UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE AND ENGINEERING
FINAL EXAMINATION, APRIL 2001
APS 103 – ENGINEERING, SOCIETY AND ENVIRONMENT I
EXAM TYPE: No aids permitted.
Examiner - W.H. Vanderburg

Instructions

You must answer a total of four questions, each of equal value. From PART A you must answer either Question 1 or Question 2; from PART B you must answer either Question 3 or Question 4; from PART C you must answer both questions.

Please answer PARTS A and B in a first examination booklet, and PART C in a second booklet.

PART A

1. Using concepts developed in the course, explain the essential differences between the technological cycles of the Ford Model T and the Ford Mustang.

2. Explain the changes in the goals of the corporation when it began to make use of modern technological knowledge.

PART B

3. Explain why the modern large corporation was incompatible with the social structures of the first generation of industrial societies.

4. Explain the theory of the revised sequence and its implications for economic democracy. Include in your explanation the nature of advertising and the need for corporate planning.

PART C

5. Explain why it is possible for the GDP to be rising while the standard of living is falling. Suppose two different economies produce the same outputs of goods and services but the one does it with conventional approaches for the engineering, management and regulation of technology and the other with preventive approaches. Which of these two economies would have the higher GDP? Explain your answer.

6. What does the demand-control model imply for how engineers should organize work to achieve the best possible signal-to-noise ratio of desired to undesired effects?

UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE AND ENGINEERING

APS105 — Computer Fundamentals
Final Examination — April, 2001

Examiner: John Carter

Duration: 2.5 h

Exam Type: A
This is a "closed book" examination; no aids are allowed.

Calculator Type: 4
No calculators are allowed.

All questions are to be answered on the examination paper. If the space provided for a question is insufficient, extra pages are provided at the end of the examination. If you use these pages, please indicate clearly what you have done.

The examination has fourteen pages.

The marks allocated to the questions, out of a total of 135, are shown in the question headings.

You must use the Java programming language to answer programming questions. You may use any of the methods from the `Math`, `String`, and `Stdin` classes.

Name _____

Student Number _____ ecf login _____

MARKS

1	2	3	4	5	6	7	8	9	Total
/20	/12	/4	/4	/15	/20	/20	/20	/20	/135

1. [20 Marks]

Each part of this question is worth two marks.

(a) Suppose that the following declarations have been made.

```
int i = 3, j = 5;
```

Using these starting values, find the value of each variable after execution of the statement

```
i *= ++j - 3;
```

i: _____ j: _____

(b) Simplify the expression `!(a >= b || a <= c)` as much as possible.

(c) Given that `x` and `y` are variables of type `double`, write an expression that would be true if and only if `x` and `y` would be equal if they were both rounded to two decimal places.

(d) If `p` and `q` are references to objects of the same type, under what circumstances will the expression `p == q` be true?

(e) Trace a binary search as it seeks the value 40 in the array called `list` shown below. To show your trace, print the value of the array element examined at each stage of the search.

index	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
`list`	23	28	31	34	38	42	47	50	51	55	61	66	73	75	84

(f) Suppose that an array initially contains the values {6, 2, 4, 1, 5}. If the array is to be sorted into ascending order using an insertion sort, show the contents of the array as it would appear after each of the first two passes of the insertion sort.

(g) What is the difference between an instance field and a class field?

(h) What is a queue?

(i) Evaluate the prefix expression: + × 2 3 - 6 ÷ 8 2

(j) Convert the expression (5 - 2) × (6 - 2 ÷ 2) to postfix form.

2. [12 Marks]

The Legendre polynomials are defined as follows:

$$L_n(z) = \begin{cases} 1 & \text{if } n = 0 \\ z & \text{if } n = 1 \\ \dfrac{(2n-1)zL_{n-1}(z) - (n-1)L_{n-2}(z)}{n} & \text{if } n > 1 \end{cases}$$

(a) Find $L_2(z)$ and $L_3(z)$ in simplified form

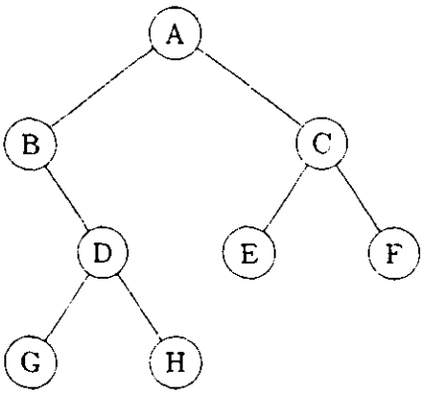
(b) Find the value of $L_4(2)$ by hand.

