National University of Computer and Emerging Sciences, Lahore Campus

Course Name:	Data Structures	Course Code:	CL2001
Program:	BS(CS)	Semester:	Fall 2023
Duration:	1.0 Hours	Total Marks:	50
Paper Date:	-Dec-23	Weight:	
Section:	BCS-3F	Pages:	2
Exam:	Quiz-2		

Student : Name: **Roll No.** **Section:**

Instruction/Notes:

Problem: Binary Search Tree (BST) Operations

You are tasked with implementing a class BST to manage a binary search tree. The class should support various operations on the tree, and you need to handle specific scenarios efficiently. Below are the tasks to be accomplished:

Task 1: Insertion and Path Sums

1. Implement the insert method to add keys to the BST.
2. Implement the pathSums method to return a vector containing the sums of keys along each path from the root to each leaf.

Task 2: Equality Check and Sub-Tree Verification

1. Overload the == operator to check if two BSTs have the exact same data.
2. Implement the isSubtree method to determine if one BST is a sub-tree of another.

Task 3: Subset Verification and Key Promotion

1. Implement the isSubset method to check if the data of one BST occurs in another.
2. Modify the searchAndPromote method to search for a key and promote it to the root efficiently.

Task 4: Breadth Calculation and Level Trimming

1. Implement the breadth method to calculate the breadth of the tree, considering the widest level.
2. Implement the trimBelowK method to recursively trim levels below a given level k.

Task 5: Lowest Common Ancestor

Implement the lowestCommonAncestor method to find the lowest common ancestor of two keys.

Additional Information:

- Ensure proper error handling and synchronization in your code.
- Optimize the methods to achieve efficient time complexities, especially for search and tree traversal operations.
- Provide a user-friendly interface for users to interact with the BST efficiently.

Challenge: Design the system to handle large and complex BST scenarios and optimize the methods for performance and scalability.