University of Toronto
csc148F—Introduction to Computing, Fall 1996

Second Term Test — Horton's 1:00 section

Duration: 50 minutes

Aids allowed: None

Make sure that your examination booklet has 4 pages (including this one). Write your answers in the spaces provided. Write legibly.

Family Name: SOLUTIONS

Lecturer: __________

First Name: __________

Tutor: __________

Student # : __________

1.	________	/ 7
2.	________	/ 3
3.	________	/ 15
3.	________	/ 10
Total	________	/ 35

Question 1

[7 marks]

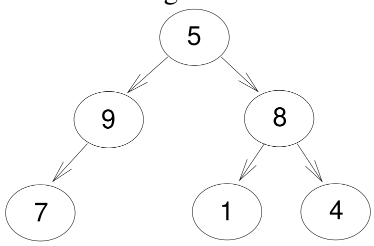
Complete the following OOT function, whose purpose is to print all of the negative values in a linked list of integers.

```
type listNode :
    record
        num : int
        link : ^listNode
    end record

function printNegatives (front : ^listNode) : int

    var temp : ^listNode := front
    loop
        exit when temp = nil
        if temp -> num < 0 then
            put temp -> num
        end if
        temp := temp -> link
    end loop

end printNegatives
```

Question 2

[3 marks]

Consider a subprogram whose purpose is to print the nodes of a tree in pre order. In what order would it print the nodes of the following tree:



(Recall that in a pre-order traversal of a tree, each node is processed before its children have been processed.)

ORDER:

5 9 7 8 1 4

Question 3

[15 marks in total]

Consider the following OOT function:

```
function mystery (n, p : int) : int

    % Preconditions: ??
    var answer : int := 1
    var count : int := 0
    loop
        % Loop invariant: ??
        exit when count = p
        answer := answer * n
        count := count + 1
    end loop
    % Postconditions: ??

    result answer
end mystery
```

(a) [2 marks]
Trace a call to mystery (2, 5), and fill out the table below to show the sequence of values taken by the variables.

n	p	answer	count
2	5	1	0
2	5	2	1
2	5	4	2
2	5	8	3
2	5	16	4
2	5	32	5

(b) [6 marks]
Write appropriate preconditions and postconditions for this function. Hint: Your precondition should be enough to ensure termination.
PRECONDITIONS:

```
The most important precondition is:
     p >= 0
```

POSTCONDITIONS:

```
The most important postcondition is:
     answer = n^p
```

(c) [7 marks]
Which of the following are loop invariants for the loop in function mystery? Circle Yes or No as appropriate.

	Is it a loop invariant?	
$answer = n \times count$	YES	$\boxed{\text{NO}}$
$answer = n^{count}$	$\boxed{\text{YES}}$	NO
$answer = n^{p}$	YES	$\boxed{\text{NO}}$
$answer = n^{(count+1)}$	YES	$\boxed{\text{NO}}$
$count \geq 0$	$\boxed{\text{YES}}$	NO
$(p - count) \geq 0$	$\boxed{\text{YES}}$	NO
$count \geq p$	YES	$\boxed{\text{NO}}$

Question 4

[10 marks]

Complete the following OOT function, whose purpose is to return true if there are 1 or more negative values in a binary tree of integers. Do not assume that the tree is a binary *search* tree.

Hint: Use recursion.

```
type treeNode :
    record
        num : int
        left, right : ^treeNode
    end record

function hasNegs (root : ^treeNode) : boolean

    if root = nil then
        result false
    else
        result (root -> num < 0) or
            hasNegatives (root -> left) or
            hasNegatives (root -> right)
    end if

end hasNegs
```