DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

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Experiment-6

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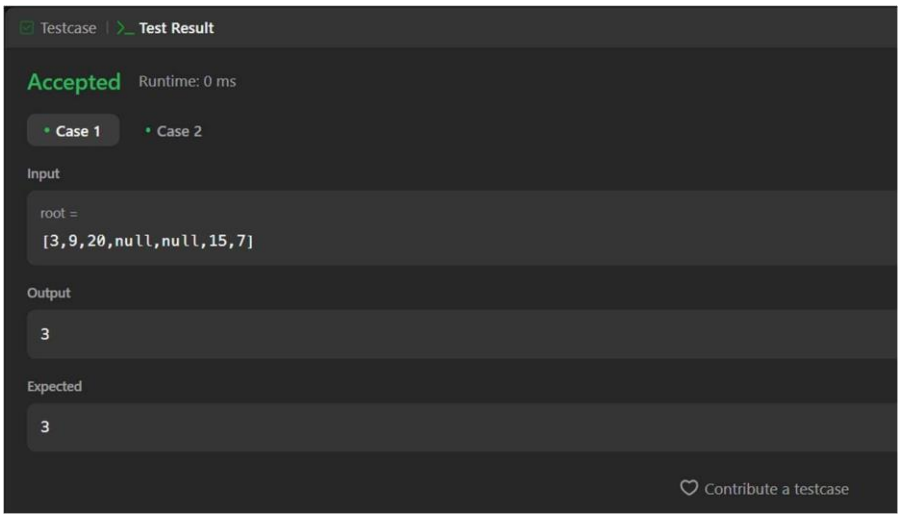
Subject Code: 22ITP-351

Problem 1. Maximum Depth of Binary Tree

- Code:

```
class Solution {
public:
    int maxDepth(TreeNode* root)
        { if (root == nullptr) { return
        0;
        } int leftDepth = maxDepth(root->left);
    int rightDepth = maxDepth(root->right);
    return max(leftDepth, rightDepth) + 1; }
};
```

- Output:



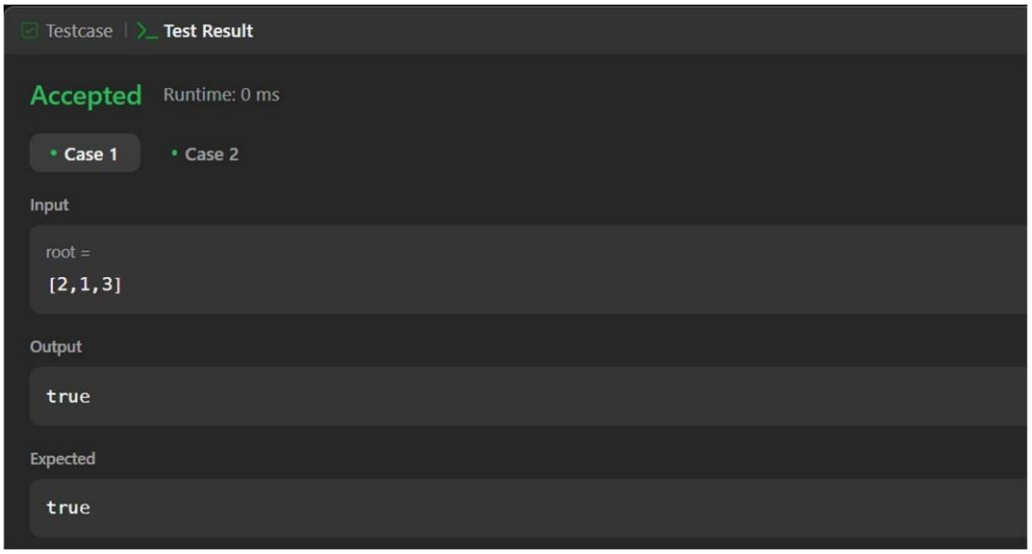
Problem 2. Validate Binary Search Tree

- Code:

```
class Solution { public:
    bool isValidBST(TreeNode* root) {
      return isValidBSTHelper(root, LONG_MIN, LONG_MAX);
    }

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

- Output:



Problem 3. Symmetric Tree

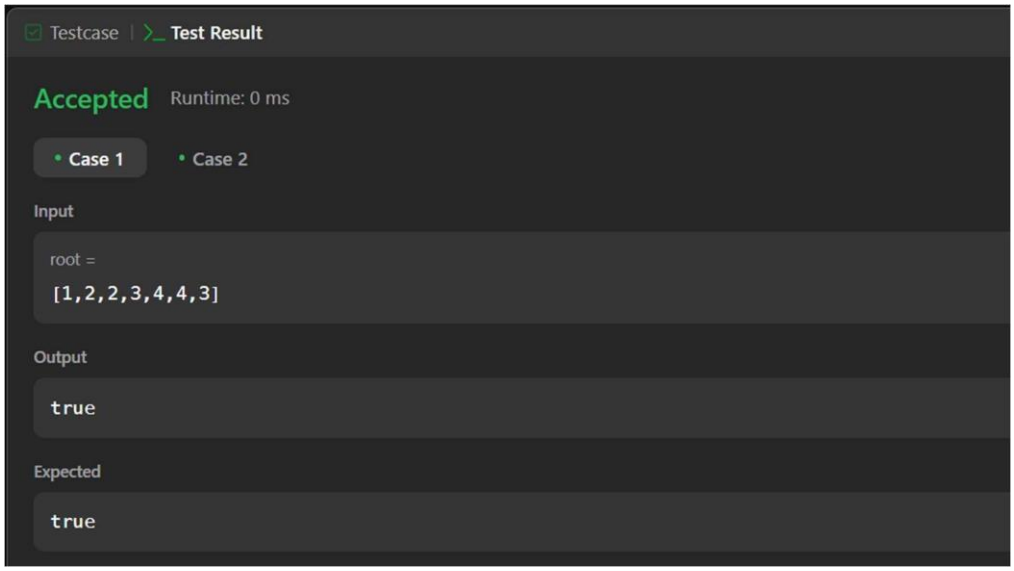
- Code:

```
class Solution { public:
  bool isSymmetric(TreeNode* root) {
    if (root == nullptr) { return true;
    }
```

```
        return  isMirror(root->left,  root->right);
    }

    bool isMirror(TreeNode* left, TreeNode* right) {
        if (left == nullptr && right == nullptr) { return
        true;
        }
        if (left == nullptr || right == nullptr) { return
            false;
        }
        return (left->val == right->val) && isMirror(left->left, right->right) &&
    isMirror(left->right, right->left); }
};
```

- Output:



Problem 4. Binary Tree Level Order Traversal

- Code:

```
class Solution { public:
    vector<vector<int>> levelOrder(TreeNode* root) {
        vector<vector<int>> result; if
        (root == nullptr) {
            return result;
        }
```

```
        queue<TreeNode*> q;
        q.push(root);      while
        (!q.empty()) {
           int levelSize = q.size(); vector<int>
           currentLevel; for (int i = 0; i <
           levelSize; ++i) { TreeNode* node =
           q.front();                    q.pop();
           currentLevel.push_back(node->val);
           if (node->left) {
                q.push(node-
              >left); } if (node-
              >right) {
                 q.push(node->right);
              }
           }
           result.push_back(currentLevel);
        }       return
        result;
     }
};
```

- Output:

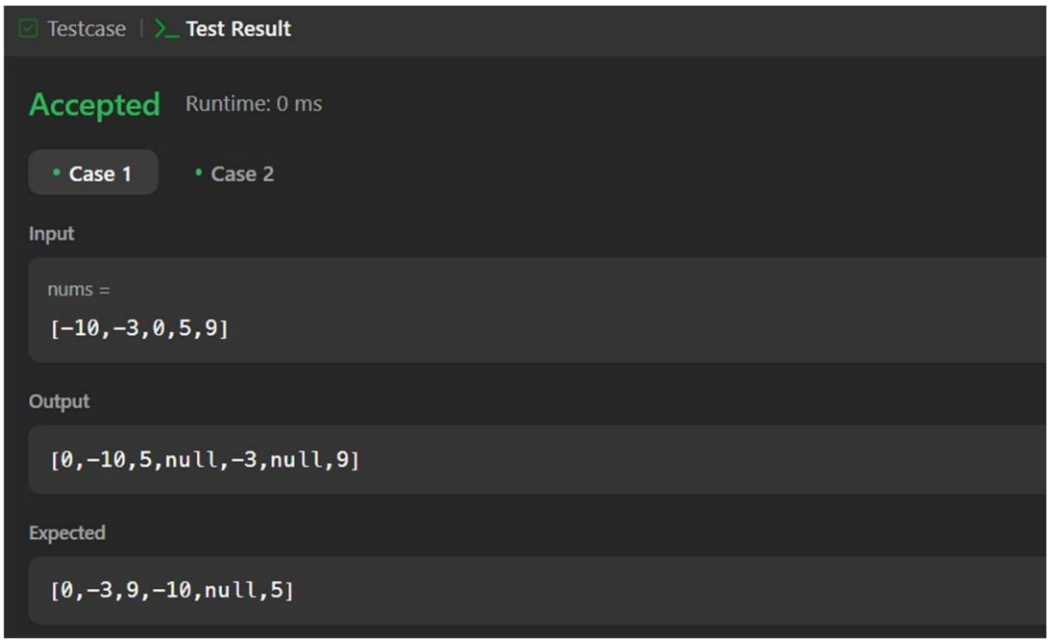
Problem 5. Convert Sorted Array to Binary Search Tree

- Code:

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

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

- Output:



Problem 6. Binary Tree Inorder Traversal

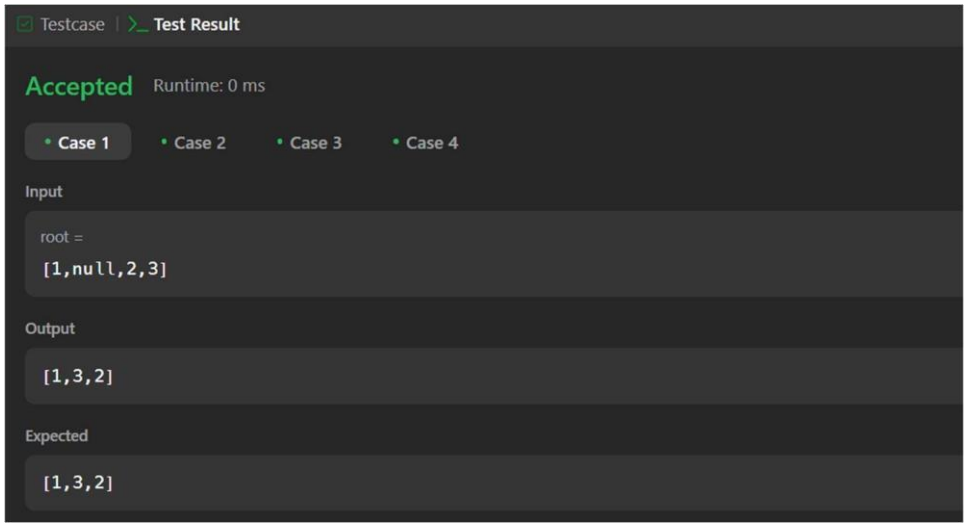
- Code:

```
class Solution { public:
```

```
vector<int> inorderTraversal(TreeNode* root) {
    vector<int> result; inorderTraversalHelper(root,
    result);
    return result;
}

void inorderTraversalHelper(TreeNode* root, vector<int>& result) {
    if (root == nullptr) {
        return; }
    inorderTraversalHelper(root->left,    result);    result.push_back(root-
    >val);
    inorderTraversalHelper(root->right, result); }
};
```

- Output:



Problem 7. Construct Binary Tree from Inorder and Postorder Traversal

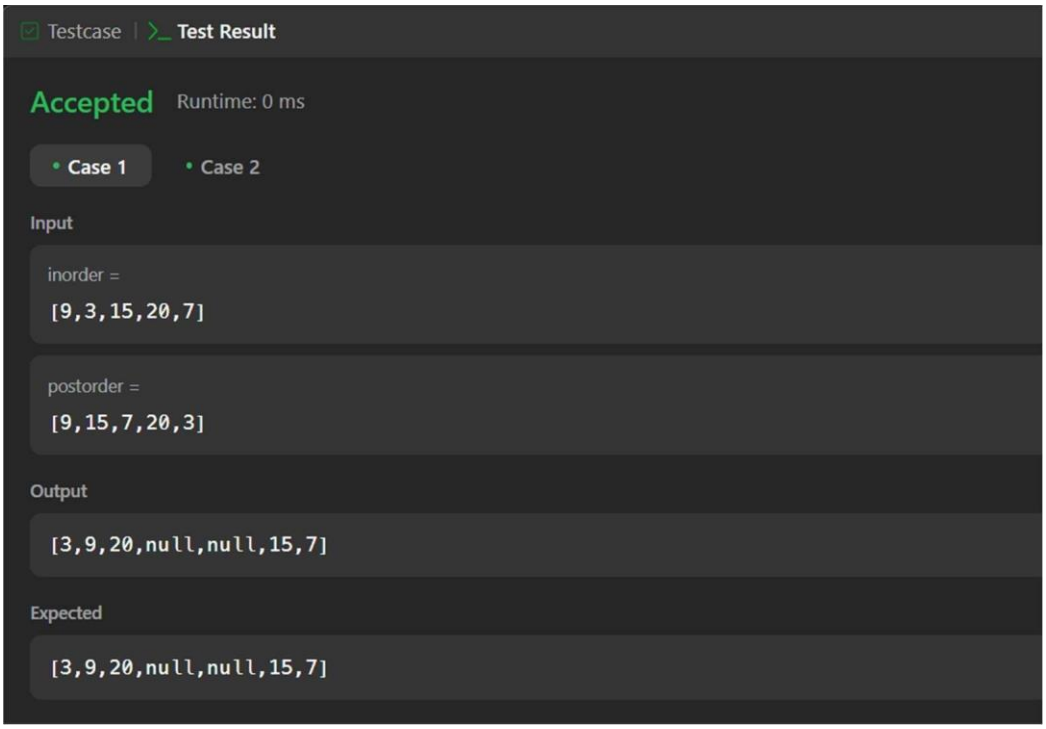
- Code:

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

```
        }
        return buildTreeHelper(inorder, postorder, 0, inorder.size() - 1, postIndex, inMap); }

    TreeNode* buildTreeHelper(vector<int>& inorder, vector<int>& postorder, int inStart, int inEnd,
int& postIndex, unordered_map<int, int>& inMap) { if (inStart > inEnd) { return nullptr;
        }
        TreeNode* root = new TreeNode(postorder[postIndex]); postIndex--
        ;
        int inRoot = inMap[root->val];
        root->right = buildTreeHelper(inorder, postorder, inRoot + 1, inEnd, postIndex, inMap);
        root->left = buildTreeHelper(inorder, postorder, inStart, inRoot - 1, postIndex, inMap); return
        root;
    }
};
```

- Output:



Problem 8. Kth Smallest Element in a BST

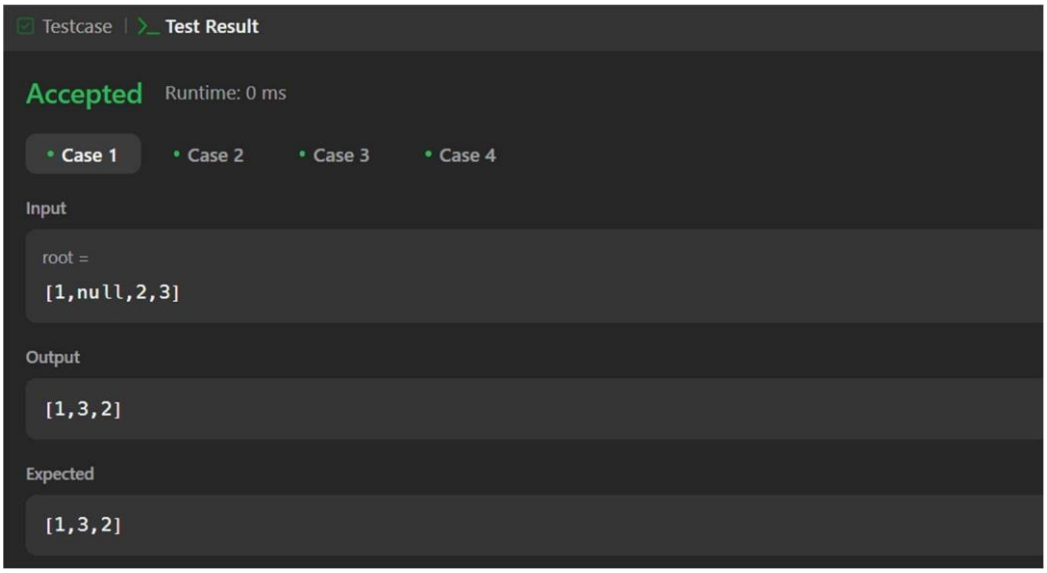
- Code:
  class Solution { public:

```
int kthSmallest(TreeNode* root, int k) { int
   count = 0; int result = 0;
   kthSmallestHelper(root, k, count,
   result); return result;
}

void kthSmallestHelper(TreeNode* root, int k, int& count, int& result) {
   if (root == nullptr) { return;
   }
   kthSmallestHelper(root->left, k, count, result);
   count++; if (count == k) { result = root->val;
   return;
   }

   kthSmallestHelper(root->right, k, count, result);
}
};
```

- Output:



Problem 9. Populating Next Right Pointers in Each Node

- Code:

```
class Solution { public:
```

```
Node* connect(Node* root) {
if (root == nullptr) { return
nullptr;
    }
    queue<Node*>          q;
    q.push(root);         while
    (!q.empty())      {      int
    levelSize = q.size();
       for (int i = 0; i < levelSize; ++i) {
          Node*   node   =   q.front();
          q.pop();
          if (i < levelSize - 1) {
            node->next = q.front();
          } else { node->next =
            nullptr;
          } if (node->left)
          {
            q.push(node-
          >left); } if (node-
          >right) {
            q.push(node->right);
          }
       }
    }      return
    root;
  }
};
```

- Output:

Problem 10. Binary Tree Inorder Traversal

Code:

```
class Solution { public:
   vector<int> inorderTraversal(TreeNode* root) {
      vector<int> result; inorderTraversalHelper(root,
      result);
      return result;
   }

   void inorderTraversalHelper(TreeNode* root, vector<int>& result) {
      if (root == nullptr) {
         return; }
      inorderTraversalHelper(root->left,  result);  result.push_back(root-
      >val);
      inorderTraversalHelper(root->right, result); }
};
```

- Output: