 3a. Explain your choice of parameters, helper functions, base cases, recursive decomposition, if you use them. Show the correctness of code by tracing it with following test cases :

(silly 3317) = 4
(silly 5) = 1
(silly 2) = 0
(silly 8402) = 0