Experiment-6

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Semester: 6th **Date of Performance:**07/03/25
Subject Name: AP LAB-II **Subject Code:** 22ITP-351

Problem-1

1. Aim: Maximum Depth of Binary Tree Given the root of a binary tree, return its maximum depth.A binary tree's maximum depth is the number of nodes along the longest path from the root node down to the farthest leaf node.

2. Objective:

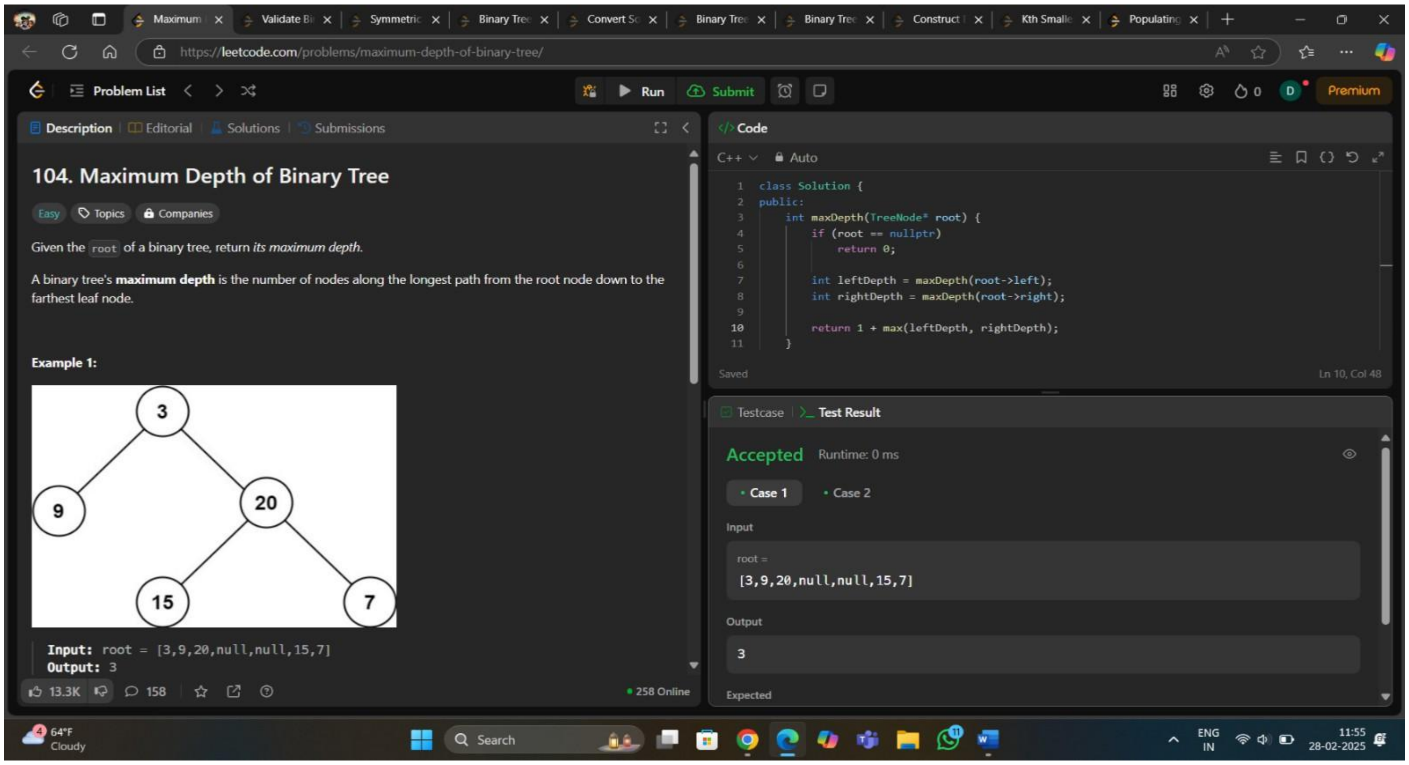
1. Learn how to recursively or iteratively compute the height (or depth) of a binary tree.

2. Understand the properties of a Binary Search Tree (BST).

3. Code:

```
class Solution {

public:

    int maxDepth(TreeNode* root) {

        if(root==nullptr){

            return 0;

        }

        int leftdepth=maxDepth(root->left);

        int rightdepth=maxDepth(root->right);



        return 1+max(leftdepth,rightdepth);

    }

};
```

4. Output:



104. Maximum Depth of Binary Tree

Given the `root` of a binary tree, return *its maximum depth*.

A binary tree's **maximum depth** is the number of nodes along the longest path from the root node down to the farthest leaf node.

Example 1:

```
Input: root = [3,9,20,null,null,15,7]
Output: 3
```

```
class Solution {
public:
    int maxDepth(TreeNode* root) {
        if (root == nullptr)
            return 0;

        int leftDepth = maxDepth(root->left);
        int rightDepth = maxDepth(root->right);

        return 1 + max(leftDepth, rightDepth);
    }
```

Accepted Runtime: 0 ms

Case 1 Case 2

Input

```
root =
[3,9,20,null,null,15,7]
```

Output

```
3
```

Expected

Problem-2

1. Aim:

a) Validate Binary Search Tree :Given the root of a binary tree, determine if it is a valid binary search tree (BST).A valid BST is defined as follows:

- left subtree of a node contains only nodes with keys less than the node's key.
- The right subtree of a node contains only nodes with keys greater than the node's key.
- Both the left and right subtrees must also be binary search trees.