(c) Complete the definition of a method `legendre` that returns the value of $L_n(z)$. If `n` < 0, the method should return the value zero.

```
public static double legendre (int n, double z)
```

3. [4 Marks]

The diagram shows a binary tree.



(a) In what order would the nodes of the tree be visited by an in-order traversal?

(b) In what order would the nodes of the tree be visited by a pre-order traversal?

4. [4 Marks]

Draw a diagram showing the binary search tree that would be produced by inserting the following items *in the indicated order* into an initially empty tree.

Guy Ahmed Kason Candy Susan Humie John

5. [15 Marks]

Write a method called `range` that has a single parameter, a two-dimensional array of `double` values. The method should return the difference between the largest and smallest values in the array.

6. [20 Marks]

Complete the definition of the method `longest` so that it returns the longest word in the string `s`. Assume that the words in `s` are always separated by exactly one blank. If the string contains more than one word of the maximum length, return the first one.

```
public static String longest (String s)
 {
```

7. [20 Marks]

Write a class Lock that could be used to create electronic lock objects. Each lock may be in either an open (unlocked) or a closed (locked) state and each one is protected by its own integer key which must be used to unlock it. The class should contain the following methods.

- `public Lock (int key)`
  Create a lock that is initially open.
- `public void close ()`
  Close the lock.
- `public void open (int key)`
  Open the lock if and only if the parameter key matches the lock's own key. If the lock is closed and the keys do not match, count the failed attempt. If the same lock receives three or more failed attempts in a row, print the message `"ALARM"`.

The following main method illustrates how the Lock class should work.

```
public static void main (String[] args)
 {
  Lock lock1 = new Lock(111);
  Lock lock2 = new Lock(222);

  lock1.close();
  lock2.close();

  lock1.open(123);          // fails to open lock1
  lock1.open(456);          // fails to open lock1
  lock2.open(222);          // opens lock2
  lock1.open(789);          // fails - prints ALARM
  lock1.open(111);          // opens lock1
 }
```

Use this page and the following one for your definition of the Lock class.

Answer to Question 7 (*continued*)

8. [20 Marks]

To help people to keep track of their CD collections, you are to write an instance method `insert` for the `List` class that will insert a node representing a CD into a list. The nodes of the linked list are defined by the following:

```
class Node
 {
  String artist;
  String title;
  Node link;
 }
```

The entries in the list should be maintained in ascending order by artist and then, if necessary, by title if there is more than one title by the same artist. For example, the CD by the group *Abba* with the title *Gold* should precede the CD by *Abba* with the title *Greatest Hits*. Assume that upper case letters are used for the first character of each word and that all other letters are lower case.

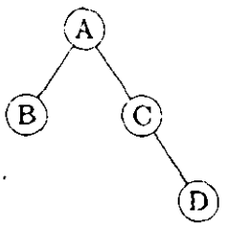
```
class List
 {
  private Node head;

  public void insert(String artist, String title)
   {
```

Answer to Question 8 (*continued*)

9. [20 Marks]

Suppose that we define the *level* of a node in a binary tree as the number of edges on the path from the node to the root. For example, in the binary tree shown in the diagram, the levels of A, B, C, and D are, respectively, 0, 1, 1, and 2.



We can then define the *height* of a binary tree as the maximum level of any node in the tree. Thus the height of the binary tree shown above is 2. Using this definition of height, complete the definitions of a pair of methods for the `Tree` and `Node` classes that return the height of a binary tree. If the tree is empty, the value -1 should be returned.

```
class Tree
 {
  private Node root;

  public int height ()
   {




   }
  class Node
   {
    int info;
    Node lLink;
    Node rLink;

    int height ()
     {
```

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