University of Swaziland
Department Of Computer Science
Supplementary Examination
July 2009

Title of paper: *C under Unix*

Course number: *CS344*

Time Allowed: *Three (3) hours*

Instructions:

- *Each question is worth 20 marks*
- *Answer any five (5) questions from questions 1 to 7*

This paper may not be opened until permission has been granted by the invigilator

Question 1-20 marks

(i) State whether each of the following is true or false. If false explain why?

[10 Marks]

(a) All variables must be declared before they are used.
(b) C++ considers the variables **number** and **Number** to be identical.
(c) Variable declarations can appear almost anywhere in the body of a C++ program.
(d) The default case is required in the **switch** selection structure.
(e) An array may store many different types of values.
(f) Both protected and public members of a super-class are visible to the derived subclass.
(g) Protected members of a super-class are visible to friends of the sub-class.
(h) If class A is a friend of class B, and class B is a friend of class C, then class A is a friend of class C.
(i) A class may have more than one constructor functions.
(j) A subclass inherits only the public members of its super-class.

(ii) Write a C++ statement(s) to accomplish each of the following *[10 marks]*

(a) Declare an double precision pointer y, set it to point to some arbitrary memory location, and initialize the value of this location to be 7.4.
(b) Print the value float X in a field of 15 characters with precision of 3.
(c) Sum the multiples of 5 between 0 and 100 using a **for** loop.
(d) Declare an array of 5 integers called **scores** and initialize all its components to 0.
(e) Determine and print the largest value contained in array **w** of float.

Question 2 – 20 marks

(i) Briefly describe the five (5) basic concepts of object-oriented programming?

[5 marks]

(ii) Explain how each of the concepts described in (b) above is implemented in C++?

[15 marks]

Question 3 – 20 marks

(i) Explain the following concepts, giving examples where possible?

(a) Function Prototype *1 mark*
(b) Function Signature *1 mark*
(c) Function Overloading *1 mark*
(d) Friend function *1 mark*
(e) Access member function *1 mark*

(ii)

(a) What is a constructor function? *2 marks*
(b) How and when is a constructor function called? *2 marks*
(c) A class may have more than constructor function. How is this possible? *2 marks*

(iii)

(a) What is a polymorphic function? *2 mark*
(b) Explain two (2) cases (concepts) which give rise to polymorphic functions. *3 marks*
(c) What is function template? *2 marks*
(d) Do you see any relationship between a function template and polymorphism? *2 marks*

Question 4 – 20 marks

(i) Using a function template, write a function **Swap** that takes two variables as arguments and swaps the values of the variables. *[5 marks]*

(ii) Using a template, write a function IndexOfSmallest (*A, first, last*) that takes three arguments. The first argument A is an array, and the second and third arguments are integer index values. The function must return the index of the smallest value in the array in the index range***first*** to ***last***. [*7marks*]

(iii) Using the functions **Swap** and **IndexOfSmallest** above, write a function SelectionSort **(A, first, last)** that takes an array and sorts the elements in the array **recursively**. The first argument is the name of the array,***first*** is the index of first element in the array and ***last*** is the index of last element in the array. The pseudocode for recursive selection sort is as follows, assuming elements are sorted in ascending order.

```
SelectionSort (A, first, last)
Begin
  Find smallest element in A[first..Last] and place it in its correst positions, A[first].
  Find n smallest element in A[first+1..last] and place it in its correct position, A[first+1].
   .
   .
  Repeat until all elements are sorted
End;
```

[*8 marks*]

Question 5– 20 marks

(k) Define a name structure containing a string field for a **name**, an integer for **feet**, and another integer for **arms**. *5 marks*

(l) Use the new structure to define an array of 6 items of the structure defined in (a) above. . *5 marks*

(m) Write a function that will print out all the data in the array declared above in the following format (*assuming appropriate assignments for,* ***name,feet*** *and* ***arms****, have been made for each data item in the array*).

```
A Human being has 2 legs and 2 arms
A dog has 4 legs and 0 arms
```

7 marks

(n) Write code segments to illustrate how these values (human being, 2, 2) would have been assigned to the corresponding variables by using a loop that reads all corresponding values (name, feet and arms) from standard input.

