THE UNIVERSITY OF ZAMBIA
School of Natural Sciences
Department of Computer Science

FINAL EXAMINATION

CSC 2000
Computer Programming

Date:	23rd November 2018
Time:	14:00hrs – 17:00hrs
Duration:	3 Hours
Venue:	P207

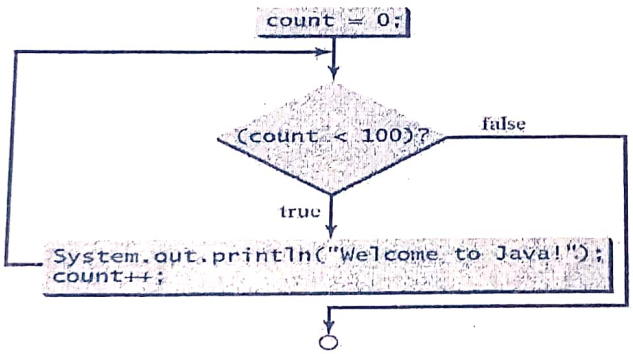
Instructions

1. There are **two (2) sections** in this exam paper.
2. *Answer all the questions in **Section A*** and choose *any three (3) questions from **Section B***

SECTION A. Short answers (40 marks)

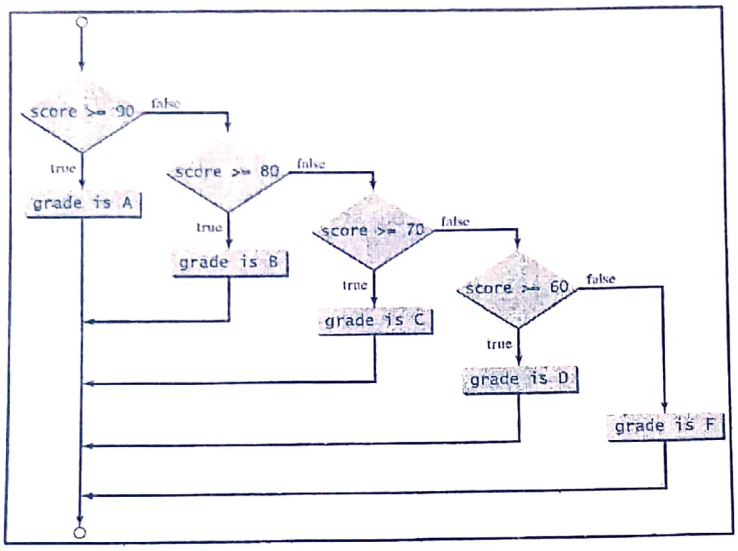
You are required to answer all questions in this section.

1. Illustrate and explain state transitioning of a java thread. **[6 marks]**
2. In Java programming an object is said to have both state and behavior. What does Java use to define state and behavior? **[2 marks]**
3. While designing a program, a programmer notes that variable **a** needs to accessible to all classes in the same package only, variable **b** can be accessed from anywhere, variable **c** should only be accessed from inside the same class and variable **d** is accessible only to classes in the same package and to its subclasses. All variables are of type integer. Write code to declare the variables clearly showing the access modifiers. **[4 marks]**
4. Briefly explain the types of programming errors a programmer may encounter in java. **[3 marks]**
5. What is the major difference between checked and unchecked exceptions? **[2 marks]**
6. List all the java primitives together with their size in bits. **[4 marks]**
7. Write java code that implements the following flow chart. **[3 marks]**



8. Briefly explain three methods for executing SQL queries using java? **[3 marks]**
9. What is the difference between method overriding and method overloading? **[4 marks]**
10. While trying to write code Chibwe faces some challenges related to the scope of variables. Briefly explain the three variable types found in java to help Chibwe overcome his challenges. **[3 marks]**
11. What are the three conditions that must be met when choosing an identifier **[3 marks]**

12. To assign grades to students, a programmer comes up with the following flow chart. Write java code that implements the flow chart. **[3 marks]**



if score >= 90)
else if score > 80)
return good

SECTION B (60 marks)

Answer any three (3) of the five (5) questions. Each question carries **20 marks**

1. Loops are a fundamental concept in all programming languages. For this reason, java also has loop implementations.
   a) What is a sentinel and when does it come in useful? **[3 marks]**
   b) How do you write an infinite loop using the "while", "for" statement? **[2 marks]**
   c) Consider the following code snippet. What is wrong with the code and what would you propose as a remedy. **[3 marks]**
   d) Hexadecimals are often used in computer systems programming. To convert a decimal number d to a hexadecimal number you need to find the hexadecimal digits h_n, h_{n-1}, h_{n-2}, ... , h_2, h_1, and h_0 such that

   $$d = h_n \times 16^n + h_{n-1} \times 16^{n-1} + h_{n-2} \times 16^{n-2} + \ldots + h_2 \times 16^2 + h_1 \times 16^1 + h_0 \times 16^0$$

