



MACHAKOS UNIVERSITY

University Examinations for 2019/2020 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTING AND INFORMATION TECHNOLOGY

SECOND YEAR SPECIAL/SUPPLEMENTARY EXAMINATION FOR

BACHELOR OF SCIENCE (COMPUTER SCIENCE)

SCO 204: DATA STRUCTURES AND ALGORITHMS

DATE: 21/1/2021

TIME: 8:30 – 10:30 AM

INSTRUCTIONS

This paper consists of FIVE questions.

Answer QUESTION ONE and other TWO questions in this paper.

QUESTION ONE (COMPULSORY) (30 MARKS)

- (a) Explain each of the following terms: (8 marks)
- (i) Structured data type;
 - (ii) Linear data structure;
 - (iii) Abstract data type;
 - (iv) Data hiding.
- (b) (i) Distinguish between *overflow* and *underflow* errors in a tree data structure. (4 marks)
- (ii) Outline **three** operations that could be carried out on a queue data structure. (3 marks)
- (c) (i) A programmer intends to use a data structure in a program he is creating. Explain **three** factors he would consider when choosing the data structure. (6 marks)
- (ii) Write a C language statement that may be used to declare a two-dimensional array. (2 marks)
- (d) The following is a list of students' names in a certain class. Use it to answer the questions that follow.
- Joseph, Patrick, Carol, Neim, Violet, Diana, Abram.*
- (i) Construct a binary tree; (3 marks)
 - (ii) Write the output generated when the tree in (i) is traversed using:
 - I. preorder strategy; (2 marks)
 - II. postorder strategy. (2 marks)

QUESTION TWO (20 MARKS)

- (a) (i) Explain **two** time complexities associated with data structures. (4 marks)
- (ii) A student declared a list of Size 10 and entered the following data elements.
- Students = {Mark, John, Peter, Simon, Mshindi, Zawadi, Pendo, Amani}
- Write the output produced when each of the following operations is carried out on the list.
- I. Head(Tail)(Tail)(Students)
- II. Isfull(Students) (4 marks)
- (b) (i) Write a program in C language that could be used to determine the average of 10 integers using array data structure. (4 marks)
- (ii) Distinguish between *overloading* and *downloading* errors in data structures. (4 marks)
- (c) Explain the most suitable data structure for each of the following scenarios: (4 marks)
- (i) Distributing purchases to several customers;
 - (ii) Banking university fees;
 - (iii) Carrying out an audit trail in a system;
 - (iv) Marking assignments.

QUESTION THREE (20 MARKS)

- (a) Explain **three** types of time complexity. (6 marks)
- (b) (i) Describe bubble sort as used in data structures. (3 marks)
- (ii) Using bubble sort organize the following data items. (3 marks)
- | | | | | |
|----|----|----|----|----|
| 78 | 49 | 36 | 21 | 53 |
|----|----|----|----|----|
- (c) Distinguish between *upheaping* and *downheaping* operations of a heap data structure. (4 marks)
- (d) A community hospital stores patients' data in a database. The database contains fields such as *PatientNo*, *PatientName*, *Residence*, *AgeinYears* and *Gender*.
- Create a record using C programming language that could be used to store the data. (4 marks)

QUESTION FOUR (20 MARKS)

- (a) (i) Distinguish between *binary search tree* and *balanced tree* as used in data structures. (4 marks)
- (ii) Represent the expression $(x - y) / (w - z) * q$ using an expression tree. (3 marks)
- (b) Write a *pseudocode* that may be used to add an item into a stack. (3 marks)
- (c) Compare *greedy* and *divide-and-conquer* approaches as used algorithms. (4 marks)
- (d) Joan, a computer scientist used graph data structure in a program. Describe **three** operations that she could implement in the program. (6 marks)

QUESTION FIVE (20 MARKS)

- (a) (i) Outline **two** mathematical notations used to classify algorithms. (2 marks)
- (ii) Describe **three** classes of algorithms used in computer science. (6 marks)
- (b) (i) Compare *heap* and *stack* data structures in terms of:
- I. memory utilization; (2 marks)
 - II. speed of execution. (2 marks)
- (ii) During a programming lesson, students were required to carry out a performance analysis of a program they had created. Outline **four** importance of this exercise. (4 marks)
- (c) Figure 1 shows a transport network system. Use it to answer the question that follows:

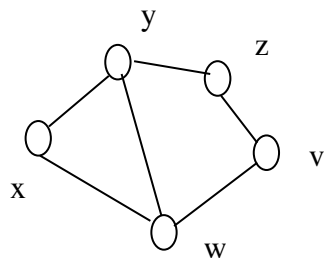


Figure 1

Represent the network in an adjacency matrix. (4 marks)