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Iqra University, Islamabad Campus
Faculty of Computing & Technology
Data Structures and Algorithms (CSC232)
Assignment # 4

Problem 1: [CLO1]

You are managing an online bookstore where books are organized based on their ISBN numbers (unique for each book). The bookstore uses a Binary Search Tree (BST) to efficiently store and retrieve book records. The ISBN numbers of the books are as follows:

18000, 15000, 30000, 20000, 10000, 25000, 35000.

Task:

1. Construct a Binary Search Tree (BST) using the given ISBN numbers.
2. The bookstore has implemented a feature to remove books that are out of stock. Write an algorithm and demonstrate the step-by-step procedure to delete the book with ISBN 20000 from the BST.
3. After deletion, ensure the BST property is maintained.

Problem 2: [CLO1]

An e-commerce platform uses a BST to store the discount percentages for various products. Each product is assigned a unique discount percentage.

Task:

1. Build a BST using the following discount percentages: 20, 10, 30, 5, 15, 25, 35.
2. Write an algorithm to find the product with the **highest discount**.
3. Write another algorithm to find the **second-highest discount** and explain the steps involved.

Problem 3: [CLO1]

A stock tracking system uses a BST to store daily closing prices of a stock. The system supports insertion, search, and finding the range of prices.

Task:

1. Build a BST using the following stock prices: 150, 120, 200, 100, 130, 180, 220.

2. Write an algorithm to find the price closest to 170 in the BST.
3. Demonstrate the process to delete the stock price 150 and show the updated BST.

Problem 4: [CLO1]

A social media platform models user interactions as a weighted directed graph. Each node represents a user, and each edge represents a mention or tag, with the weight indicating the number of mentions.

Task:

1. Create a graph for the following interactions:
    - User 1 → User 2 (mentions: 5), User 1 → User 3 (mentions: 3), User 2 → User 4 (mentions: 8), User 3 → User 4 (mentions: 2), User 4 → User 5 (mentions: 1).
2. Represent the graph in an adjacency matrix.
3. Find the shortest path from User 1 to User 5 based on the weights.
4. Determine the in-degree and out-degree for each user.
5. Convert the graph into a rooted tree with User 1 as the root.

Problem 5: [CLO1]

An airline models its flight routes as a weighted directed graph. Each node represents an airport, and each edge represents a flight route, with the weight indicating the flight duration (in hours).

Task:

1. Create a graph for the following flight routes:
    - Airport X → Y (duration: 2), X → Z (duration: 3), Y → W (duration: 4), Z → W (duration: 1), W → V (duration: 2).
2. Represent the graph using an adjacency matrix.
3. Find the shortest path from X to V.
4. Determine the in-degree and out-degree for each airport.
5. Convert the graph into a rooted tree with X as the root.

Problem 6: [CLO1]

A company models its supply chain as a weighted directed graph. Each node represents a supplier, and each edge represents a supply route, with the weight indicating the transportation cost.

Task:

1. Draw a graph for the following supply chain:
    - Supplier S1 → S2 (cost: 50), S1 → S3 (cost: 30), S2 → S4 (cost: 40), S3 → S4 (cost: 20), S4 → S5 (cost: 10).
2. Represent the graph in an adjacency matrix.
3. Calculate the shortest path from S1 to S5 based on transportation costs.
4. Find the in-degree and out-degree of each supplier.
5. Convert the graph into a rooted tree with S1 as the root.