   These hexadecimal digits can be found by successively dividing d by 16 until the quotient is 0. The remainders are h_0, h_1, h_2, ... , h_{n-2}, h_{n-1}, and h_n.
      I. Write java code for a class called MyInteger. MyInteger should have one constructor that accepts an integer as an argument. It should also have a method that returns the hexadecimal equivalent of the integer. **[8 marks]**
      II. Write a test class for MyInteger. **[4 marks]**

```
double item = 1; double sum = 0;
while (item != 0) {
  sum += item;
  item -= 0.1;
}
System.out.println(sum);
```

2. Two programing students decide to meet at a restaurant between 12:00hrs and 13:00hrs. They agree that whoever arrives first should wait for the other for no more than 15 minutes. One of the students develops a concern for the possibility of them successfully meeting. Being a programming savvy he decides to write a program to estimate the probability of them meeting. For this he uses a Monte Carlo simulation.
   a) Monte Carlo simulations require random number generation. Which java class can be used to generate random numbers? **[2 marks]**
   b) How can a java programmer write code to make use of code written by other programmers? Write code for making sure that the class in Q2(a) is made available. **[4 marks]**
   c) Either student can arrive from the 1st to 59th minute in the 12:00-13:00 period. The students arrive at times x_1 and x_2. If x_1-x_2 <= *15* it implies that the students meet and thus we consider this as a hit. The probability of the students meeting is

approximately *numberOfHits/numberOfTrials*. Assuming the students arrive between

```
public class Test {
  public static void main(String[] args) {
    int x = 1;
    int[] y = new int[10];
    m(x, y);
    System.out.println("x is " + x);
    System.out.println("y[0] is " + y[0]);
  }
  public static void m(int number, int[] numbers) {
    number = 1001;
    numbers[0] = 5555;
  }
}
```

12:00 and 13:00, write code for a class that can be used to generate MonteCarlo objects. The class should have two constructors. One for specifying the number of trials and another that sets the number of trials to 1000000. The class should also have a method for generating a random number using the same seed and also a method for invoking the experiment that returns the probability of meeting. **[8 marks]**

d) Write code for a class for running 10 experiments using the MonteCarlo class. The class then reports the probability as an average of running the 10 experiments. **[6 marks]**

3. Complete programming languages need a kind of container object that holds a fixed number of values of a single type. For this java uses arrays.

a) Write code showing how one can declare, create and initialize an array of integers in one step. **[3 marks]**

b) Even though arrays are single typed it is sometimes necessary to work with different subtypes derived from the same supertype in the same array. Clearly explain giving an appropriate example how this can be achieved. **[6 marks]**

c) Java is said to pass objects by value and not by reference

I. There are important differences between passing a value of variables of primitive data types and passing arrays. What are these differences? **[4 marks]**

II. What is the output of the following code? **[4 marks]**

d) A linear search algorithm compares a key element, *key*, sequentially with each element in an array. The method continues to do so until the *key* matches an element in the array or the array is exhausted without a match being found. If a match is made, the linear search returns the index of the element in the array that matches the *key*. If no match is found, the search returns *-1*. Write code for a method that implements a linear search algorithm. **[3 marks]**

4. Selections are a very useful concept in java.
   a) Using generic code, explain how a switch statement works. **[6 marks]**
   b) Write a program that prompts a user to enter a numerator and denominator of a fraction. The program then uses the numerator and denominator to determine whether the number is a proper fraction or an improper fraction. If it is a proper fraction, it displays the number. If not, it reduces it to a mixed fraction or to an integer. **[7 marks]**
   c) Write a program that prompts the user to enter the coordinates of two points (x_1, y_1) and (x_2, y_2), and displays the line equation in the slope-intercept form, i.e., $y = mx + b$. m and b can be computed using the following formula:

$$m = (y_2 - y_1)/(x_2 - x_1) \qquad b = y_1 - mx_1$$

   Don't display m if it is *1* and don't display b if it is *0*. **[7 marks]**

5. A programmer is planning to write a program for handling different types of cars; type A, B and C. All cars need to be able to accelerate and shift gears up. The shift gears up function gets an integer as input and returns the next gear. The acceleration function gets the time period in seconds as an integer and current speed in km/h as an integer and then returns a new speed in km/h. These basic functions should be inherited and implemented by all car types.
   a) What java construct can be used to force programmers to implement the said functions? **[2 marks]**
   b) Write code for establishing such a contract. **[6 marks]**
   c) The following table shows how the different car types implement the acceleration and shift gears up functions. It also shows some extra functionality which each car type has. The extra functionalities are safety features which stop the car (return speed 0) if the input is true (condition detected). Write code for the implementation of the three car types. **[12 marks]**

Car type	**Type A**	**Type B**	**Type C**
Acceleration function	20m/s². Maximum speed 140km/h	23m/s². Maximum speed 160km/h	27m/s². Maximum speed 240km/h
Shift gears up function	Maximum gear 4	Maximum gear 5	Maximum gear 6
Extra functionality	Can automatically break when it detects an object	Can detect stress of the driver	Can detect soberness of the driver.

The end of the examination paper