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School of Electrical Engineering
and Computer Science

ITI 1120 / 1520 Fall 2011
Introduction to Computing I
Midterm Examination

Length of Examination: 1.5 hours **October 30, 2011, 14:00**

Professors: Diana Inkpen, Nathalie Japkowicz

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 5, and the array A initially contains the following values: {1, 3, 5, 7}. 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 (A[1] < A[X-3]) AND (A[A[1]] + X < 5)

b) T / F (NOT (A[3] MOD 2 = 0)) OR (X MOD 3 = 3)

c) T / F (A[3] MOD 4 + 6) = (A[A[1] - 1] × 2)

d) T / F (A[2] MOD 2 = 0) OR
((X = A[A[0] +1]) AND (NOT (A[1] MOD 2 = 0)))

Part b)

Te descurciWhat would be the values of X, Y, and Z after the following algorithm executes, if A has the value {1, 2, 3, 7, 6} and N is 5?

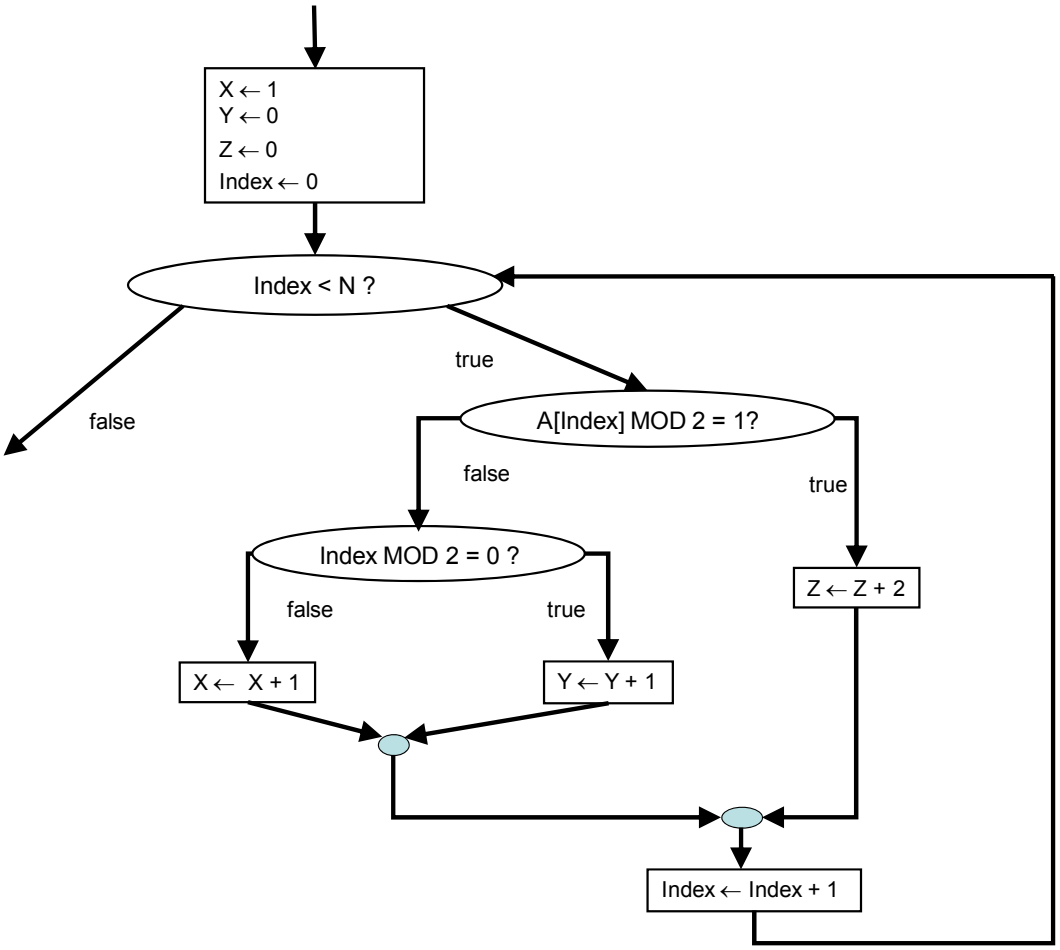
GIVENS: A, N

RESULTS: X, Y, Z

HEADER: (X, Y, Z) ← AnAlgorithm(A, N)

