



COMSATS UNIVERSITY ISLAMABAD

DEPARTMENT OF COMPUTER SCIENCE

Terminal Exam Spring 2024

Course: CSC211 Data Structures & Algorithms	Date: June 6 th 2024
Class: BCT-3A	Instructor: Rashid Mehmood
Time Allowed: 3 Hours	Maximum Marks: 50

- All questions are self-explanatory and require no further explanations during exam time.
- Make sure that you have signed the attendance sheet before leaving the examination room.
- Return the question paper along with the answer sheet.
- Attempt all questions.

(CLO - 1: Employ linear data structures to solve computing problems.)

Question 1:

Marks 5

Suppose you are responsible for organizing the display space allocation for the Career Expo project competition at your university, featuring projects from various categories: web applications, smartphone applications, desktop applications, AI and ML-based applications, and hardware-based applications. Each category consists of 10 selected projects, making a total of 50 projects.

During the Career Expo event, various changes may occur that require adjustments to the display space allocation. Write C/C++ code for the following two situations. Also provide the required structures to represent the given scenario in system's memory.

- Project groups arrive at the event venue at different times, and their display space allocation should be determined based on their categories and arrival times. Impl
- ement the `insertByCategoryAndTime` function to accommodate the insertion of new project groups into the linked list.
- Throughout the event, project groups may withdraw from the competition, get disqualified, or experience technical difficulties, requiring their removal from the display space allocation. Implement the `deleteByGroupID` function to handle the deletion of project groups from the linked list.

Question 2:

Marks 5

Assume that you have already implemented the Stack Program. By using that, maintain the stack in such a way that value at top is always smallest one. You can't apply the sort method or can't use any additional ADT except stack.

Question 3:

Marks 5

The following picture shows that Ahmed, Javeria, Kamal and Bushra are standing in front of counter to be served.

- What kind of Data Structure can be used to implement the above Scenario?
- The variable `FRONT` points to (Name of person).
- The variable `REAR` points to (Name of person).
- When the counter person says "next" which operation is triggered?
- When Bushra leaves all move one step ahead, what kind of inefficiency you see in terms of coding?
- How this inefficiency can be resolved?
- If the store has the policy to serve aged persons first then which Abstract Data Type will be used for the Scenario?



(CLO - 2: Use non-linear data structures to solve computing problems.)

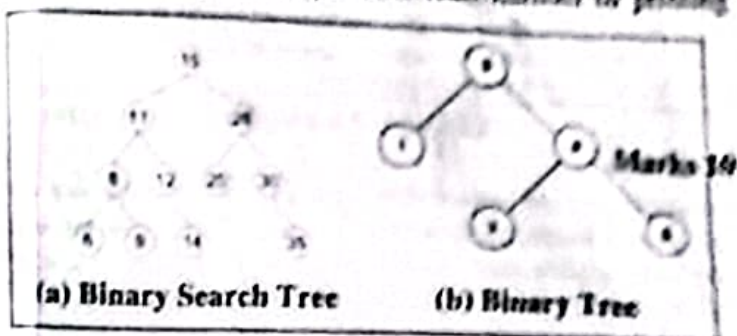
Question 4:

Marks 10

- Construct AVL tree for the following keys and show each rotation.

9	27	50	15	2	21	36
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- b) Consider a BST and a sum value. Write C/C++ code to display the pair(s) of nodes with the given sum.
Example: If sum is 32 for tree (a) in the given tree, then output pair will be 17 and 20.
- c) Write C/C++ code to determine if a dynamic Binary Tree is Binary Search Tree or not. For example in the given figure tree (a) is a Binary Search Tree but tree (b) is just a Binary Tree.
- d) Assume that you have to schedule printer jobs in the shortest job first fashion. Write the C/C++ code to organize all the requests for a printer in memory in such a way that request for least number of printing pages could be accessed in constant time. A printer job can be described by document id and number of pages.



Question 5:

Imagine planning a power distribution network, where connecting power stations to various consumption points requires minimizing the total distance covered by power lines. Each connection's distance influences the overall cost, comprising factors like terrain and infrastructure requirements. Details of consumption points connection and distance is given below

- Between A and C 15 miles
- Between B and C 20 miles
- Between B and D 25 miles
- Between C and E 30 miles
- Between D and E 35 miles
- Between E and F 40 miles
- Between E and G 45 miles
- Between F and G 50 miles

- a) Generate the Undirected Graph from above given information.
- b) Create Minimum spanning tree from the graph generated above using Kruskal's Algorithm.
- c) Write Kruskal's Algorithm Function Code in C/C++ with comments to elaborate where needed.

(CLO - 3: Analyze the time complexity of various algorithms.)

Question 6:

Marks 10

- a) Assume there are 100 candidates for a job interview. They all have same qualification but their job experience varies. Arrange them in descending order with respect to experience in years so that the employer could call the experienced candidates first for interview. Choose an efficient sorting algorithm for this and write C/C++ code for that.
- b) Assume there is a list of 100 employees stored in an ascending order with respect to their employee ids. You are required to write C/C++ function for searching an employee in that list such that the worst case complexity of that code should not go beyond $O(\log N)$.
- c) Assume you have the following keys: ISB, LHR, KHI, MUX, MUR, PESH, QUE, FSB, BWP, SGD, RWP and hash function is (sum of first and second letter code) mod 13. For example in ISB you just take the sum of letter code for I and letter code for S and then take the mod. The letter codes are given in the following table.

Note that multiple letters can have the same code. For example A, B and C all are assigned the code 1.

Letter	Code	Letter	Code	Letter	Code	Letter	Code
A, B, C	1	G, H, I	3	M, N, O	5	S, T, U	7
D, E, F	2	J, K, L	4	P, Q, R	6	V, W, X, Y, Z	8

1. You have a hash table with 13 buckets. Show how this hash table will be filled using linear probing.
2. You have a hash table with 13 buckets. Show how this hash table will be filled using chaining.

BEST OF LUCK