

University of Swaziland
Final Examination
MAY 2011

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

95

Assuming an array based implementation of a list,

- (a) Using C++ notation, define the structure of an ordered List. 5 marks
- (b) Write C++ 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++ 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

- (a) List and describe the operations of a queue data structure. 6 marks
- (b) With the aid of a diagram, 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++ notation, write
 - (i) A function that removes all elements from a queue and the 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 4

96

- (a) Using C++ 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.

200	98	10	20	400	15	250	315	70	75
650	100	150	30	170	200	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 5

- (a) Write the pseudocode for inserting into a B-tree of order b. *4 marks*
- (b) Follow the pseudocode outlined in (a) above and construct a B-tree of order 5 containing the following values.

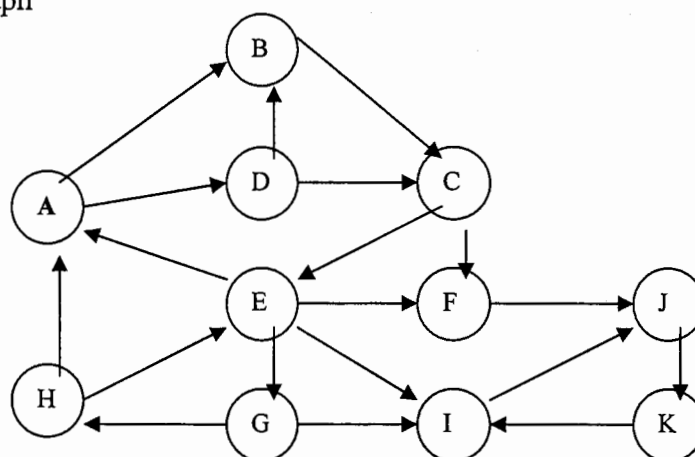
200	98	10	20	400	15	250	315	70	75
650	100	150	30	170	800	50	80	100	400

Assume values are inserted in the given order. *15 marks*

- (c) List all node values in the B-tree constructed above assuming level-order traversal. What is the running time of this traversal? *3 marks*
- (d) What is the height of a B-tree of order 19 containing 130000 values. *3 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 E.
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 E. Assume adjacent nodes are visited in alphabetic order. *10 marks*