



TECHNICAL UNIVERSITY OF MOMBASA

Institute of Computing & Informatics

UNIVERSITY EXAMINATION FOR:

BTIT/SEP 2014Y2S2, BSIT/SEP 2014/J-FT Y2S1, BMCS 14S Y2S2,

BSSC 14S Y2S2

ICS 2105/EIT 4213 DATA STRUCTURES & ALGORITHMS

END OF SEMESTER EXAMINATION

SERIES: APRIL 2016

TIME: 2 HOURS

Paper 1

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of Five questions. Attempt Question One and any two other

Do not write on the question paper.

Question One

(a.) (i.) You are employed by a software company designing an application for use by produce wholesalers. Your job is to implement the data structure used to store the inventory of the warehouse containing the produce. The data structure must be able to add a product with an associated code indicating its likelihood to spoil, remove a product that is most likely to spoil (to ship it from the warehouse), and return the overall number of products in the inventory. Discuss your ADT of choice and its implementation. [5marks]

(b.) (i.) Define the term algorithm. [2mars]

(ii.) In your own experience in today life where do you think you apply the concept of algorithms? Discuss with an example. [4 marks]

- (c.) (i.) Differentiate between a recursion and an iteration in program development. Use a high level language example to explain the difference. [6marks]
- (d.) (i.) What do the terms time efficiency and space efficiency mean with reference to an algorithm? [6marks]
- (ii.) State any other three parameters of concern when it comes to measuring time efficiency? [3 marks]
- (iii.) Give the asymptotic growth rate of $S(n)$, the number of steps required by the following code segment. [4marks]
- ```

sum=0;
for(i=0; i < n; i++){
 j=i;
 while(j !=0){
 if(j % 2 == 0)
 sum++;
 j /= 2;
 }
}

```

### **Question Two**

- (a.) (i.) What is a linked list? Explain. [2marks]
- (ii.) Outline the properties of the linked list abstract data type. [4marks]
- (iii.) Write an algorithm used to delete an element from the list [6marks]
- (b.) (i) Write a pseudo code algorithm that prompts the user for three integers , evaluates the largest and print's the maximum [4 marks]
- (ii) Implement the algorithm above into a program using a high level language. [4 marks]

### **Question Three**

- (a.) (i.) Define a stack ADT. [2marks]
- (ii.) Write an algorithm that demonstrates the Push and Pop stack fundamental operations [8marks]
- (iii.) Briefly explain any two applications of stack in computer science [4 marks]
- (b.) (i.) Define the term Abstract Data Type (ADT) and hence give its properties. [6marks]

### **Question Four.**

- (a.) The merge sort algorithm is stated as follows:

If we are required to sort an array, we can divide the array into two sub-arrays of about equal length, sort each sub-array separately, and finally merge the two sub-arrays.

Write a method that accepts an unsorted integer array and uses the above algorithm to sort the array. (10 marks)

- (b.) The basic operation of the insertion sort is the insertion of a single element into a sequence of sorted elements so that the resulting sequence is still sorted. The process is illustrated below for an array of five integers. The original array is shown in (i.)

(i.) 

|     |    |     |     |     |
|-----|----|-----|-----|-----|
| 235 | 45 | 182 | 205 | 390 |
|-----|----|-----|-----|-----|

(ii.) 

|    |     |     |     |     |
|----|-----|-----|-----|-----|
| 45 | 235 | 182 | 205 | 390 |
|----|-----|-----|-----|-----|

(iii.) 

|    |     |     |     |     |
|----|-----|-----|-----|-----|
| 45 | 182 | 235 | 205 | 390 |
|----|-----|-----|-----|-----|

(iv.) 

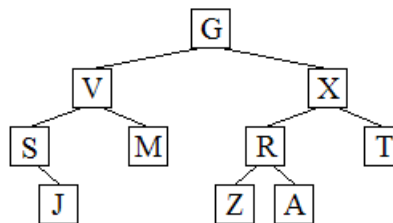
|    |     |     |     |     |
|----|-----|-----|-----|-----|
| 45 | 182 | 205 | 235 | 390 |
|----|-----|-----|-----|-----|

Write a method that accepts as a parameter an array of integers and uses this algorithm to sort the elements in the array.

(10 marks)

**Question Five**

- (a) List the order in which the contents of the following tree would be visited, for each of the given traversals:



- (i) Preorder
- (ii) In order
- (iii) Post order

[9marks]

- (b) Consider the following code segment

Arr [4] = {6,4,3,1}

j = 0 , k = 10

While (j < 4) do

If (arr [j] < k) then

k =arr [j]

Endif

$j = j+1$

End while

Display k.

- (i) What does the code display, dry run to show your answer [5marks]
- (ii) Using a high level language, Implement the algorithm in to a program [4marks]
- (c) What are the limitations of arrays?. Explain how you can overcome the limitations [2marks]