



Machakos University

University Examinations 2021/2022

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTING AND INFORMATION TECHNOLOGY

SECOND SEMESTER EXAMINATIONS FOR THE DEGREE OF BACHELOR OF COMPUTING AND INFORMATION TECHNOLOGY

SIT 261: DATA STRUCTURES AND ALGORITHMS

DATE: DECEMBER 2021

TIME: 2 HOURS

Instructions

This paper consists of FIVE questions

*Answer **question one** and other **two** questions in this paper*

Question One [30 Marks]

- (a) Define the terms:
- (i) Data structure
 - (ii) Algorithm
- (2 marks)**
- (b) There are various common problems that applications face currently, which necessitate the use of data structures. Describe three such problems.
- (6 marks)**
- (c) Explain the meanings of the following characteristics of an algorithm:
- (i) Finiteness
 - (ii) Feasibility
 - (iii) Independent
- (6 marks)**
- (d) An algorithm is required to compare three numbers then display the larger of the three. Write the algorithm.
- (6 marks)**
- (f) With reference to data structures, describe the following terminologies. Provide an example of each.
- (i) Interface
 - (ii) Implementation
- (4 marks)**
- (e) Describe the following basic characteristics of data structures:

- (i) Correctness
- (ii) Time complexity
- (iii) Space complexity

(6 marks)

Question Two [20 Marks]

- (a) There are three cases usually used to compare various data structure's execution time in a relative manner. Discuss these three cases. **(6 marks)**
- (b) Various data types are used in data structures and algorithms. Describe the two broad categories of data types, giving an example of each. **(4 marks)**
- (c)
 - (i) Define the array data structure. **(2 marks)**
 - (ii) Differentiate between *size* and *index*. **(2 marks)**
 - (iii) Let **LA** be an unordered Linear Array of **N** elements and **K** is a positive integer such that $K \leq N$. Write an algorithm that inserts an item into the K^{th} position of **LA**. **(6 marks)**
- (d) With the use of suitable diagrams, differentiate between a circular list and a doubly linked list. **(4 marks)**

Question Three [20 Marks]

- (a) Using a suitable diagram, describe the stack data structure. **(4 marks)**
- (b) Discuss three real life application areas of the stack data structure. **(6 marks)**
- (c)
 - (i) Explain the tasks performed by the *push()* and *pop()* operations of the stack. **(2 marks)**
 - (ii) Write appropriate algorithms to illustrate how each of the above operations can be implemented in a stack. Explain your algorithms. **(8 marks)**

Question Four [20 Marks]

- (a) With respect to the tree data structure, define the following terms:
 - (i) parent
 - (ii) child
 - (iii) sibling
 - (iv) ancestor
 - (v) descendant**(5 marks)**
- (b)
 - (i) Using a suitable diagram, describe what a binary tree is. **(3 marks)**
 - (ii) State three distinct characteristics of a binary tree. **(3 marks)**
- (c)
 - (i) Briefly explain an application area of a binary tree. **(2 marks)**
 - (ii) Write a suitable algorithm for searching a binary tree. **(7 marks)**

Question Five [20 Marks]

- (a) Distinguish the following constructs used in data structures, giving an example of each:
 - (i) infix, postfix and prefix expressions
 - (ii) inorder, postorder and preorder traversals**(9 marks)**
- (b)
 - (i) Define a linked list. **(1 mark)**

- (ii) Using appropriate diagrams, explain how the following operations are carried out on a linked list:
 - 1. Insertion of an item. **(3 marks)**
 - 2. Deletion of an item. **(3 marks)**
- (c) Write suitable algorithms to display the following from a linked list:
 - (i) first element **(2 marks)**
 - (ii) last element **(2 marks)**