Université d'Ottawa
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ITI 1120 / 1520 Fall 2007
Introduction to Computing I
Midterm Examination

Length of Examination: 1.5 hours **October 27, 2007, 10:00**

Professors: Diana Inkpen, Daniel Amyot

Instructions: Please read carefully!

1. **Complete all sections of the identification area in ink.**
2. This is a closed-book test. **No books, papers, calculators or other electronic devices are permitted.**
3. Answer all questions on the question sheet in the area provided. **Questions answered in pencil will not be re-graded even if there is a marking error.**
4. The marks allocated to each question are indicated. Not all questions are worth the same amount, so plan your time accordingly. The midterm will be scored out of 40 marks, which represents 20% of your final grade.
5. Algorithms are to be described using the format from the lectures and the notes.
6. You can use the back of the question sheet pages, or page 10, for calculations and other work. Pages 10 and 11 can be detached as they will not be marked.
7. Les réponses en français sont acceptées.

Identification:

Name: _____

Student number: _____

Lecture Section (circle one):

A B

For use of grader:

Question	Marks available	Marks received
1	8	
2	12	
3	8	
4	12	
Total	40	

Question 1 (8 marks total – 4 marks for each part)

Part a)

The integer X has the value 3, and the array Y initially contains the following values: {2, 4, 6, 8, 10}. Specify if the following Boolean expressions evaluate to true or to false. Circle the letter T corresponding to true, or the letter F corresponding to false, for each of the four Boolean expressions.

a) (T) / F — (Y[1] < Y[X]) AND (X - 5 + Y[Y[1]] < 9)

b) T / (F) — (Y[0] / 2 > X MOD 5) AND (NOT (Y[4] MOD 2 = 0))

c) T / (F) — (Y[3] MOD 2 = 1) OR (X = Y[Y[0] +1]) OR (NOT (Y[4] MOD 2 = 0))

d) T / (F) — (Y[Y[1] - 1] × 3) = (Y[3] MOD 3 + 6)

Part b)

What would be the values of B, C, and D after the following algorithm executes, if A has the value {1, 6, 5, 3, 9, 21, 10} and N is 7?

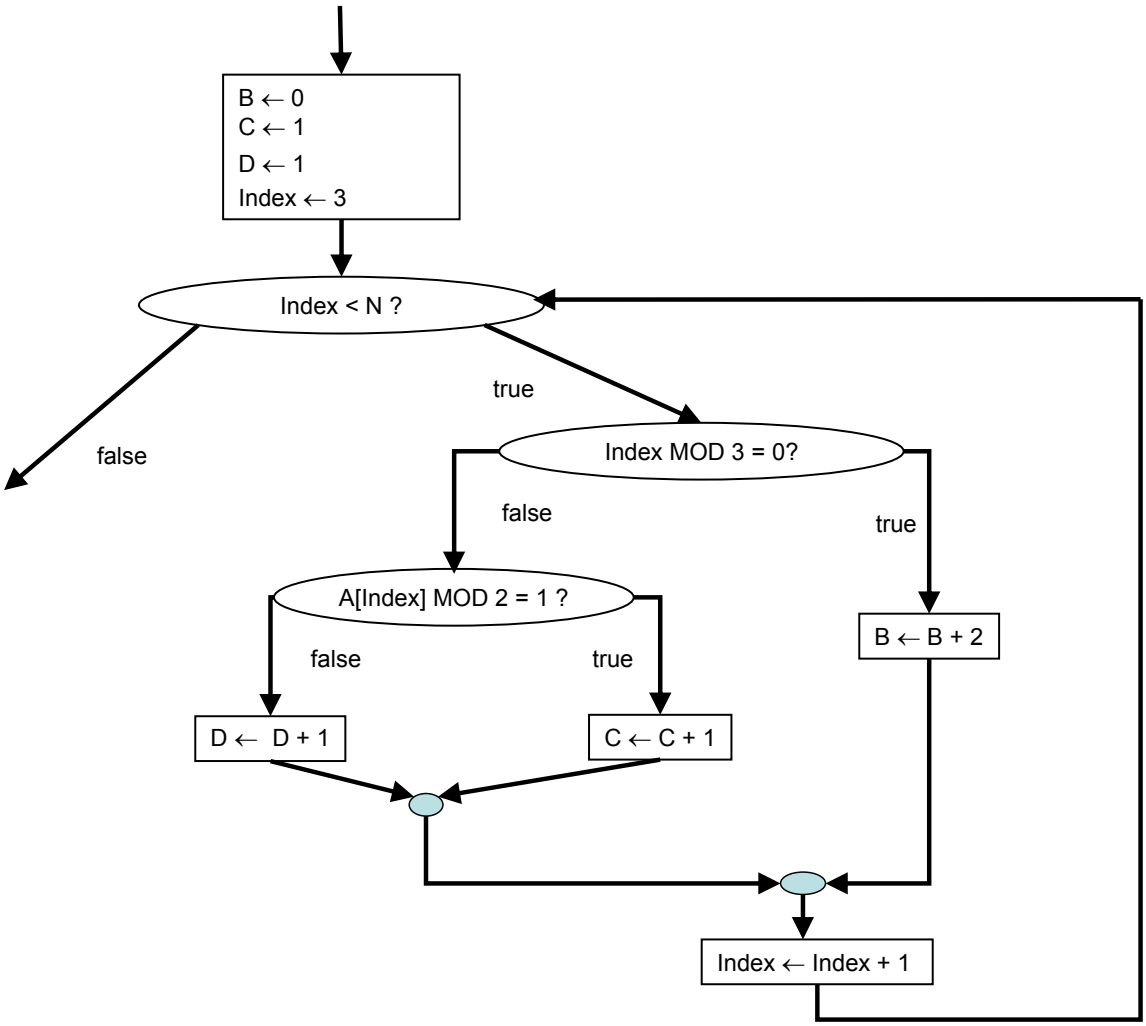
GIVENS: A, N

RESULTS: B, C, D

HEADER: (B, C, D) ← AnAlgorithm(A, N)

INTERMEDIATE: Index

BODY:



Answer: B = _____4_____

C = _____3_____

D = _____1_____

Question 2 (12 marks in total – 6 marks for each part)

Part a)

The following program attempts to compute the maximum and the second maximum value in an array input by the user. We assume that the numbers in the array are positive. For example, if the array is {10, 12, 31, 5, 7}, the variable "first" becomes 31, and "second" becomes 12. However, three logic errors were made when producing this program. **Fix the errors below, by suggesting corrections for three lines of code (near the original lines).**

```
import java.io.* ;

class Q2a
{
    public static void main (String[] args)
    {
     // DECLARE VARIABLES/DATA DICTIONARY
     int [] a;           // GIVENS: the array of values
     int index;          // INTERMEDIATES: index through array
     int first, second;  // RESULTS: values of Max and Second Max

     System.out.println( "Please input the array:  " );
     a =  ITI1120.readIntLine();

      // BODY OF ALGORITHM
     first =  -1; second = -1;
     index = 0;

     while (index < a.length) // removed =
     {
       if (a[index] > first)
       {
          second = first;
          first = a[index];
       }
       else
       {
         if (a[index] < second) // changed < into >
         {
            second = a[index];
         }
         // else: do nothing
       }
       index = index + 1; // changed – into +
     }

     System.out.println("The maximum number is " + first);
     System.out.println("The second number is " + second);
  }
}
```

Part b)

What would be printed by the following program? Circle the letter next to the correct answer.

```
class Q2b
{
    public static void main (String[] args)
    {
     int [] a;
     int i;
     int j;

     a = new int[] {1, 2, 3, 4, 5};
     i = a.length - 1;
     j = 1;

     while ( i >= 1 )
     {
       if (a[i] % 2 == 0)
       {
          j = j + 1;
        }
       else
        {
          a[i] = a[i] + a[i-1];
        }

       i = i - 1;
     }

     System.out.print( a[j] + " ");

     for (i=0; i< a.length; i++)
        System.out.print( a[i]+ " " );
    }
}
```

Answers:

a) 4 1 2 3 4 5

b) 2 1 3 3 7 5

c) 4 1 2 5 4 9

d) 2 1 2 3 4 9

e) There is a run-time execution error.

Question 3 (8 marks) Java

Translate the algorithm found in appendix A on page 11 to a Java program by completing the partially filled `main( )` method below and on the next page. You do not need to add an identification section to the program.

```
public static void main( String[] args )
{
   // DECLARE VARIABLES / DATA DICTIONARY



    // GIVENS: the array of grades and its length
    double [] grades;
    int n;

    int index;   // INTERMEDIATES: index in the array
    int N_Summa; // number of students with grades >= 9
    int N_Magna; // number of students with grades >= 8
                 // and < 9

    int [] R; // RESULTS: an array with two elements




    // READ IN GIVENS

   System.out.println( "Enter an array of grades: " );

   // Please complete: read the array and find its length



   grades = ITI1120.readDoubleLine( );
   n = grades.length;




   // ALGORITHM BODY:  next page
```

```
    // ALGORITHM BODY


   R = new int [2];
   index = 0;
   N_Summa = 0;
   N_Magna = 0;

   while (index < n)
   {
    if (grades[index] >= 8.0)
     {
      if (grades[index] >= 9.0)
       {
         N_Summa = N_Summa + 1;
       }
      else
       {
         N_Magna = N_Magna + 1;
       }
     }
    else
     {
      ; // do nothing
     }
    index = index + 1;
   }

   R[0] = N_Magna * 100 / n;
   R[1] = N_Summa * 100 / n;









   // PRINT OUT RESULTS AND MODIFIEDS
   System.out.println("Percentage of Magna Cum Laude: " + R[0]);
   System.out.println("Percentage of Summa Cum Laude: " + R[1]);

}
```

Question 4 (12 marks) Algorithm

The *variance* of a set of values is a measure used in statistics to provide information about how much a set of values diverge from its mean.

Suppose that you have N values represented using X_i where $0 \leq i \leq N\text{-}1$. The variance *Var* is computed according to the following formula:

$$Var = \frac{(X_0 - M)^2 + (X_1 - M)^2 + \ldots + (X_{N-1} - M)^2}{N}$$

where

$$M = \frac{X_0 + X_1 + \ldots + X_{N-1}}{N}$$

is the mean of the values.

Write an algorithm that will take as input an array X of length N (number of values) and compute the variance *Var* of this array of values. You do not have access to a "square" operator.

[Use this page and the next for the answer; it is suggested to put the body on the next page.]

Answer:

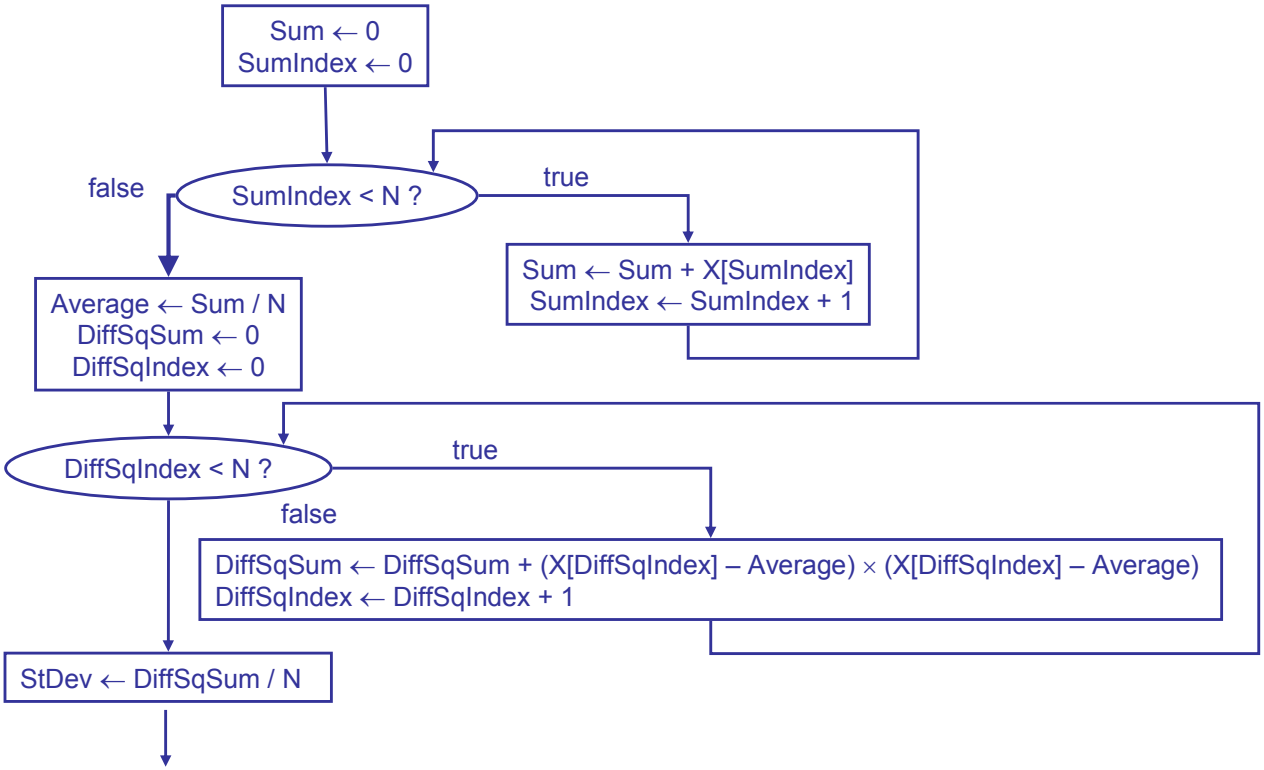
```
GIVENS:
    X               (an array containing a collection of real numbers)
    N               (the length of the array)

RESULTS:
    Var             (the standard deviation of the values in the array)

INTERMEDIATES:
    Sum             (accumulates the sum of the array)
    SumIndex        (used as array index to find sum of array)
    Average         (average of array elements)
    DiffSqSum       (accumulates the sum of the squares of the
                     differences)
    DiffSqIndex     (used as array index to find sum of squares of
                     differences)

HEADER
    Var ← Variance(X, N)
```

Question 4 continued:



This page is for calculations and other work
(you can detach this page; it will not be marked)

Appendix A: Algorithm for Question 3 (you can detach this page)

GIVENS:

Grades *(array of numeric grades)*
N *(number of students, number of grades in the array)*

INTERMEDIATES:

N_Magna *(number of students with grades >= 8 and < 9)*
N_Summa *(number of students with grades >= 9)*
Index *(index for the array)*

RESULT: R *(array of percentages)*
(R[0] = percentage of students with grades >= 8 and < 9)
(R[1] = percentage of students with grades >= 9)

HYPOTHESIS: N > 0

HEADER: R ← Honours (Grads, N)

BODY: