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University Examinations 2024/2025

SECOND YEAR FIRST SEMESTER FOR THE DEGREE OF BACHELOR OF SCIENCE IN DATA SCIENCE, BACHELOR OF SCIENCE IN COMPUTER SCIENCE, BACHELOR OF SCIENCE IN COMPUTER TECHNOLOGY, BACHELOR OF SCIENCE IN COMPUTER SECURITY AND FORENSICS, BACHELOR OF SCIENCE IN BUSINESS INFORMATION AND TECHNOLOGY, BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY

CCS 3200: DATA STRUCTURES AND ALGORITHMS

DATE: DECEMBER 2024 **TIME: 2 HOURS**

INSTRUCTIONS: *Answer question **ONE** (Compulsory) and any other **TWO** questions*

QUESTION ONE (30 MARKS)

a) Define the following terms: (8 Marks)

i. Data type

ii. Queue ADT

iii. Root node

iv. The height of a tree

b) Clearly differentiate between the following terms: (6 Marks)

i. Linked list and array

ii. Iteration and recursion

iii. Tree and hash table

c) Define the term algorithm analysis and discuss the TWO important quantitative metrics of interest in algorithm analysis. (6 Marks)

d) Explain the importance of an end node in a linked list. (2 Marks)

e) Given the following scenarios; state and explain the most suitable Abstract Data Type(ADT) to use:

i. Serving customers in a banking hall

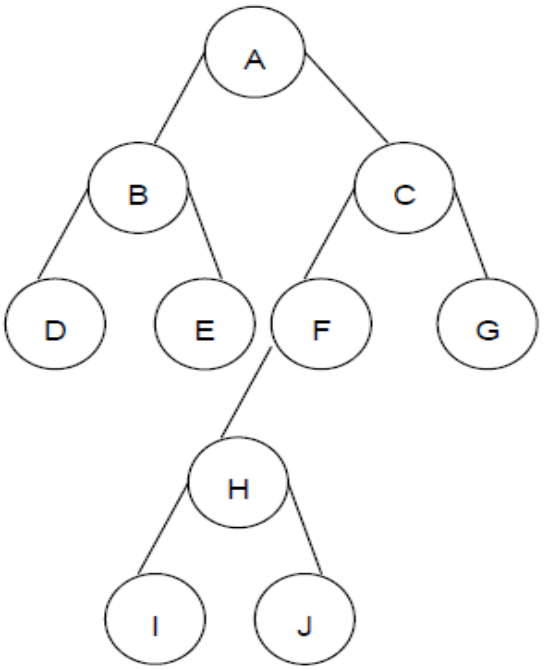
ii. Deleting characters using the backspace key

iii. Checking if an expression has the correct set of delimiters (3 Marks)

f) Given three assignment marks out of 50, 70 and 30 respectively, write an algorithm that computes the average calculated as a mark out of 100. (5 Marks)

QUESTION TWO (20 MARKS)

a) Consider the tree given below:



i. Is the tree a binary tree? Justify

ii. Is the tree a complete tree? Justify (4 Marks)

Show the traversal sequence when searching for J using depth first search for:

iii. Inorder traversal

iv. Preorder traversal

v. Postorder traversal (6 Marks)

b) Write an algorithm that accepts and stores the prices of ten items in an array, the algorithm should then

calculate and output the average price of the items. (5 Marks)

c) Using the prices 10,20,30,40,50,60,70,80,90,100 show a trace of how your algorithm in (b) above arrives at the average. (5 Marks)

QUESTION THREE (20 MARKS)

a) Using a diagram discuss the concept of the binary search tree property. (3 Marks)

b) Discuss in detail how a stack operates and state any TWO stack applications. (3 Marks)

c) Given an empty stack called "plates " with a maxsize of 6, using a diagram clearly show the status (position of the pointer top, the cell occupied by the element - where appropriate or the element displayed -where appropriate) of the stack when we:

i. Push(23)

ii. Push(10)

iii. Pop()

iv. Pop()

v. Pop() (10 Marks)

d) Given the following values; explain the execution steps of binary search algorithm to search for the number 3.

2, 3, 8, 16, 22, 27, 28, 36, 40, 48 (4 Marks)

QUESTION FOUR (20 MARKS)

a) Discuss how a circular queue operates and write algorithms to achieve the enqueue() and dequeue() operations in a circular queue. (8 Marks)

b) Citing an example discuss how a greedy algorithm works. (3 Marks)

c) You have been provided with the following values; 2, 10, 8, 5, 4, 16

Sort the values in an ascending order, clearly showing your working using:

i. Selection sort

ii. Insertion sort

iii. Bubble sort (9 Marks)

QUESTION FIVE (20 MARKS)

a) Citing examples discuss the THREE types of time complexities. (6 Marks)

b) Using a well labeled diagram(s) explain the following concepts of a tree

i. Degree

ii. Size

iii. Leaf nodes

iv. Level (8 Marks)

c) Convert the following infix expression into a binary tree: (2 + y) – (a * b) (3 Marks)

d) Discuss the major disadvantage brought about by linear queues, state the implementation of queues that solves the stated problem and discuss how it is solves it. (3 Marks)