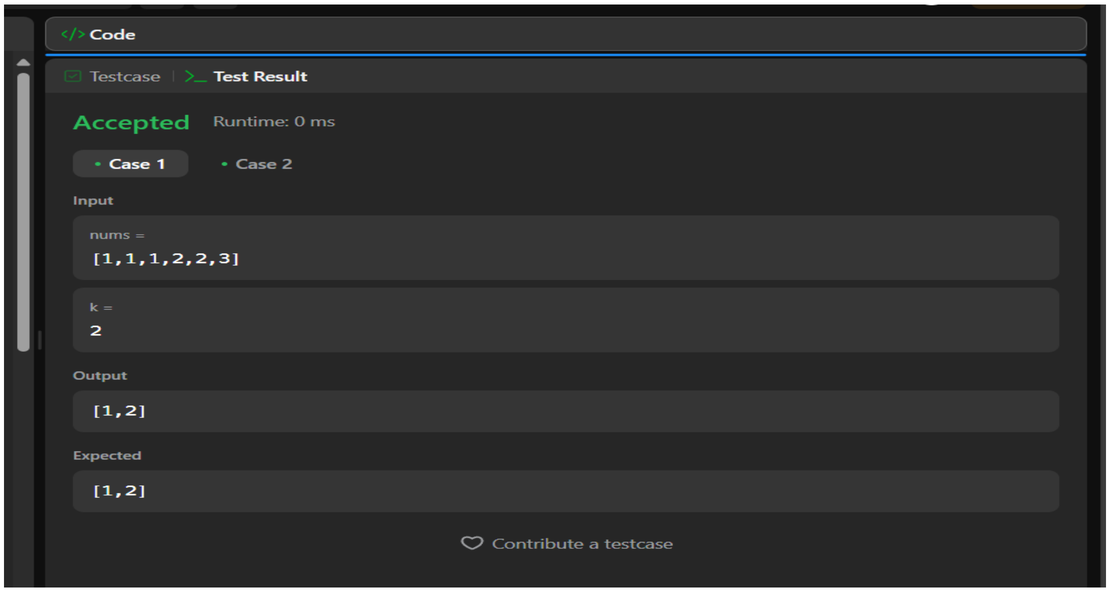
2. Objective:

- Understand mirror properties of a binary tree.
- Learn Breadth-First Search (BFS) using queues.

3. Code:

```
class Solution {

public:

    bool isValidBST(TreeNode* root) {
        return isValidBSTHelper(root, LONG_MIN, LONG_MAX);
    }

private:
    bool isValidBSTHelper(TreeNode* root, long minVal, long maxVal) {
        if (!root) return true;
        if (root->val <= minVal || root->val >= maxVal) return false;
        return isValidBSTHelper(root->left, minVal, root->val) &&
               isValidBSTHelper(root->right, root->val, maxVal);
    }
};
```

4. Output:



Accepted Runtime: 0 ms

```
Input
nums =
[1,1,1,2,2,3]
k =
2
Output
[1,2]
Expected
[1,2]
```

Problem-3

1. Aim:

Given the root of a binary tree, check whether it is a mirror of itself (i.e., symmetric around its center).

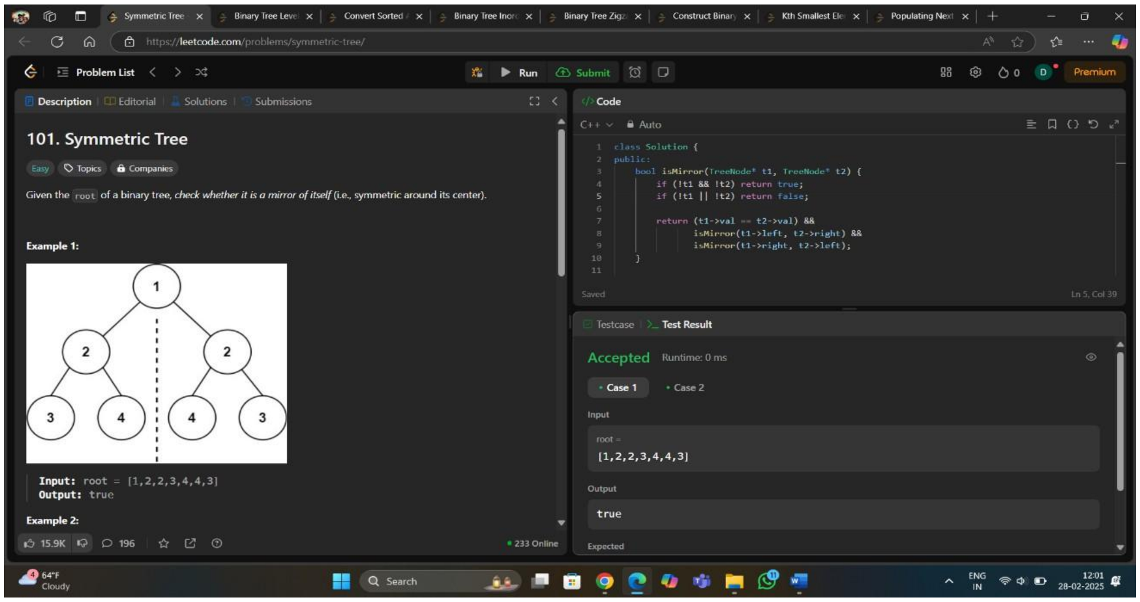
2. Objective:

- Learn Breadth-First Search (BFS) using queues.
- Learn how to construct a height-balanced BST from a sorted array.