8 marks

Question 6– 20 marks

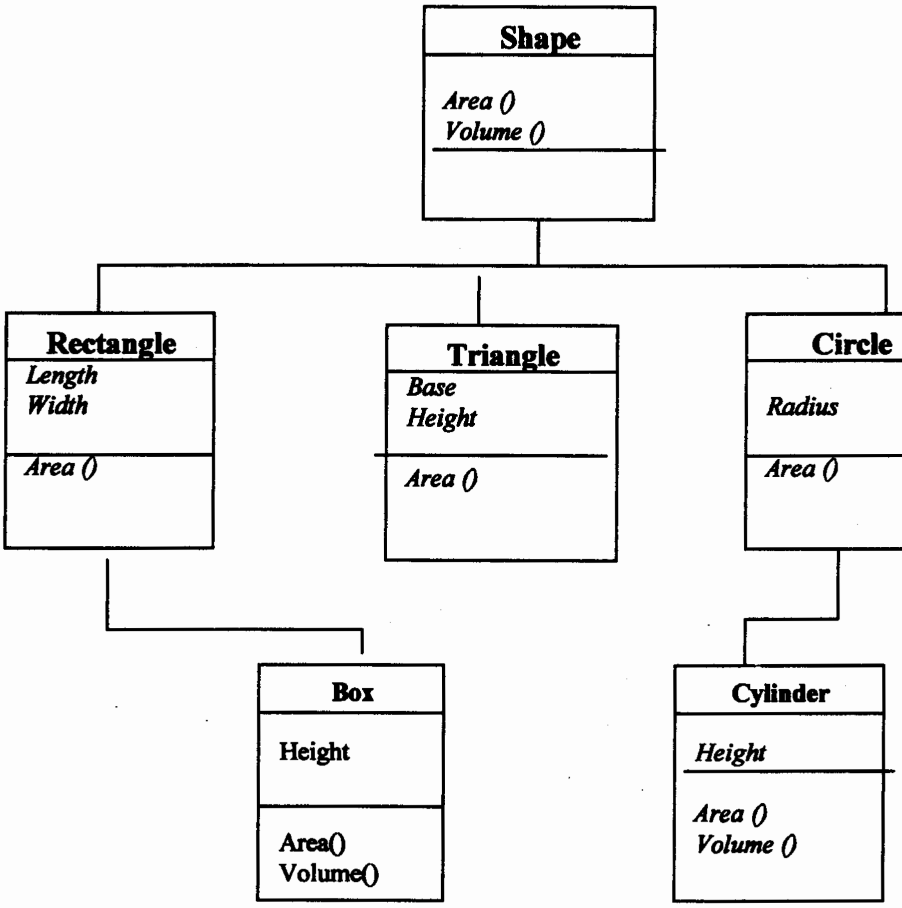
Create a class called **IntegerSet**. Each object of class **IntegerSet** can hold integers in the range 0 through 100. A set is represented internally as an array of ones and zeros. Array element **a [i]** is 1 if **i** is in the set. Array element **a[j]** is 0 if j is not in the set. The default constructor initializes a set to an empty set. A set is empty if all its array elements are initialized to 0.

Implement the following operations on a set:

- **Insert (e)** – adds a new element **e** into the set.
- **Remove (e)** – remove element **e** from the set.
- **IsMember (e)** – returns true if element **e** is in the set and false otherwise.
- **Print ()** – display all elements of the set on standard output.

Question 7– 20 marks

Consider the following class hierarchy for shapes



Using C++ notation implement the above class hierarchy. Your implementation must be as close as possible to the above design. You may add necessary operations, but all the attributes have been specified. [*20 marks*]

The following formulas are useful.

VolumeOfCylinder = BaseCircleArea * Height;
AreaOfCylinder = 2*BaseCircleArea + 2*Pi*RadiusofBaseCircleArea*Height.

VolumeOfBox = BaseRectangleArea * Height;
AreaOfBox = 2*BaseRectangleArea + 2*Height*Length + 2 * Height *Width;