University of Swaziland
Supplementary Examination
JULY 2015

Title of paper : Data structures

Course number : CS342

Time Allowed : Three(3) hours

Instructions :

- *Each question carries 25 marks*
- *Answer any four (4) questions from questions 1 to 6.*

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

Question 1

Assuming an array based implementation of an un-ordered list, and using C++/C#/Java notation (where necessary),

(a) Define a class of an un-ordered List. 5 *marks*

(b) Write functions that implement the **Create**, **IsEmpty**, **Insert** and **Delete** operation on the structure described in (a) above. 12 *marks*

(c) Using the big-O notation, estimate the running times of the implementations given in (b) above. 4 *marks*

(d) Write a recursive function that prints all the elements in a List. 4 *marks*

Question 2

(a) List and describe the operations of a stack data structure. 5 *marks*

(b) Using C++/C#/Java notation, write a linked-list based implementation of a stack, including a definition of structure and the operations on the stack. 20 *marks*

Question 3

(i) Construct a 2-3 tree containing the following values:

Mumba, Banda, Dube, Cele, Langa, Nkomo, Gule, Khan, Johnson, Zulu, Oyoko, Mamba, Xaba, Musi, Sambo, Dube, Zulu, Odumbe, Jele, Gama, Masango, Hlubi, Hlophe, Cele, Sukati

Assuming the values are inserted in the order given above. *15 marks*

(ii) What is the height of the tree 3 makrs

(iii) With the aid of a example, briefly explain the advantages and disadvantages of using (a,b) trees. 7 marks

Question 4

(a) List and describe the operations of a queue data structure. 6 *marks*

(b) Compare a *Simple array-based implementation* and a *Simple linked list implementation* of a queue in terms of the memory requirements and the running times of the operations. In your opinion which one is a better implementation? 7 *marks*

(c) Using C++/C#/Java notation, write

(i) A function that removes all elements from a queue and returns the sum of the elements. 3 *marks*

(ii) A function that replaces each item in a given queue of numbers by its double (number multiplied by 2). 5 *marks*

(d) Using the big O notation, estimate the running time of the functions given in (c) above. 4 *marks*

Question 5

(a) Using C++/C#/Java notation, define the structure of a binary search tree. *7 marks*

(b) Assuming your definition in (a) above, write a function that implements an in-order traversal of a binary search tree. *4 marks*

(c) Construct a binary search tree T containing the following values.

250	98	100	20	400	15	250	315	70	75
650	10	150	30	170	250	250			

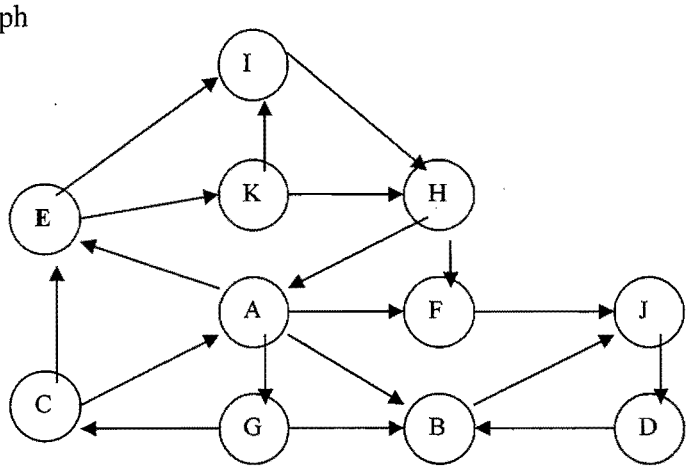
Assume values are inserted in the given order. 6 *marks*

(d) List all node values in left shell of the root node of T? *2 marks*

(e) Trace the execution of iterative pre-order traversal algorithm on tree T. 6 *marks*

Question 6

Consider the following graph



(a) Show the adjacency matrix representation of the above graph G. *4 marks*

(b) Show the adjacency list representation of the above graph G. *4 marks*

(c) List all the nodes of G, assuming Breadth-First Search (BFS) starting from node A. You may assume adjacent nodes are visited in alphabetical order. *7 marks*

(d) Trace the execution of the Breadth-First Search (BFS) algorithm on the above graph G starting from node A. Assume adjacent nodes are visited in alphabetic order. *10 marks*