3. Code:

```
      class Solution {

public:

    bool checkForSubTrees(TreeNode* p, TreeNode* q) {

        if (p == NULL && q == NULL) {

            return true;

        }

        if (p == NULL || q == NULL) {

            return false;

        }

        if (p->val != q->val) {

            return false;

        }



        bool leftSide = checkForSubTrees(p->left, q->right);

        bool rightSide = checkForSubTrees(p->right, q->left);

        if (leftSide && rightSide) {

            return true;

        }
        return false;

    }



    bool isSymmetric(TreeNode* root) {

        if (root == NULL || (root->left == NULL && root->right == NULL)) {

            return true;

        }

        if ((root->left == NULL && root->right != NULL) ||

            (root->left != NULL && root->right == NULL)) {

            return false;

        }



        return checkForSubTrees(root->left, root->right);

    }

};
```

4.Output:



101. Symmetric Tree

Given the `root` of a binary tree, *check whether it is a mirror of itself* (i.e., symmetric around its center).

Example 1:

```
Input: root = [1,2,2,3,4,4,3]
Output: true
```

Example 2:

```
class Solution {
public:
    bool isMirror(TreeNode* t1, TreeNode* t2) {
        if (!t1 && !t2) return true;
        if (!t1 || !t2) return false;

        return (t1->val == t2->val) &&
               isMirror(t1->left, t2->right) &&
               isMirror(t1->right, t2->left);
    }

```

Accepted Runtime: 0 ms

Input

```
root =
[1,2,2,3,4,4,3]
```

Output

```
true
```

Expected

Problem-4

1. **Aim**: Given the root of a binary tree, return *the level order traversal of its nodes' values*. (i.e., from left to right, level by level).

2. **Objective:**

- To find the median of two sorted array
- The overall run time complexity should be O(log (m+n)).

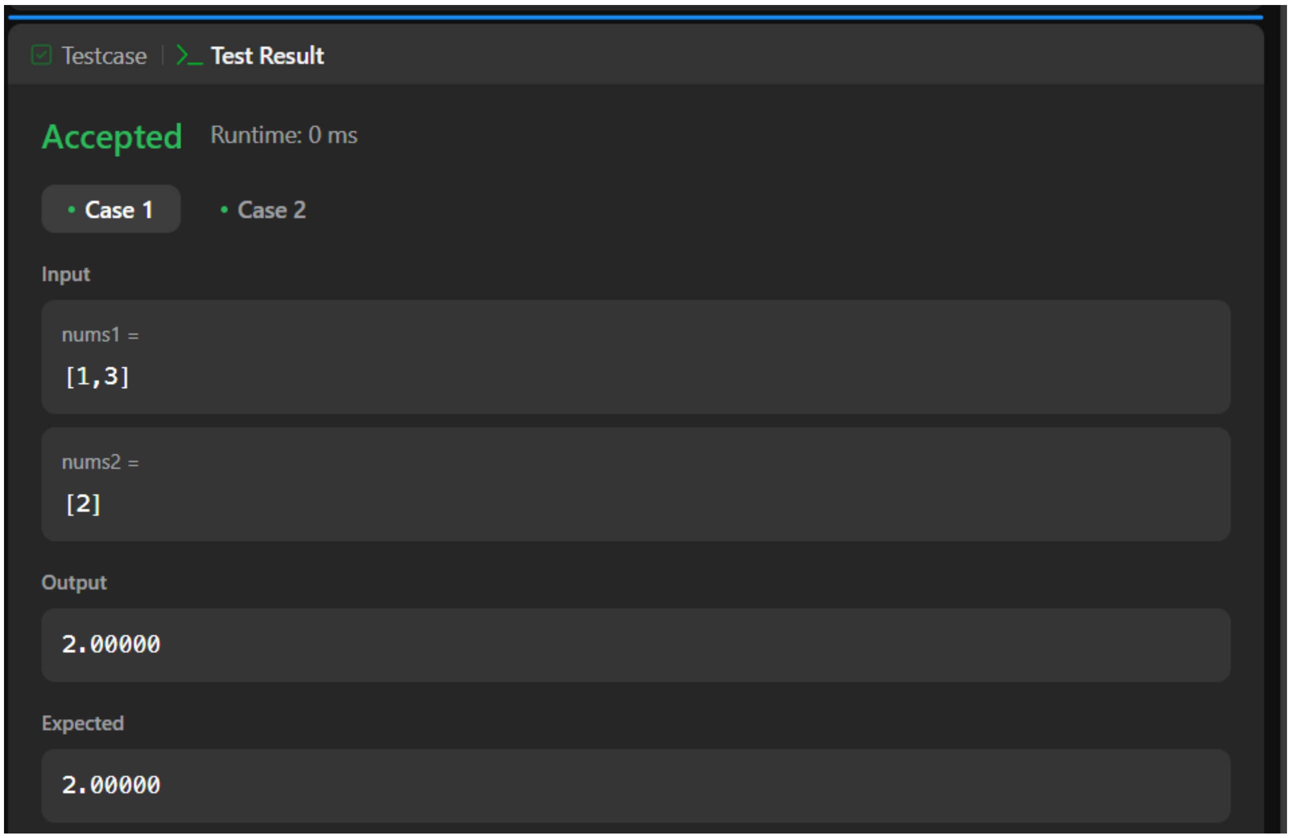
3. **Code:**

```
class Solution {

public:

double findMedianSortedArrays(vector<int> &nums1, vector<int> &nums2) {

    int n1 = nums1.size(), n2 = nums2.size();


// Ensure nums1 is the smaller array for simplicity

if (n1 > n2)

    return findMedianSortedArrays(nums2, nums1);


int n = n1 + n2;

int left = (n1 + n2 + 1) / 2; // Calculate the left partition size

int low = 0, high = n1;


while (low <= high) {

    int mid1 = (low + high) >> 1; // Calculate mid index for nums1

    int mid2 = left - mid1; // Calculate mid index for nums2


    int l1 = INT_MIN, l2 = INT_MIN, r1 = INT_MAX, r2 = INT_MAX;
```

```
// Determine values of l1, l2, r1, and r2

if (mid1 < n1)

    r1 = nums1[mid1];

if (mid2 < n2)

    r2 = nums2[mid2];

if (mid1 - 1 >= 0)

    l1 = nums1[mid1 - 1];

if (mid2 - 1 >= 0)

    l2 = nums2[mid2 - 1];


if (l1 <= r2 && l2 <= r1) {

    // The partition is correct, we found the median

    if (n % 2 == 1)

        return max(l1, l2);

    else

        return ((double)(max(l1, l2) + min(r1, r2))) / 2.0;

}

else if (l1 > r2) {

    // Move towards the left side of nums1

    high = mid1 - 1;

}

else {

    // Move towards the right side of nums1

    low = mid1 + 1;
```

```
            }

        }



        return 0; // If the code reaches here, the input arrays were not sorted.

    }

};
```

4. Output:



Accepted Runtime: 0 ms

Input

nums1 =
[1,3]

nums2 =
[2]

Output

2.00000

Expected

2.00000

Problem-5

1. **Aim:** Given an integer array nums where the elements are sorted in ascending order, convert it to a height-balanced binary search tree.

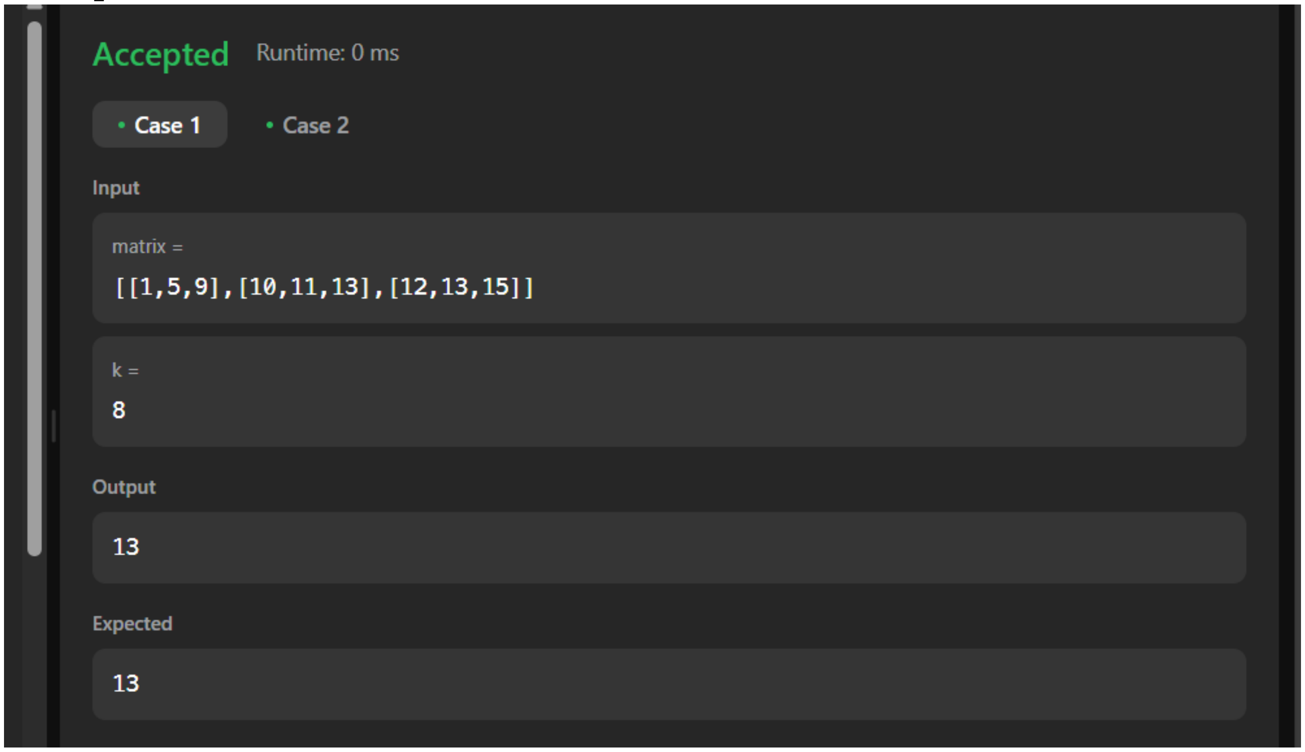
2. **Objective:**

- kth smallest element in the sorted order, not the kth distinct element.

