



MULTIMEDIA UNIVERSITY OF KENYA
FACULTY OF COMPUTING AND INFORMATION TECHNOLOGY
UNIVERSITY EXAMINATIONS 2023/2024
SECOND YEAR SECOND SEMESTER EXAMINATION FOR THE DEGREE OF
BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY
BACHELOR OF SCIENCE IN COMPUTER TECHNOLOGY

UNIT CODE: ICS 2105 UNIT NAME: DATA STRUCTURES AND ALGORITHMS

DATE: APRIL 2024

TIME: 2 HOURS

INSTRUCTIONS:

ANSWER YOUR QUESTIONS IN ANSWER BOOKLET PROVIDED.

ANSWER QUESTION ONE [COMPULSORY] AND ANY OTHER TWO QUESTIONS.

QUESTION ONE (THIRTY MARKS)

- a) What is a Data Structure and why is it important in computer science? (4 Marks)
- b) Explain the concept of Big O notation and provide an example to demonstrate how it is used to analyze the efficiency of an algorithm. (5 Marks)
- c) Describe a real-world scenario where a stack is more suitable than a queue, and explain why. (4 Marks)
- d) Explain the concept of hashing in data structures. What are collision resolution techniques and why are they important? (6 Marks)

- e) Explain Dijkstra's algorithm for finding the shortest path in a graph. What type of problems is this algorithm best suited for? (4 Marks)
- f) Write a Python class to implement a stack with push, pop, and peek methods. (7 Marks)

QUESTION TWO (TWENTY MARKS)

- a) Compare and contrast arrays with linked lists in terms of memory allocation, insertion/deletion operations, and access time. (6 Marks)
- b) Describe the properties of each of the four Python built-in data structures. For each one of them, show a sample code how it is declared/created in Python. (8 Marks)
- c) Implement a Python function that performs binary search on a sorted array. (6 Marks)

QUESTION THREE (TWENTY MARKS)

- a) What are the differences between a binary tree and a binary search tree? Give an example of a situation where a binary search tree offers advantages over a regular binary tree. (6 Marks)
- b) Explain the advantages of Linked Lists over Arrays giving examples of applications where you might select a Linked List instead of an array. (6 Marks)
- c) Write a Python function to find the height of a binary tree. (8 Marks)

QUESTION FOUR (TWENTY MARKS)

- a) Compare and contrast “Quick Sort” and “Merge Sort” sorting algorithms in terms of their time complexity, space complexity, and stability. (6 Marks)
- b) Discuss any other three sorting algorithms that you are familiar with other than the two in (a) above. (6 Marks)
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- c) Write a Python function to detect a cycle in a linked list. It should return a “True” if a cycle is detected and a “False” otherwise. (8 Marks)

QUESTION FIVE (TWENTY MARKS)

- a) Describe the process of Breadth-First Search (BFS) in graph traversal, and explain a situation where BFS is preferred over Depth-First Search (DFS). (6 Marks)

- b) Describe at least 4 properties of a binary search tree. (8 Marks)
- c) Implement a Python function that given a binary tree will calculate and return the height of the binary tree using recursion. (6 Marks)