

SCHOOL OF SCIENCE & MEDICINE

Exam Title: **PROBLEM SOLVING AND PROGRAMMING 2**

SPRING 2016

EXAMINATION FOR THE DEGREE PROGRAMMES IN

BSC Computing September 2015 and January 2016

Exam Code: 20162AIAP114AWP

TIME ALLOWED: **2 HOURS**

MATERIALS PERMITTED: None

MATERIALS PROVIDED: A sheet with general relevant code will be provided electronically.

INSTRUCTIONS:

1. Answer ALL **FOUR** questions. For Question 3, you need to answer either A or B.
2. This examination requires both written work in the answer book as well as practical work on the computer.
3. Be tidy with your written work. Marks may be deducted for untidy work. You must save your practical work on the designated disk drive on the desktop of your computer.
4. You must organize your answers into folders, one folder for each question. Do not provide more than one answer to each question.

Question 1	25	Practical
Question 2	20	practical
Question 3 (either A or B)	20	written
Question 4	35	written

Question 1 (practical) (25 marks)

Define a data structure that represents a student record. The record should contain the following fields:

1. Student ID;
 2. Student Name;
 3. Year and term (this can be entered as YYTT, i.e if the year is 2016 and the term is Spring, then 1602 will be entered, i.e Winter term 01, Spring term 02, and so on)
 4. Three marks for three modules per term.
- A. Declare a variable of the structure above. Populate the variable with a student named "James Bond" with suitable data details, and then display the structure details to the output.
- B. Declare an array of 4 students based on the structure above.
- C. Test your answer for a students' names "James Bond 1" and "James Bond 2" and so on.

(A:10 marks, B:5 marks, C:5 marks)

Question 2 (practical) (20 marks)

Bubble Sort and Insertion sort are two sorting algorithms. The function definitions for the two algorithms are given below:

```
void BubbleSort(int A[], int size)
{
    for (int c = 0 ; c < size-1 ; c++)
    {
        for (int d = 0 ; d < size-c-1; d++)
            if (A[d] > A[d+1])
                Swap(A[d], A[d+1] );
    }
}
```

```
void InsertionSort(int A[], int size)
{
    int d;
    for (int c = 1 ; c <= size - 1; c++) {
        d = c;
        while ( d > 0 && A[d] < A[d-1]) {
            Swap( A[d], A[d-1]);
            d--;
        }
    }
}
```

- A. Implement your own swap function. Test the working of the two algorithms with **A={6, 3, 6, 8, -2, 0}**.
- B. Modify the two functions by displaying (i.e. tracing) the content of the array "A" for each iteration of the outer for loop.
- C. Provide the results from each algorithm by printing out the number of comparisons and swapping happening until the data get sorted.

(A: 8 marks, B: 6 marks, C:6 marks)

Question 3 (written) (20 marks)**Answer either A or B.****A: Linked list**

Using the linked list in Figure 1 below, **write the necessary program statements in your answer book:**

1. to insert a node containing 10.2 between the nodes for 12.6 and 7.7;
2. to add a node containing 50.5 at the beginning of the list;
3. to delete the node for 7.9;
4. to delete all nodes.

(5 marks each [1..4])

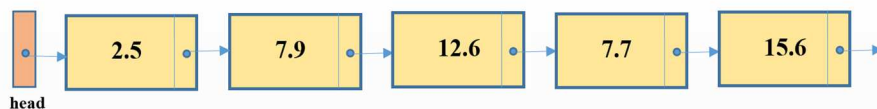


Figure 1

B: Hashing

Hashing is one of the important searching methods in computing. You are asked to design a hashing system for the Applied Computing Department to save and retrieve the student information. The Department currently has a relatively small number of students (around 70), but yet it is growing fast.

1. Design a hashing table that can accommodate the future growth of the Department to up to 100 students.
2. Design a hashing function that can use the student ID as a search key.
3. Design a rehashing function that can be used to produce a minimum clashes as possible.
4. Justify your answers by giving a suitable example.

(5 marks each [1..4])

Question 4 (written) (35 marks)

Phone systems have become essential in our lives as such systems allow us to retrieve names and contact numbers of our contacts. But sometimes, we get into difficulty in mapping contact numbers to names of the persons who have the numbers.

In this question you need to suggest a data structure to host the contact and access the contact using either their names or their numbers. Your solution may involve even more than one data structure.

To answer this question, you need to do the following:

- A. Write the needed program statements to represent your suggested structure(s).
- B. Write a function that performs the data insertion (NB: you may use some of the data items provided in the table below as examples).
- C. Discuss your solution regarding efficiency and space used for saving and retrieving data in/from memory.

(A:15 marks, B:10 marks, C:10 marks)

John	Barry	Suzan	Hanah	Jack	Sarah
3260	2234	3412	3299	3232	6515

- END OF PAPER -