3. **Code:**

```
    class Solution {
public:
    int kthSmallest(vector<vector<int>>& matrix, int z) {
        int n = matrix.size(), m = matrix[0].size();
        int a[n*m], k=0;
        for(int i=0; i<n; i++){
            for(int j=0; j<m; j++){
                a[k] = matrix[i][j];
                k++;
            }
        }
        sort(a, a+(n*m));
        return a[z-1];
    }
};
```

4. Output:



```
Accepted   Runtime: 0 ms
• Case 1   • Case 2
Input
matrix =
[[1,5,9],[10,11,13],[12,13,15]]
k =
8
Output
13
Expected
13
```

Problem-6

1. Aim: Given the root of a binary tree, return the inorder traversal of its nodes' values.

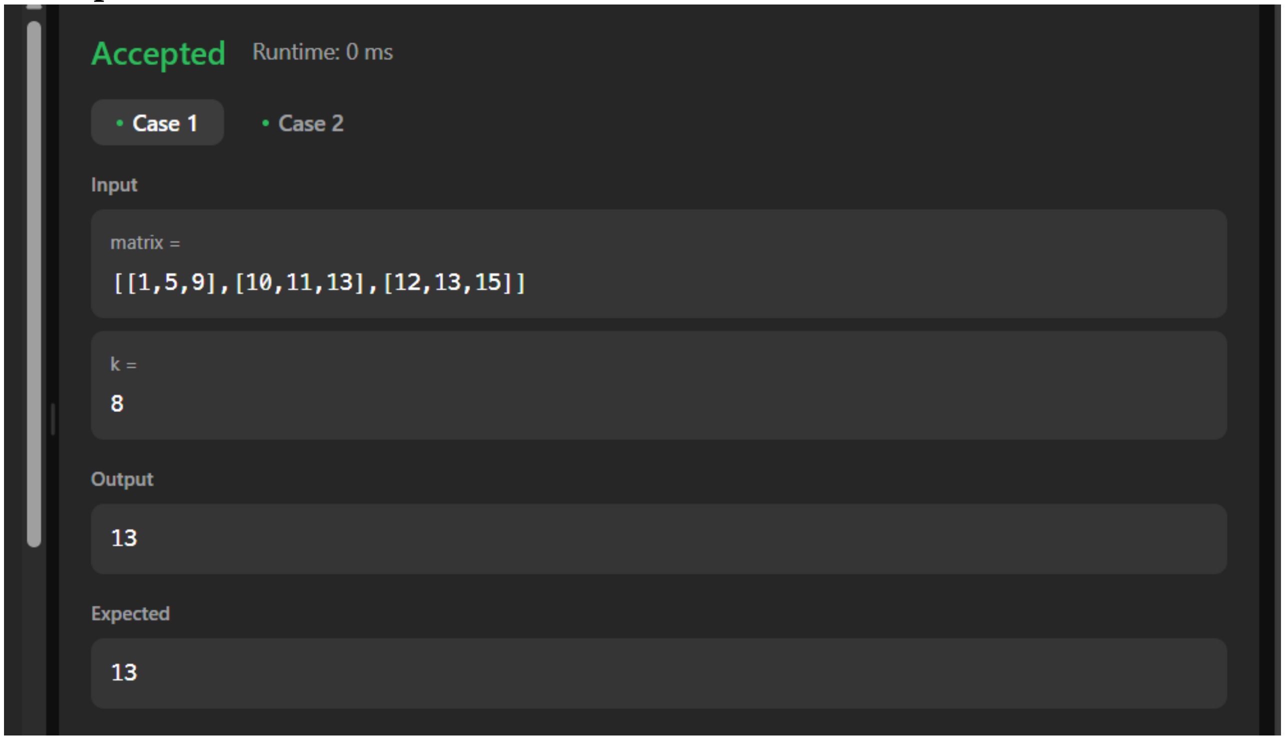
2. Objective:

- kth smallest element in the sorted order, not the kth distinct element.

3. Code:

```
     class Solution {
 public:
    int kthSmallest(vector<vector<int>>& matrix, int z) {
        int n = matrix.size(), m = matrix[0].size();
        int a[n*m], k=0;
        for(int i=0; i<n; i++){

            for(int j=0; j<m; j++){

                a[k] = matrix[i][j];

                k++;

            }

        }

        sort(a, a+(n*m));

        return a[z-1];

    }

};
```

4. Output:



```
Accepted   Runtime: 0 ms

Case 1   Case 2

Input
matrix =
[[1,5,9],[10,11,13],[12,13,15]]
k =
8

Output
13

Expected
13
```

Problem-7

1. **Aim**: Given the root of a binary tree, return the zigzag level order traversal of its nodes' values. (i.e., from left to right, then right to left for the next level and alternate between).

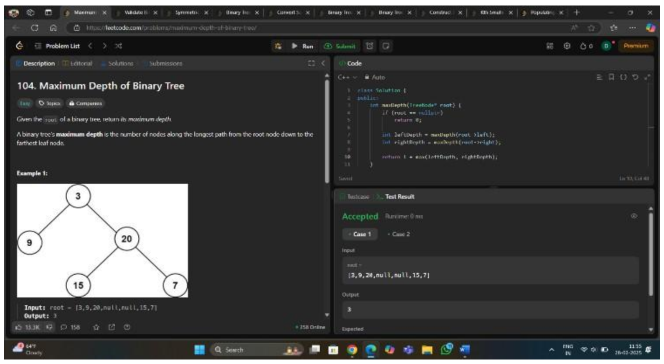
2. **Objective:**
3. Learn how to recursively or iteratively compute the height (or depth) of a binary tree.

4. Understand the properties of a Binary Search Tree (BST).

3. **Code:**

```
class Solution {

public:

    int maxDepth(TreeNode* root) {

        if(root==nullptr){

            return 0;

        }

        int leftdepth=maxDepth(root->left);

        int rightdepth=maxDepth(root->right);



        return 1+max(leftdepth,rightdepth);

    }

};
```

4. **Output:**



104. Maximum Depth of Binary Tree

Given the root of a binary tree, return its maximum depth.

A binary tree's **maximum depth** is the number of nodes along the longest path from the root node down to the farthest leaf node.

Example 1:

```
Input: root = [3,9,20,null,null,15,7]
Output: 3
```

```
class Solution {
public:
    int maxDepth(TreeNode* root) {
        if (root == nullptr)
            return 0;

        int leftDepth = maxDepth(root->left);
        int rightDepth = maxDepth(root->right);

        return 1 + max(leftDepth, rightDepth);
    }
```

Accepted Runtime: 0 ms

Case 1 Case 2

Input
```
root =
[3,9,20,null,null,15,7]
```
Output
```
3
```
Expected

Problem-8

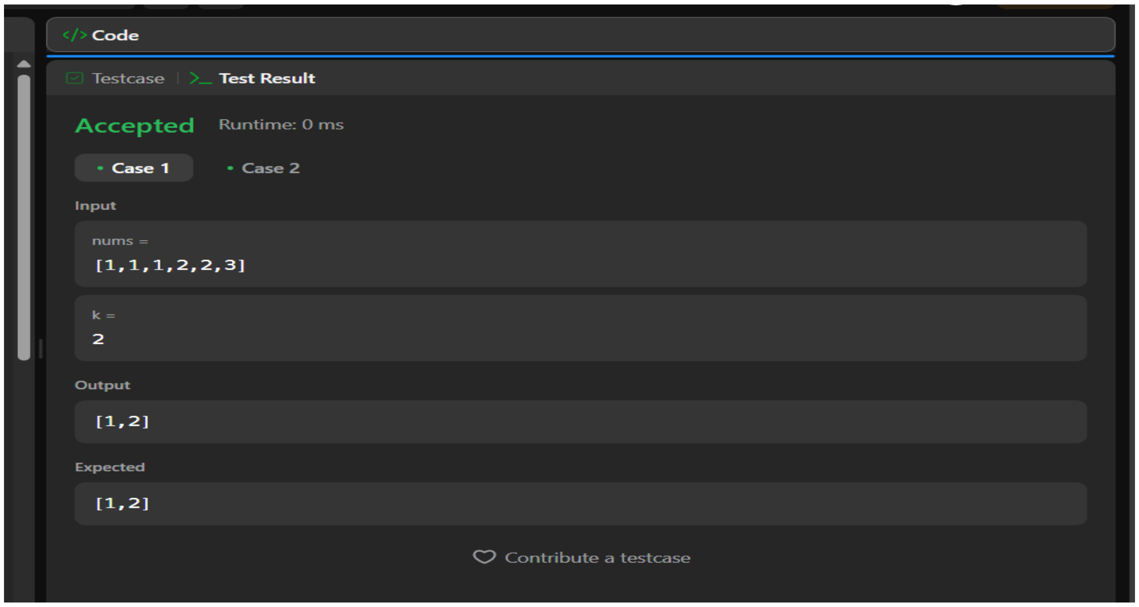
1. Aim:
Given two integer arrays inorder and postorder where inorder is the inorder traversal of a binary tree and postorder is the postorder traversal of the same tree, construct and return the binary tree.

2. Objective:
- Understand mirror properties of a binary tree.
- Learn Breadth-First Search (BFS) using queues.

3. Code:

```
class Solution {

public:

    bool isValidBST(TreeNode* root) {

        return isValidBSTHelper(root, LONG_MIN, LONG_MAX);

    }



private:

    bool isValidBSTHelper(TreeNode* root, long minVal, long maxVal) {

        if (!root) return true;

        if (root->val <= minVal || root->val >= maxVal) return false;

        return isValidBSTHelper(root->left, minVal, root->val) &&

               isValidBSTHelper(root->right, root->val, maxVal);

    }

};
```

4. Output:



Accepted Runtime: 0 ms

Case 1 Case 2

Input

```
nums =
[1,1,1,2,2,3]
k =
2
```

Output

```
[1,2]
```

Expected

```
[1,2]
```

Problem-9

1. Aim:

Given the root of a binary search tree, and an integer k, return the kth smallest value (1-indexed) of all the values of the nodes in the tree.

2. Objective:

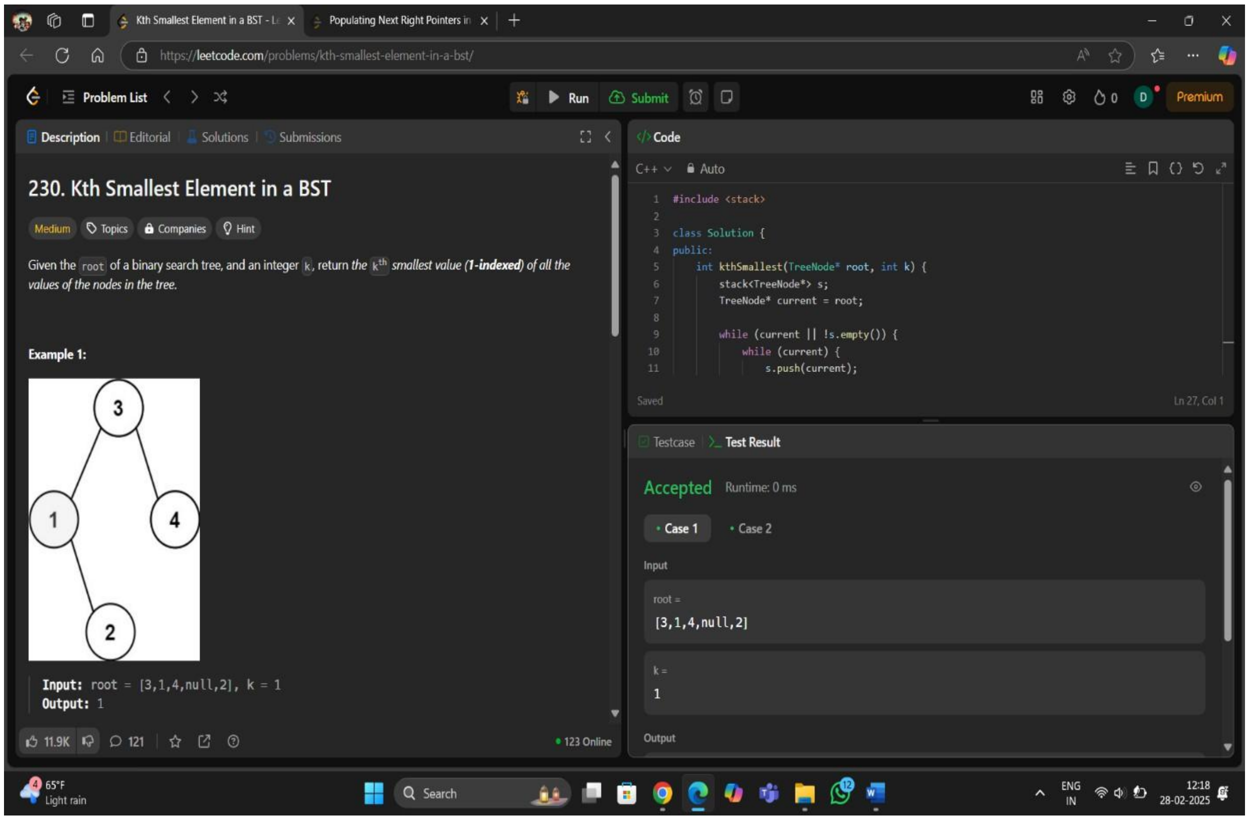
- Learn Breadth-First Search (BFS) using queues.
- Learn how to construct a height-balanced BST from a sorted array.

3. Code:

```
    class Solution {
public:
  bool checkForSubTrees(TreeNode* p, TreeNode* q) {
    if (p == NULL && q == NULL) {
      return true;
    }

    if (p == NULL || q == NULL) {

        return false;

    }

    if (p->val != q->val) {

        return false;

    }



    bool leftSide = checkForSubTrees(p->left, q->right);

    bool rightSide = checkForSubTrees(p->right, q->left);

    if (leftSide && rightSide) {

        return true;

    }

    return false;

}



bool isSymmetric(TreeNode* root) {

    if (root == NULL || (root->left == NULL && root->right == NULL)) {

        return true;

    }

    if ((root->left == NULL && root->right != NULL) ||

        (root->left != NULL && root->right == NULL)) {

        return false;

    }
```

```
        return checkForSubTrees(root->left, root->right);

    }

};
```

4.Output:



Kth Smallest Element in a BST - L
Populating Next Right Pointers in
https://leetcode.com/problems/kth-smallest-element-in-a-bst/
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28-02-2025

230. Kth Smallest Element in a BST

Given the `root` of a binary search tree, and an integer `k`, return *the* `k`th *smallest value (**1-indexed**) of all the values of the nodes in the tree.*

Example 1:

```
Input: root = [3,1,4,null,2], k = 1
Output: 1
```

C++ Auto

```
#include <stack>

class Solution {
public:
    int kthSmallest(TreeNode* root, int k) {
        stack<TreeNode*> s;
        TreeNode* current = root;

        while (current || !s.empty()) {
            while (current) {
                s.push(current);
```

Saved   Ln 27, Col 1

Accepted Runtime: 0 ms

Case 1 Case 2

Input

```
root =
[3,1,4,null,2]
```

```
k =
1
```

Output

Problem-10

1. Aim: You are given a perfect binary tree where all leaves are on the same level, and every parent has two children. The binary tree has the following definition:

```
struct Node {
int val;
Node *left;
Node *right;
Node *next;
}
```

Populate each next pointer to point to its next right node. If there is no next right node, the next pointer should be set to NULL.
Initially, all next pointers are set to NULL.

2. Objective:

- To find the median of two sorted array
- The overall run time complexity should be O(log (m+n)).

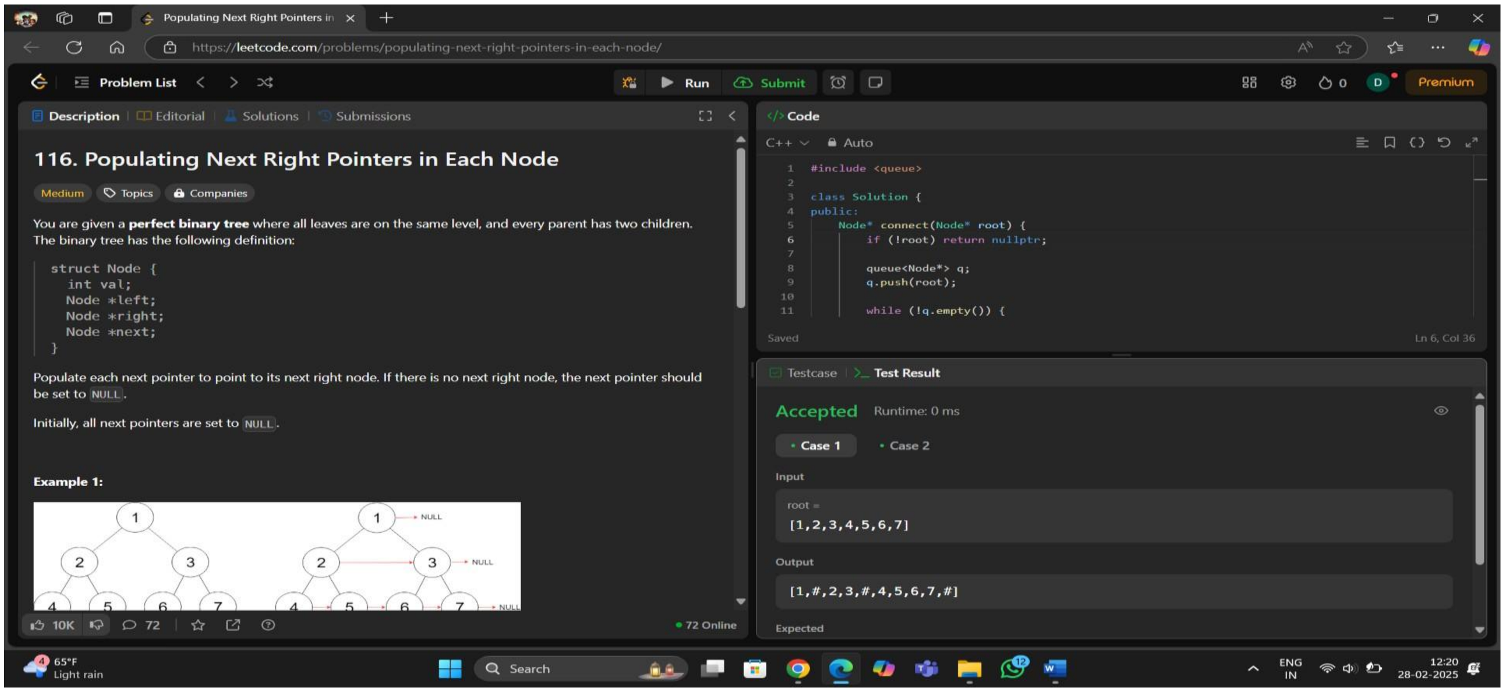
3. Code:

```
class Solution {

public:

double findMedianSortedArrays(vector<int> &nums1, vector<int> &nums2) {

    int n1 = nums1.size(), n2 = nums2.size();


// Ensure nums1 is the smaller array for simplicity

if (n1 > n2)

    return findMedianSortedArrays(nums2, nums1);


int n = n1 + n2;

int left = (n1 + n2 + 1) / 2; // Calculate the left partition size

int low = 0, high = n1;


while (low <= high) {

    int mid1 = (low + high) >> 1; // Calculate mid index for nums1

    int mid2 = left - mid1; // Calculate mid index for nums2


    int l1 = INT_MIN, l2 = INT_MIN, r1 = INT_MAX, r2 = INT_MAX;


    // Determine values of l1, l2, r1, and r2
```

```
        if (mid1 < n1)

            r1 = nums1[mid1];

        if (mid2 < n2)

            r2 = nums2[mid2];

        if (mid1 - 1 >= 0)

            l1 = nums1[mid1 - 1];

        if (mid2 - 1 >= 0)

            l2 = nums2[mid2 - 1];



        if (l1 <= r2 && l2 <= r1) {

            // The partition is correct, we found the median

            if (n % 2 == 1)

                return max(l1, l2);

            else

                return ((double)(max(l1, l2) + min(r1, r2))) / 2.0;

        }

        else if (l1 > r2) {

            // Move towards the left side of nums1

            high = mid1 - 1;

        }

        else {

            // Move towards the right side of nums1

            low = mid1 + 1;

        }

    }
```

```
        return 0; // If the code reaches here, the input arrays were not sorted.
    }
};
```

4. Output:


Populating Next Right Pointers in

https://leetcode.com/problems/populating-next-right-pointers-in-each-node/

116. Populating Next Right Pointers in Each Node

Medium

You are given a **perfect binary tree** where all leaves are on the same level, and every parent has two children. The binary tree has the following definition:

```
struct Node {
  int val;
  Node *left;
  Node *right;
  Node *next;
}
```

Populate each next pointer to point to its next right node. If there is no next right node, the next pointer should be set to NULL.

Initially, all next pointers are set to NULL.

Example 1:

```
#include <queue>

class Solution {
public:
    Node* connect(Node* root) {
        if (!root) return nullptr;

        queue<Node*> q;
        q.push(root);

        while (!q.empty()) {
```

Saved   Ln 6, Col 36

Test Result

Accepted   Runtime: 0 ms

Case 1   Case 2

Input

root =

```
[1,2,3,4,5,6,7]
```

Output

```
[1,#,2,3,#,4,5,6,7,#]
```

Expected