Experiment 6

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Subject: Advanced Programming - 2	**Subject Code:** 22ITP-351

Problem 1. 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.

Code:

```cpp
class Solution { public:
    int maxDepth(TreeNode* root) {
if(root==NULL){
        return 0;
    }
    int lheight=maxDepth(root->left);
int rheight=maxDepth(root->right);
    return max(lheight,rheight)+1;
  }
};
```
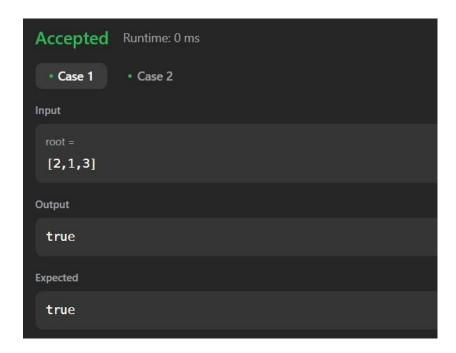
Output:

Accepted   Runtime: 0 ms

• Case 1   • Case 2

Input

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

Output

3

Expected

3

Problem 2. Given the root of a binary tree, *determine if it is a valid binary search tree (BST)*.
A **valid BST** is defined as follows:

- The 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.

Code:

```
class Solution {

bool isPossible(TreeNode* root, long long l, long long r){
    if(root == nullptr)  return true;    if(root->val < r and
root->val > l)        return isPossible(root->left, l, root-
>val) and                          isPossible(root->right,
root->val, r);    else return false; }

public:
    bool isValidBST(TreeNode* root) {
        long long int min = -1000000000000, max = 1000000000000;
return isPossible(root, min, max);
    }
};
```
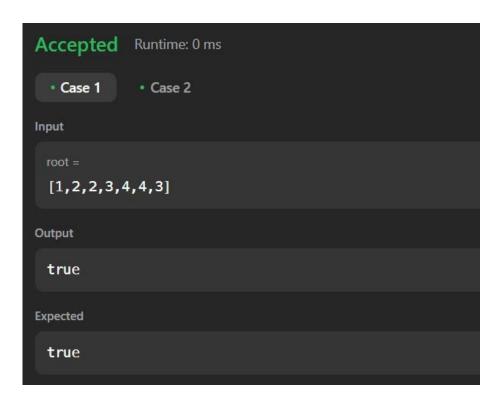
Output:

```
Accepted   Runtime: 0 ms

• Case 1      • Case 2

Input

root =
[2,1,3]

Output

true

Expected

true
```

Problem 3. Given the root of a binary tree, *check whether it is a mirror of itself* (i.e., symmetric around its center).

Code:

```
class Solution { public:
    bool isMirror(TreeNode* left, TreeNode* right) {
    if (!left && !right) return true;    if (!left || !right) return false;    return (left->val == right->val) && isMirror(left->left, right->right) && isMirror(left->right, right->left);
}

bool isSymmetric(TreeNode* root) {
    if (!root) return true;    return isMirror(root->left, root->right);
}
};
```

Output:

Accepted   Runtime: 0 ms

• Case 1   • Case 2

Input

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

Output

true

Expected

true

Problem 4. 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).

Code:

```cpp
class Solution { public:    vector<vector<int>>
levelOrder(TreeNode* root) {
        vector<vector<int>>
ans;        if (!root) return ans;
        queue<TreeNode*> q;
q.push(root);        while (!q.empty())
{            int level_size = q.size();
vector<int> level;            for (int i =
0; i < level_size; ++i) {
TreeNode* node = q.front();
q.pop();
level.push_back(node->val);

            if (node->left) q.push(node->left);
            if (node->right) q.push(node->right);
        }
        ans.push_back(level);
    }
    return ans;
  }
};
```

Output:

Accepted   Runtime: 0 ms

• Case 1   • Case 2   • Case 3

Input

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

Output

[[3],[9,20],[15,7]]

Expected

[[3],[9,20],[15,7]]

Problem 5. Given an integer array nums where the elements are sorted in **ascending order**, convert *it to a **height-balanced** binary search tree*.

Code:

```cpp
#include <vector> using
namespace std;

class Solution { public:
    TreeNode* sortedArrayToBST(vector<int>& nums) {
return helper(nums, 0, nums.size() - 1);
    }

private:
    TreeNode* helper(vector<int>& nums, int left, int right) {
if (left > right) return nullptr;
        int mid = left + (right - left) / 2;
        TreeNode* root = new TreeNode(nums[mid]);
root->left = helper(nums, left, mid - 1);          root-
>right = helper(nums, mid + 1, right);          return
root;
    }
};
```

Output:

Accepted Runtime: 0 ms

• Case 1   • Case 2

Input

```
nums =
[−10,−3,0,5,9]
```

Output

```
[0,−10,5,null,−3,null,9]
```
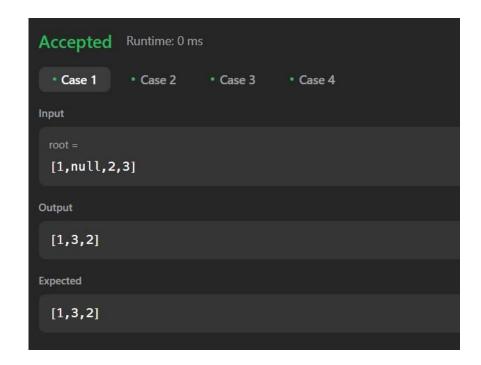
Expected

```
[0,−3,9,−10,null,5]
```

Problem 6.

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

Code:

```cpp
class Solution { public:    vector<int>
inorderTraversal(TreeNode* root) {    vector<int>
ans;
   if (root == NULL) return ans;    vector<int>
left = inorderTraversal(root->left);
ans.insert(ans.end(), left.begin(), left.end());
   ans.push_back(root->val);    vector<int> right =
inorderTraversal(root->right);
ans.insert(ans.end(), right.begin(), right.end());
return ans;
}
};
```

Output:

Accepted   Runtime: 0 ms

• **Case 1**   • Case 2   • Case 3   • Case 4

Input

root =
[1,null,2,3]

Output

[1,3,2]

Expected

[1,3,2]

Problem 7. 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.*

Code:

```cpp
class Solution {
public:
    TreeNode* buildTree(vector<int>& inorder, vector<int>& postorder) {
unordered_map<int, int> index;        for (int i = 0; i < inorder.size(); i++)
{            index[inorder[i]] = i;
    }
    return buildTreeHelper(inorder, postorder, 0, inorder.size() - 1, 0, postorder.size() - 1, index);
  }

    TreeNode* buildTreeHelper(vector<int>& inorder, vector<int>& postorder, int inorderStart, int
inorderEnd, int postorderStart, int postorderEnd, unordered_map<int, int>& index) {        if
(inorderStart > inorderEnd || postorderStart > postorderEnd) {            return nullptr;
    }
    int rootVal = postorder[postorderEnd];
TreeNode* root = new TreeNode(rootVal);        int
inorderRootIndex = index[rootVal];
    int leftSubtreeSize = inorderRootIndex - inorderStart;
    root->left = buildTreeHelper(inorder, postorder, inorderStart, inorderRootIndex - 1,
postorderStart, postorderStart + leftSubtreeSize - 1, index);
    root->right = buildTreeHelper(inorder, postorder, inorderRootIndex + 1, inorderEnd,
postorderStart + leftSubtreeSize, postorderEnd - 1, index);        return root;
  } };
```

Problem 8.
Output:

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.*

Code:

```cpp
class Solution {
public:
    void preOrderTraversal(TreeNode* root, vector<int> &v){
if(root == NULL)    return;

        //root, left, right
        v.push_back(root->val);        preOrderTraversal(root->left, v);
        preOrderTraversal(root->right, v);
    }
    int kthSmallest(TreeNode* root, int k) {
        vector<int> v;
preOrderTraversal(root, v);
sort(v.begin(), v.end());        return
v[k-1];
    }
```

};

Output:

Accepted   Runtime: 0 ms

• Case 1   • Case 2

Input

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

k =
1

Output

1

Expected

1

Problem 10.

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

Code:

```
class Solution { public:
    Node* connect(Node* root) {
if(!root) return nullptr;
queue<Node*> q;        q.push(root);
while(size(q)) {
        Node* rightNode = nullptr;
for(int i = size(q); i; i--) {
auto cur = q.front(); q.pop();
cur -> next = rightNode;
rightNode = cur;
if(cur -> right)
            q.push(cur -> right),
            q.push(cur -> left);
    }
}
    return root;
  }
};
```

Output:

Problem 11.

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

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

Given an n x n matrix where each of the rows and columns is sorted in ascending order, return *the* kth *smallest element in the matrix.*

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];
   }
};
```

Problem 12.

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