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061306T4CSC

COMPUTER SCIENCE LEVEL 6

ICT/OS/CS/CR/08/6/A

UNDERSTAND ALGORITHMS AND DATA STRUCTURES

NOV/DEC 2023

TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

WRITTEN ASSESSMENT

TIME: 3 Hours

INSTRUCTIONS TO CANDIDATE

1. *The paper consists of **two** sections: **A** and **B***
2. *Answer **ALL** questions in Section **A** and any **Three** from section **B***
3. *Marks for each question are indicated in the brackets*
4. *A separate answer booklet will be provided*
5. *Do not write on the question paper*

Candidates should answer the questions in English

This paper consists of FOUR (4) printed pages

Candidates should check the question paper to ascertain that all pages are printed as indicated and that no questions are missing

SECTION A: (40 Marks)

(Answer all the questions in this section)

1. Define the following terms. (4 Marks)
    a) Data structure
    b) Algorithm analysis
    c) Arrays
    d) Stacks
2. Outline FOUR specific characteristics of algorithms that you would prioritize when creating an algorithm. (4 Marks)
3. Algorithm X and Algorithm Y are two sorting algorithms. Algorithm X has a time complexity of $O(n^2)$, while Algorithm Y has a time complexity of O(n log n). Which algorithm would you choose for sorting a large dataset? Justify your answer. (4 Marks)
4. Using a suitable example, state the difference between static and dynamic data structures. (4 Marks)
5. Basic operations form the foundation of stack functionality; Identify THREE basic operations within the stack. (3 Marks)
6. Write an algorithm that is used to implement enqueue operations as used in queue data structure. (4 Marks)
7. Searching algorithms are used for the purpose of determining the existence and/or position of a target element within a provided data structure. Explain the following terms:
    a) Hashing technique. (2 Marks)
    b) Linear search (2 Marks)
    c) Binary Search (2 Marks)
8. Write an algorithm for a simple program that will display the largest of the three numbers. (4 Marks)
9. Outline THREE factors that June should consider when selecting appropriate data structure. (3 Marks)
10. Use a binary search tree to sort the following data in ascending order: 8, 9, 7, 12, 5, 4, 6, 10, 13, 2. (4 Marks)

SECTION B (60 Marks)

(Answer any THREE questions in this section)

11.

a. Explain the term array as used in data structures? (2 Marks)

b. An array contains the following items {15,26, 37, 45, 59, 61, 75, 82}, write a program in C++ that will implement the following features:

   i. Initialize an array called numbers with the values given above. (2 Marks)

   ii. Uses a loop to print all the elements in the array. (6 Marks)

   iii. Write a statement that prints only the first element in the array. (2 Marks)

   iv. Delete the element at position 3 from the array. (4 Marks)

   v. Search for the element 61 in the array and print its position. (4 Marks)

12.

a. Explain any TWO reasons why you should implement a list over an array data structure. (2 Marks)

b. Consider a singly-linked list [5, 8, 12, 15]; insert the element 10 at position 2, delete element 12 at position 3 and reverse the order of elements. Write an algorithm to illustrates this singly-linked list. (10 Marks)

c. Linked lists are used to represent and manipulate polynomial. Discuss FOUR types of linked lists. (8 Marks)

13.

a. Searching algorithms are used to read a particular record from a collection of records, write algorithms to demonstrate the following searching techniques.

   i. Selection sort algorithm (4 Marks)

   ii. Bubble sort (4 Marks)

b. Using the following array as an example: {24,56, 47, 35, 10, 90, 82, 31}, explain the implementation of quick sort method. (4 Marks)

c. The merge sort algorithm is stated as follows: If we are required to sort an array, we can divide the array into two sub-arrays of about equal length, sort each sub-array separately, and finally merge the two sub-arrays. Write a method that accepts an unsorted integer array and use the above algorithm to sort the array. (8 Marks)

14.

a. Assuming a queue representation through circular array, write an algorithm for deletion of an element in the queue. (4 Marks)

b. Write a pseudocode that explain the insertion in a stack data structure. (6 Marks)

c. Show how the list {4,3,1,5,9, 15,10,16} can be sorted in ascending order using a bubble sort. (6 Marks)

d. Explain any TWO applications of each of the following data structures in computer programs:

   i. Queue: (2 Marks)

   ii. Stack: (2 Marks)

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