

UNIVERSITY OF SWAZILAND
Faculty of Science
Department of Computer Science
FINAL EXAMINATION 2007

Title of paper: DATA STRUCTURES

Course number: CS342

Time allowed: Three (3) hours

Instructions: Answer any five (5) of the six (6) questions.

This examination paper should not be opened until permission has been granted by the invigilator.

Question 1

a) List and describe the operations of the stack ADT. [5]

b) Give a linked-list based implementation of the stack ADT, including definitions of relevant data types. [15]

Question 2

a) List and describe the operations of the queue ADT. [5]

b) Discuss the main advantages and disadvantages of the 2 implementations of queues: array based and linked-list based. [7]

c) Write an algorithm that replaces each item in a given queue of numbers by its double (2 multiplied by itself). [5]

d) Analyse the big-O time complexity of the algorithm given in c). [3]

Question 3

- a) List and describe the operations of the list ADT. [10]
- b) Write an algorithm to take a list and return a new list which is a copy of the given list's first half. Specifically, if the given list has N items, the returned list should contain the first $\left\lfloor \frac{N}{2} \right\rfloor$ items, in the same order. [10]

Question 4

- a) Give implementations of the Insert and Delete operations for array based lists. [6]
- b) Analyse the big-O time complexities of the implementations given in a). [4]
- c) Write an algorithm that returns the *final* position at which a given item occurs within a given list of numbers. If the item is not found, it should return the list's last position. [7]
- d) Analyse the big-O time complexity of the algorithm given in c), assuming that the given list is array based. [3]

Question 5

- a) Draw the binary search tree that results from the insertion of the following values in sequence: 5, 1, 3, 9, 7, 2. [3]
- b) Draw a binary tree consisting of 6 nodes and having a depth of 3. The nodes must be labelled 1, 2, ..., 6 according to the sequence of their *preorder* traversal. [4]
- c) Give the postorder traversal algorithm for binary trees. [3]
- d) Write an algorithm to search for a given key within a given binary search tree. [5]
- e) Give a partial implementation of the binary tree ADT consisting of the SetLeft operation and definitions of relevant data types. [5]

Question 6

- a) With the aid of a graph diagram containing at least 6 vertices and 7 edges, distinguish between breadth-first and depth-first traversal. [6]
- b) Write an algorithm to take a graph, as well as one of its vertices v , and increment by 1 the values found in v and vertices reachable from v . Assume that each vertex holds a number. [14]