



MACHAKOS UNIVERSITY

University Examinations for 2021/2022

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTING AND INFORMATION TECHNOLOGY

SECOND YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (COMPUTER SCIENCE)

BACHELOR OF SCIENCE (MATHEMATICS AND COMPUTER SCIENCE)

SCO 204: DATA STRUCTURES AND ALGORITHMS

DATE: 9/12/2021

TIME: 2.00-4.00 PM

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 as used in data structures:
- (i) abstract data structure; (2 marks)
 - (ii) encapsulation; (2 marks)
 - (iii) inheritance. (2 marks)
- (b) A student used a data structure in a program. Explain the time complexities associated with such structures. (6 marks)
- (c) (i) Distinguish between *precedence* and *associativity* as used in stacks. (4 marks)
- (ii) With the aid of a diagram in each case, describe enqueue and dequeue operations algorithms. (4 marks)
- (d) Write an algorithm for merge sort. (4 marks)
- (e) The following data items were stored in a data structure.
- 65 54 26 82 31 74 55
- (i) Draw a minimum heap for the data items. (3 marks)
 - (ii) Draw a binary search tree to represent the data items. (3 marks)

QUESTION TWO (20 MARKS)

- (a) (i) Outline **two** advantages of binary search. (2 marks)
- (ii) Explain **two** factors used to measure an algorithm's complexity. (4 marks)
- (b) John, a computer science student created a data structure to store details of a student (Registration number, Name, Gender and course).
- (i) Identify the most appropriate data structure he could have created. (1 mark)
- (ii) Using C programming language, declare a structure to store these details. (4 marks)
- (c) Figure 1 shows a graph data structure. Use it to answer the questions that follow.

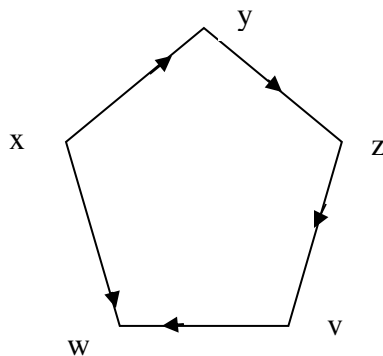


Figure 1

- (i) State the indegree and outdegree of each vertex. (2 marks)
- (ii) Prepare an adjacency matrix for this graph. (3 marks)
- (d) With the aid of a diagram, describe a doubly linked list (4 marks)

QUESTION THREE (20 MARKS)

- (a) Explain **two** applications of queue data structure. (4 marks)
- (b) (i) Describe the divide and conquer algorithm as used in data structures and algorithms. (2 marks)
- (ii) Given coins of values Ksh 1, 5, 10, 20 and 40. Write the steps that would be followed to count Ksh. 57 using the greedy algorithm. (3 marks)
- (c) (i) Distinguish between *overflow* and *underflow* errors as used in queues. (4 marks)
- (ii) Given a list, Marks = {45, 67, 63, {34, 56, 78}, 54, 98}. Write the output generated when each of the following operations are executed.
- I. Head (Tail (Marks)) (1 mark)
- II. Tail (Tail (Tail (Marks))) (1 mark)
- (d) Write an algorithm that could be used to search for an item using linear search. (5 marks)

QUESTION FOUR (20 MARKS)

- (a) Explain each of the following terms as used in a tree:
- (i) node level; (2 marks)
 - (ii) depth. (2 marks)
- (b) Write an algorithm for the pop operation in a stack. (4 marks)
- (c) (i) The following arithmetic expression was used in a C language program.
- $$x = (a+b) * (c-d)$$
- Represent it in an expression tree. (3 marks)
- (ii) With aid of an example in each case, distinguish between *infix* and *postfix* operators. (4 marks)
- (d) The following data items are stored in an array.
- 65 94 73 54 27 48
- Sort the items in ascending order using bubble sort. Show all the passes. (5 marks)

QUESTION FIVE (20 MARKS)

- (a) Outline the steps followed in insertion sort. (4 marks)
- (b) Write a pseudocode that could be used to remove an item from an array. (6 marks)
- (c) With the aid of a diagram in each case, distinguish between *depth first* and *breadth first* graph traversal strategies. (6 marks)
- (d) The following data items were stored in a stack of size 8.
- 67 88 98 57 80
- Two more items 46 and 39 were added into the stack in that order.
- (i) Draw the stack after this addition. (2 marks)
 - (ii) The stack was then implemented using an array. Draw the resultant array. (2 marks)