INTERMEDIATE: Index

BODY:



Answer: X = _____2_____

Y = _____1_____

Z = _____6_____

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

Part a)

The following method takes an array of integers (that is given) and produces a longer array with every element of the initial array duplicated. For example if the original array is a = {1, 2, 3, 4}, then the new array is b={1, 1, 2, 2, 3, 3, 4, 4}.

However, two logic errors were made in the problem solving method buildLongArray. **Fix the errors below, by suggesting corrections for two lines of code (near the original lines).**

```
public static int [] buildLongArray( int [] a)
{
   int [] b;
   int i;
   int j;

   b = new int [2 * a.length - 1];  //remove - 1

   i = 0;

   j = 0;

   while (i < a.length)
   {
      b[j] = a[i];

      b[j + 1] = a[i];

      j = j + 1;  // j = j + 2;

      i = i + 1;
   }

  return b;
}
```

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 )
   {
      char[] a = new char [] {'a','b','c','d','e','f'};

      char [] b;
      int index;

      b = myMethod(a);

      index = 0;
      while (index < b.length - 1)
      {
         System.out.print(b[index] + " ");
         index = index + 1;
      }
   }

   public static char[] myMethod( char [] a)
   {
     char[] b;
     int i = 0;

     b = new char [a.length / 2];

     while (i < a.length)
      { if (i % 2 == 1)
        {
          b[i/2] = a[i];
        }
        i = i + 1;
      }

     return b;
   }
}
```

Answers:

a) a c e

b) b d

c) b d f

d) There is a run-time execution error.

Question 3 (8 marks) Java

Translate the algorithm found in appendix A on the last page of this exam to a Java program by completing the problem solving method on the next page.

```
public class Q3
{

 public static void main( String[] args )
  {
    // DECLARE VARIABLES / DATA DICTIONARY
    int n; // GIVEN: a number to test
    boolean prime; // RESULT: true if n is prime, false otherwise

   // READ IN GIVENS
   System.out.println( "Enter a number to check: " );

   // read the number
   n = ITI1120.readInt( );

   // CALL ALGORITHM

   prime = isPrime(n);

   // PRINT OUT RESULTS AND MODIFIEDS
   if (prime)
     {
        System.out.println("The number is prime.");
     }
   else
     {
        System.out.println("The number is not prime.");
     }
  }
```

```
  public static boolean isPrime(int n)
  {

   boolean  prime = true;
   int divisor;

   if (n % 2 == 0)
      {
        prime = false;
      }
   else
      {
         ;  //do nothing
      }

   divisor = 3;
   while ((divisor < n) && prime)
   {
     if (n % divisor == 0)
      {
         prime =  false;
      }
     else
      {
         divisor = divisor + 2;
      }
    }

   return prime;

  }
}
```

Question 4 (12 marks) Algorithm

Elections Canada needs to do some post-election verification in electoral districts where the second-best candidate was very close to the best candidate. They want to know in how many districts they need to count the number of votes again. They need to re-check the votes in a district if the second-best candidate has *at least* 99% of the number of votes obtained by the best candidate. As there are hundreds of districts in Canada, they want you to solve this problem with a suitable algorithm. Elections Canada can provide an array of votes received by the best candidate of each district (Best), another similar array for the second best candidate of each district (Second), as well as the exact number of districts (N). Both arrays are sorted according to the district names, so items at the same position in the two arrays are for the same district.

For example, if we have:

Best = {1000, **1500**, 1400, 900, **2000**}
Second = {989, **1495**, 1050, 888, **1980**}
N = 5

then the number of districts where we need to re-check the votes is 2.

Write an algorithm (not Java code) that will compute the number of districts where Elections Canada needs to count the votes again.

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

Answer:

GIVENS: Best (An array of votes for winners)
Second (An array of votes for second positions)
N (Number of array elements)

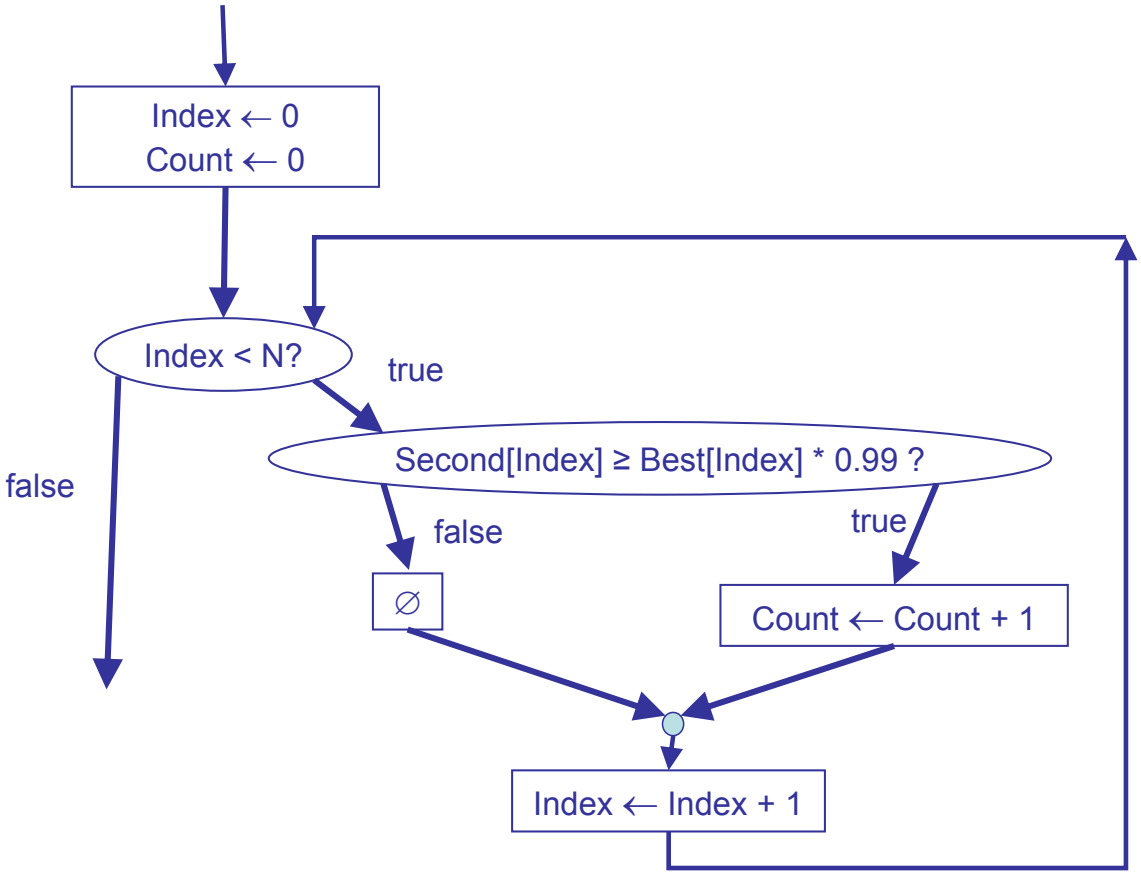
INTERMEDIATES: Index (Array index going from 0 to N-1)

RESULT: Count (Number of districts to recount votes for)

HEADER: Count ← ReCount(Best,Second,N)

BODY:

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)

This algorithm determines whether or not a given integer (greater than 2) is a prime number.

GIVENS:	N	(an integer > 2)
RESULTS:	Prime	(Boolean: true if N is prime – has no divisors other than itself or 1 – and false otherwise)
INTERMEDIATES:	Divisor	(number to try dividing into N)

HEADER: Prime ← IsPrime(N)

BODY: