**Name:** Amandeep Sharma

**UID:** 22BCS16228

**Batch:** FL\_IOT 601-A

[**1. Binary Tree Inorder Traversal**](https://leetcode.com/problems/binary-tree-inorder-traversal/)

class Solution { public:

vector<int> inorderTraversal(TreeNode\* root) { vector<int> ans; stack<TreeNode\*> stack;

while (root != nullptr || !stack.empty()) {

while (root != nullptr) { stack.push(root);

root = root->left;

}

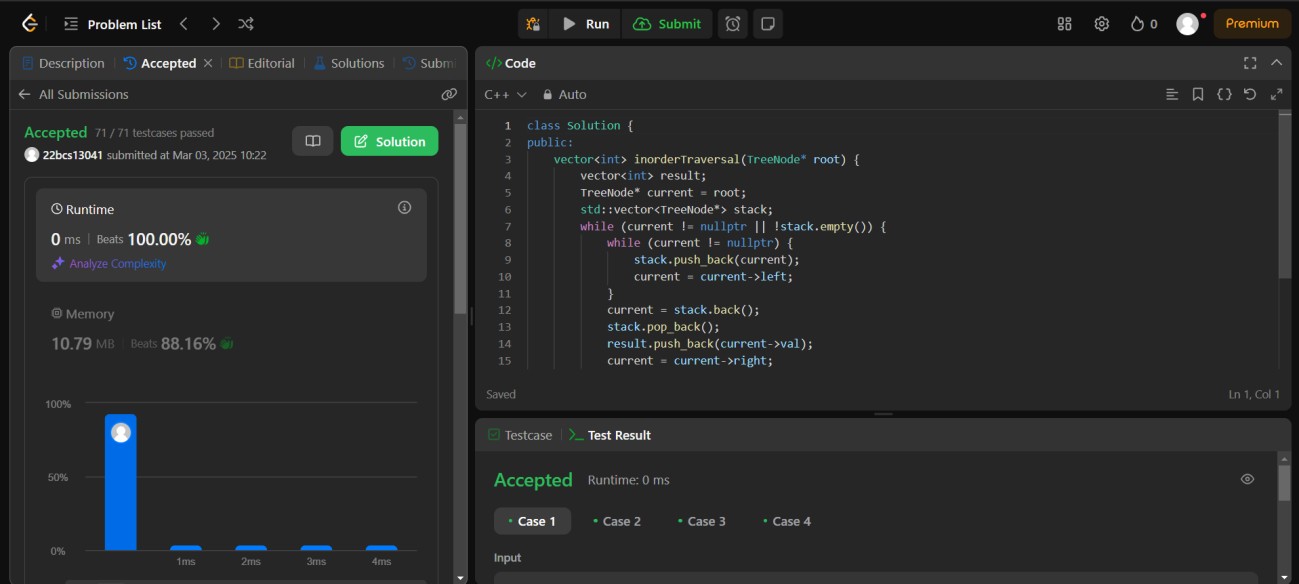
root = stack.top(), stack.pop(); ans.push\_back(root->val); root = root->right;

}

return ans;

}

};



[**2. Symmetric Tree**](https://leetcode.com/problems/symmetric-tree/)

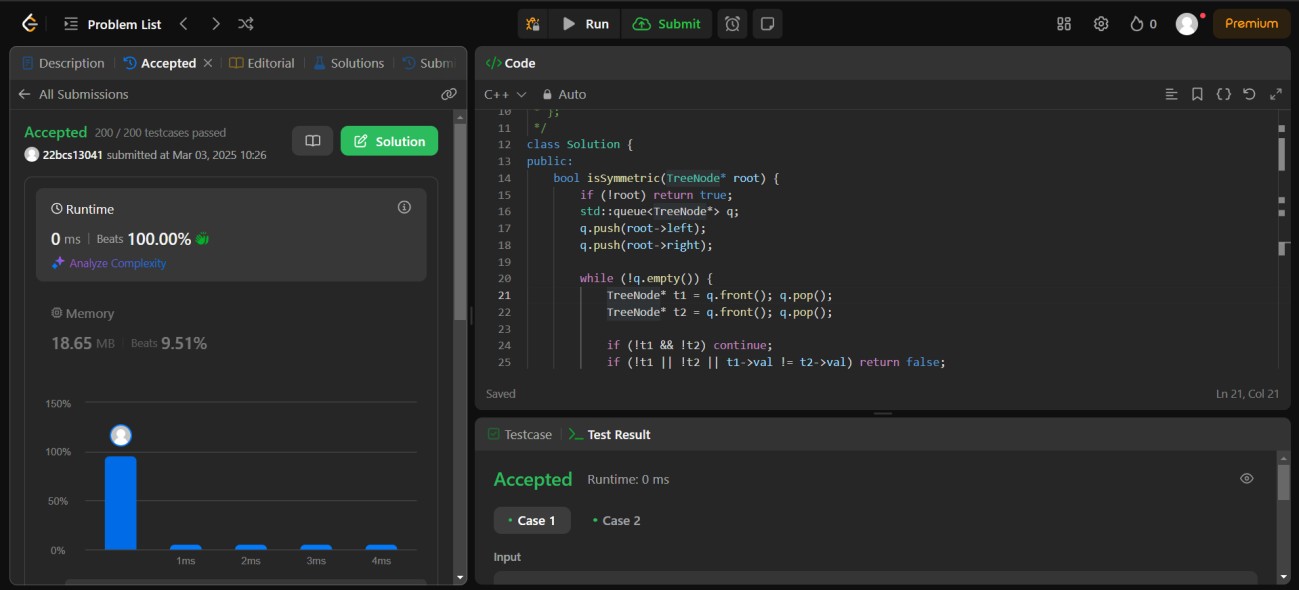
class Solution { public: bool isSymmetric(TreeNode\* root) { return isSymmetric(root, root);

} private: bool isSymmetric(TreeNode\* p, TreeNode\* q) { if (!p || !q) return p == q;

return p->val == q->val && // isSymmetric(p->left, q->right) && // isSymmetric(p->right, q->left);

}

};



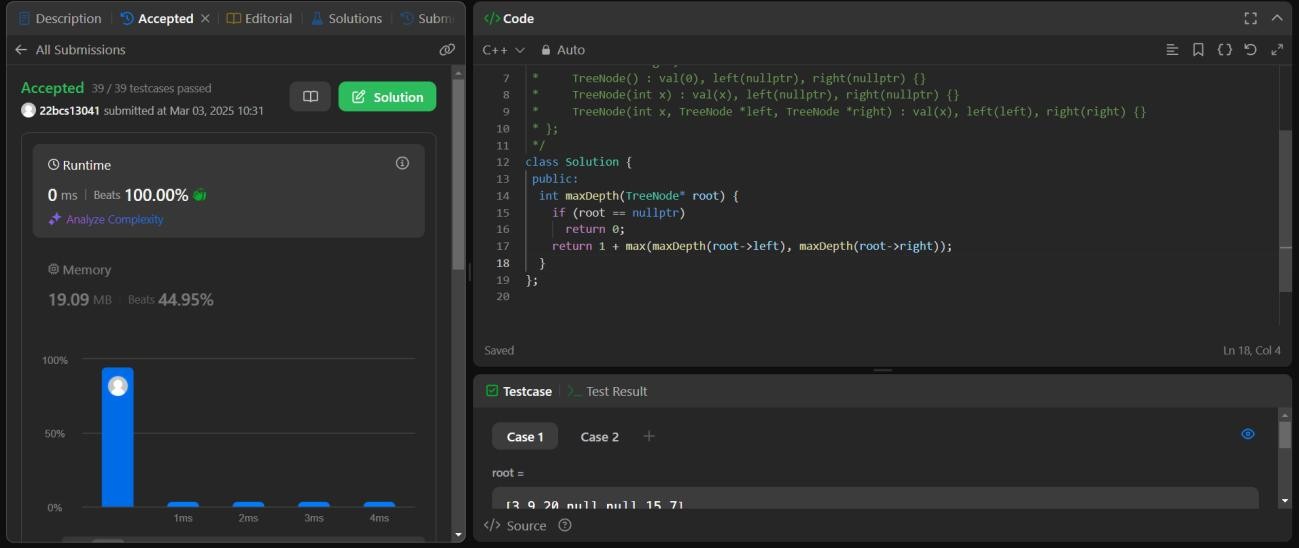
**3** [.**Maximum Depth of Binary Tree**](https://leetcode.com/problems/maximum-depth-of-binary-tree/description/)

class Solution { public:

int maxDepth(TreeNode\* root) { if (root == nullptr) return 0;

return 1 + max(maxDepth(root->left), maxDepth(root->right));

};



**4.** [**Validate Binary Search Tree**](https://leetcode.com/problems/validate-binary-search-tree/description/)

class Solution { public:

bool isValidBST(TreeNode\* root) {

return isValidBST(root, nullptr, nullptr);

}

private:

bool isValidBST(TreeNode\* root, TreeNode\* minNode, TreeNode\* maxNode) { if (root == nullptr)

return true;

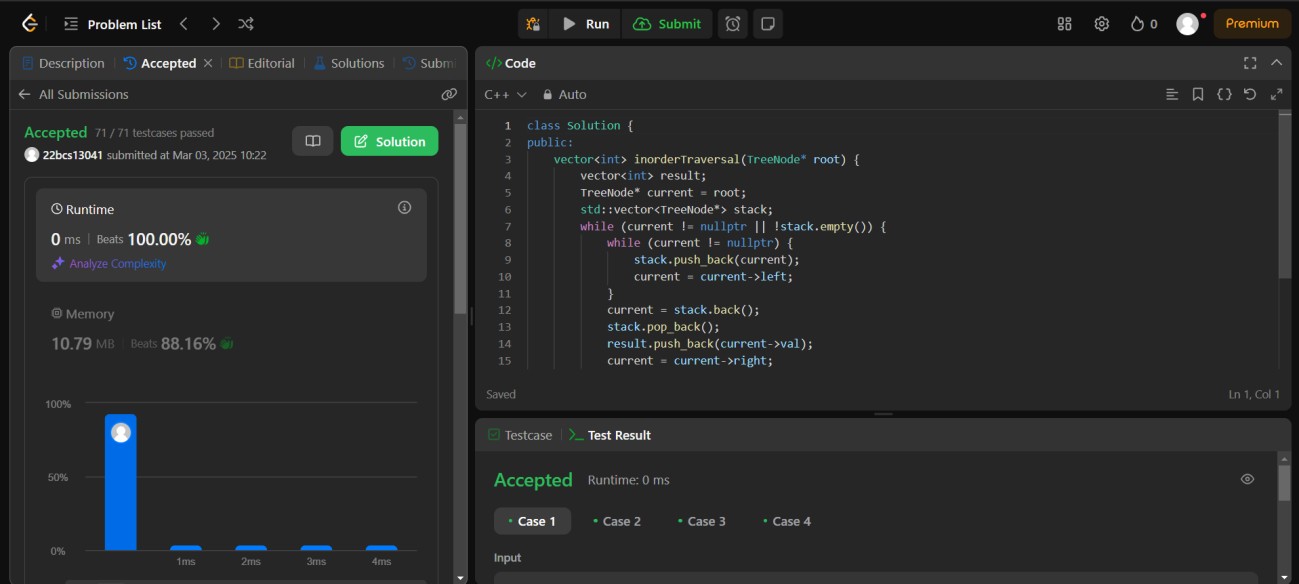
if (minNode && root->val <= minNode->val) return false;

if (maxNode && root->val >= maxNode->val) return false;

return isValidBST(root->left, minNode, root) && isValidBST(root->right, root, maxNode);

}

};



5.[**Kth Smallest Element in a BST**](https://leetcode.com/problems/kth-smallest-element-in-a-bst/description/) class Solution { public:

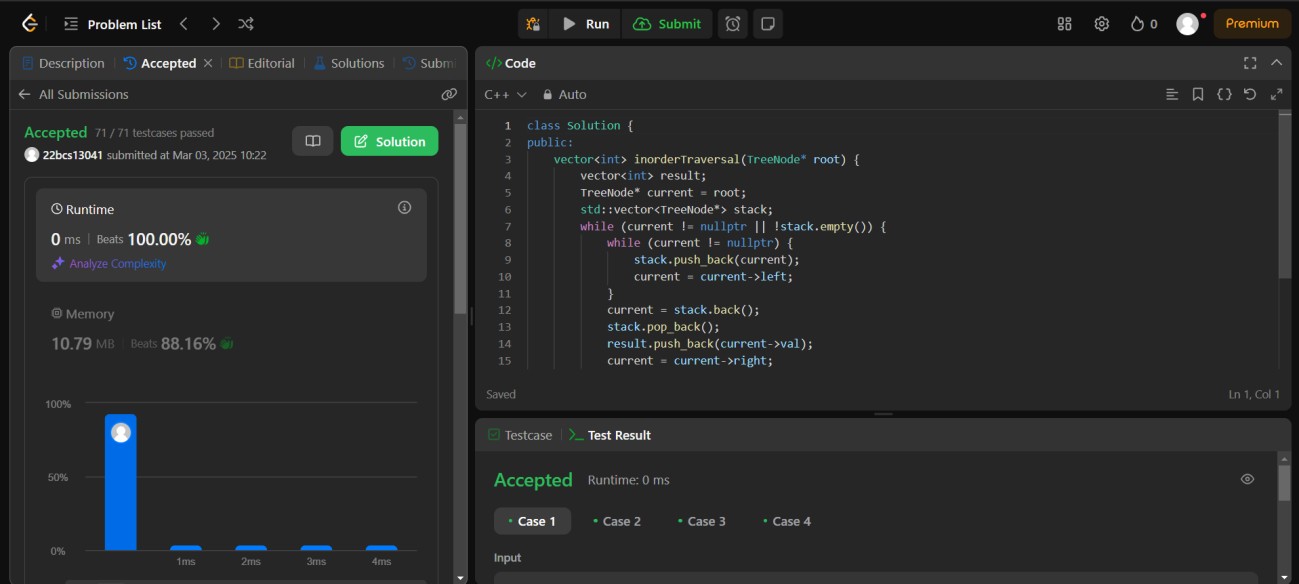
int kthSmallest(TreeNode\* root, int k) { const int leftCount = countNodes(root->left);

if (leftCount == k - 1) return root->val; if (leftCount >= k) return kthSmallest(root->left, k); return kthSmallest(root->right, k - 1 - leftCount); // leftCount < k } private:

int countNodes(TreeNode\* root) { if (root == nullptr) return 0; return 1 + countNodes(root->left) + countNodes(root->right);

}

};



**6.** [Binary Tree Level Order Traversal](https://leetcode.com/problems/binary-tree-level-order-traversal/description/)

class Solution { public:

vector<vector<int>> levelOrder(TreeNode\* root) { if (root == nullptr)

return {};

vector<vector<int>> ans; queue<TreeNode\*> q{{root}};

while (!q.empty()) { vector<int> currLevel;

for (int sz = q.size(); sz > 0; --sz) { TreeNode\* node = q.front(); q.pop();

currLevel.push\_back(node->val); if (node->left)

q.push(node->left); if (node->right)

q.push(node->right);

}

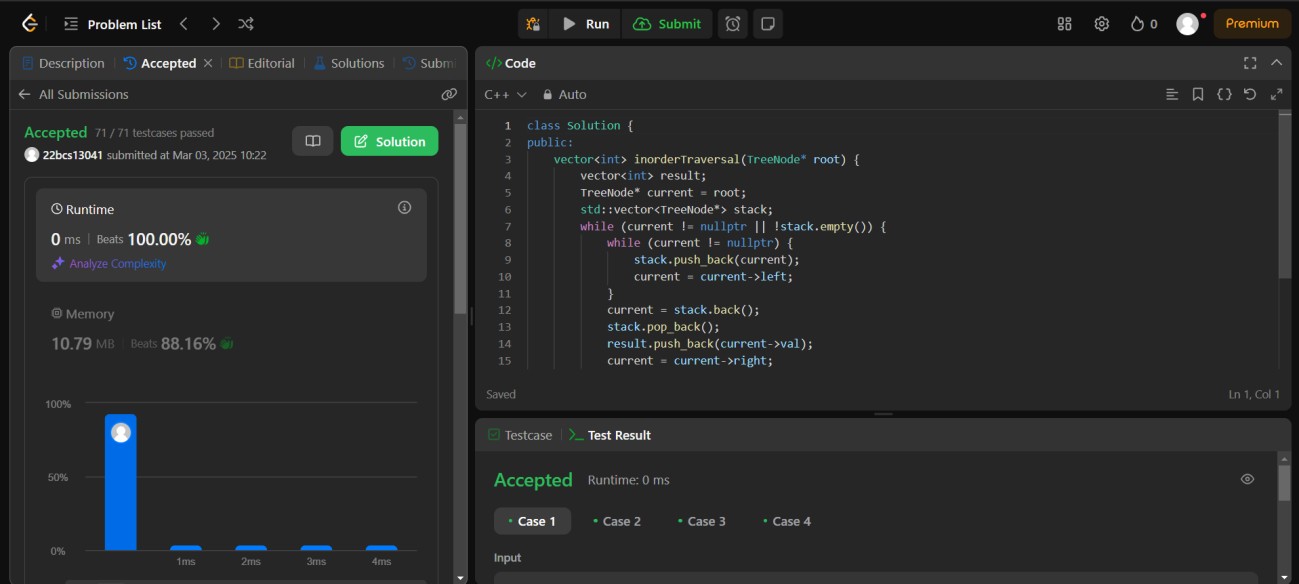
ans.push\_back(currLevel);

}

return ans;

}

};



7. [Binary Tree Level Order Traversal II](https://leetcode.com/problems/binary-tree-level-order-traversal-ii/description/) class Solution { public:

vector<vector<int>> levelOrderBottom(TreeNode\* root) { if (root == nullptr)

return {};

vector<vector<int>> ans;

queue<TreeNode\*> q{{root}};

while (!q.empty()) { vector<int> currLevel;

for (int sz = q.size(); sz > 0; --sz) { TreeNode\* node = q.front(); q.pop();

currLevel.push\_back(node->val); if (node->left)

q.push(node->left); if (node->right)

q.push(node->right);

}

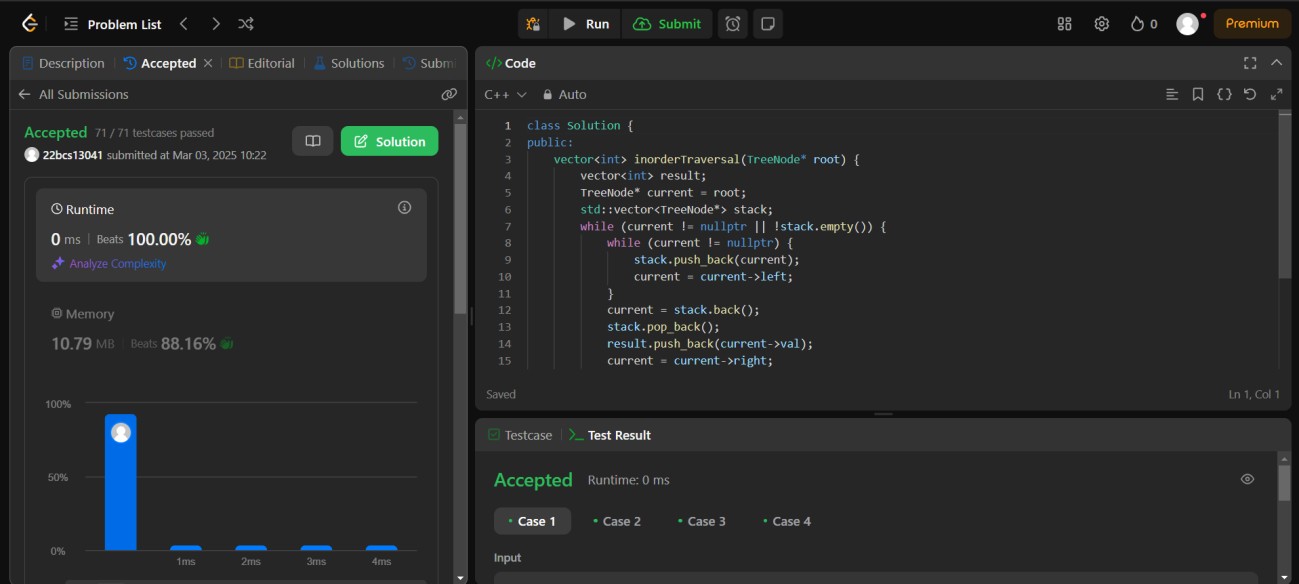
ans.push\_back(currLevel);

}

ranges::reverse(ans); return ans;

}

};



8. [.Binary Tree Zigzag Level Order Traversal](https://leetcode.com/problems/binary-tree-zigzag-level-order-traversal/description/) class Solution { public:

vector<vector<int>> zigzagLevelOrder(TreeNode\* root) { if (root == nullptr)

return {};

vector<vector<int>> ans; deque<TreeNode\*> dq{{root}};

bool isLeftToRight = true;

while (!dq.empty()) { vector<int> currLevel; for (int sz = dq.size(); sz > 0; --sz) if (isLeftToRight) {

TreeNode\* node = dq.front();

dq.pop\_front();

currLevel.push\_back(node->val);

if (node->left)

dq.push\_back(node->left);

if (node->right)

dq.push\_back(node->right);

} else {

TreeNode\* node = dq.back();

dq.pop\_back();

currLevel.push\_back(node->val);

if (node->right)

dq.push\_front(node->right);

if (node->left)

dq.push\_front(node->left);

}

ans.push\_back(currLevel);

isLeftToRight = !isLeftToRight;

}

return ans;

}

};

9. [Binary Tree Right Side View](https://leetcode.com/problems/binary-tree-right-side-view/description/)

class Solution { public:

vector<int> rightSideView(TreeNode\* root) { if (root == nullptr)

return {};

vector<int> ans;

queue<TreeNode\*> q{{root}};

while (!q.empty()) { const int size = q.size();

for (int i = 0; i < size; ++i) {

TreeNode\* node = q.front(); q.pop();

if (i == size - 1)

ans.push\_back(node->val); if (node->left)

q.push(node->left); if (node->right)

q.push(node->right);

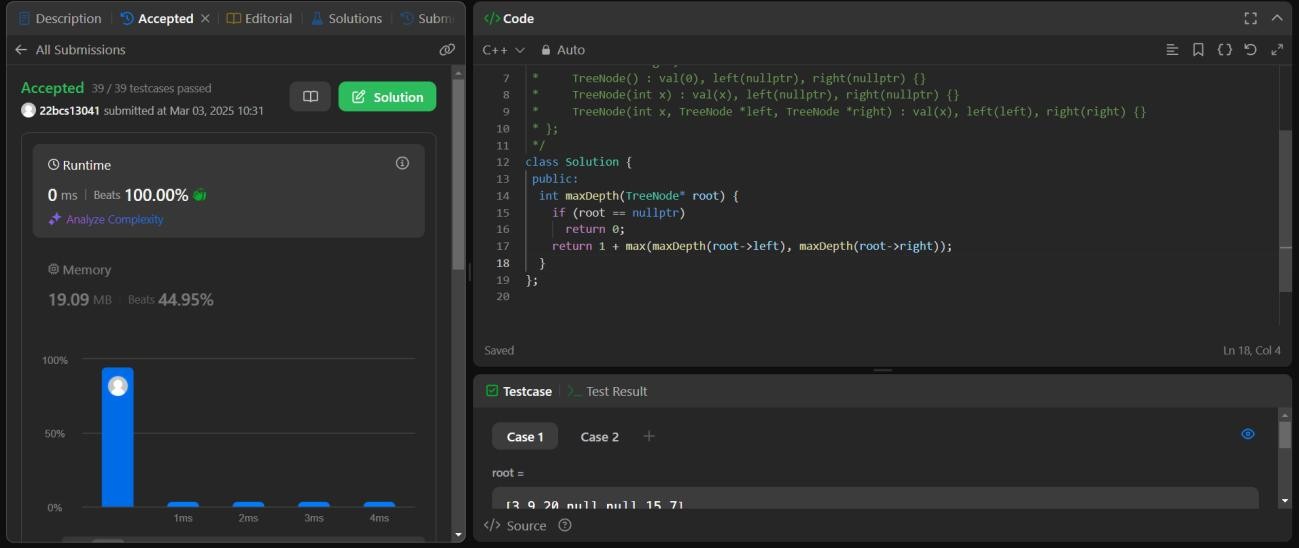
}

}

return ans;

}

};



10. [Construct Binary Tree from Inorder and Postorder Traversal](https://leetcode.com/problems/construct-binary-tree-from-inorder-and-postorder-traversal/description/) class Solution { public:

TreeNode\* buildTree(vector<int>& inorder, vector<int>& postorder) { unordered\_map<int, int> inToIndex;

for (int i = 0; i < inorder.size(); ++i)

inToIndex[inorder[i]] = i;

return build(inorder, 0, inorder.size() - 1, postorder, 0,

postorder.size() - 1, inToIndex);

}

private:

TreeNode\* build(const vector<int>& inorder, int inStart, int inEnd, const vector<int>& postorder, int postStart, int postEnd, const unordered\_map<int, int>& inToIndex) { if (inStart > inEnd)

return nullptr;

const int rootVal = postorder[postEnd]; const int rootInIndex = inToIndex.at(rootVal);

const int leftSize = rootInIndex - inStart;

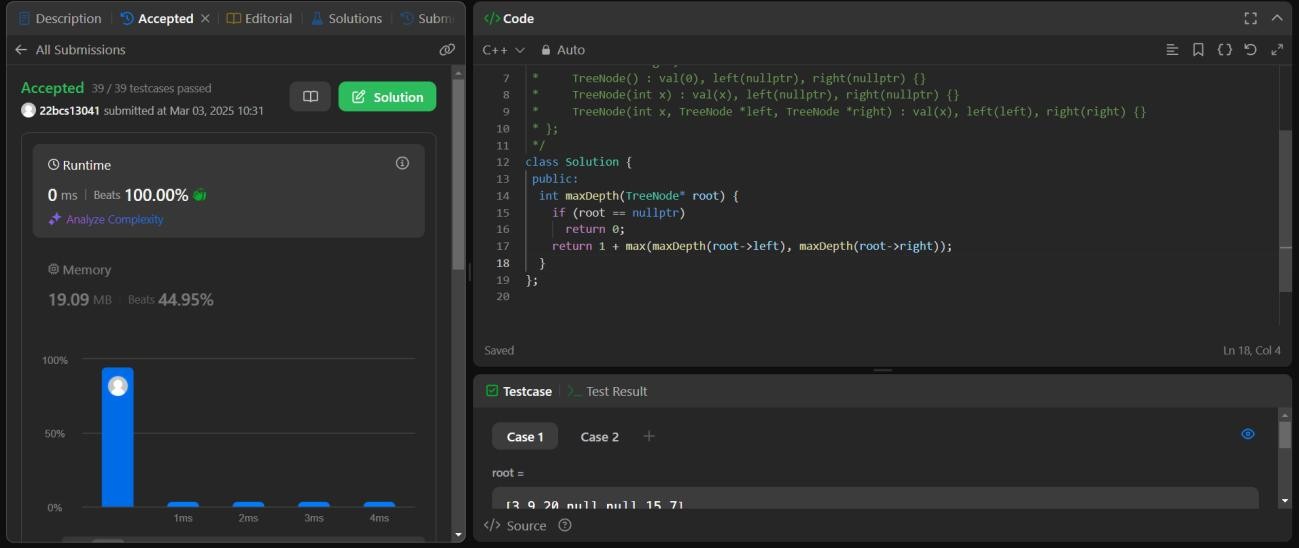
TreeNode\* root = new TreeNode(rootVal);

root->left = build(inorder, inStart, rootInIndex - 1, postorder, postStart,

postStart + leftSize - 1, inToIndex); root->right = build(inorder, rootInIndex + 1, inEnd, postorder, postStart + leftSize, postEnd - 1, inToIndex); return root;

}

};



11. [Find Bottom Left Tree Value](https://leetcode.com/problems/find-bottom-left-tree-value/description/)

class Solution { public:

int findBottomLeftValue(TreeNode\* root) {

queue<TreeNode\*> q{{root}};

TreeNode\* node = nullptr;

while (!q.empty()) { node = q.front(); q.pop(); if (node->right)

q.push(node->right); if (node->left)

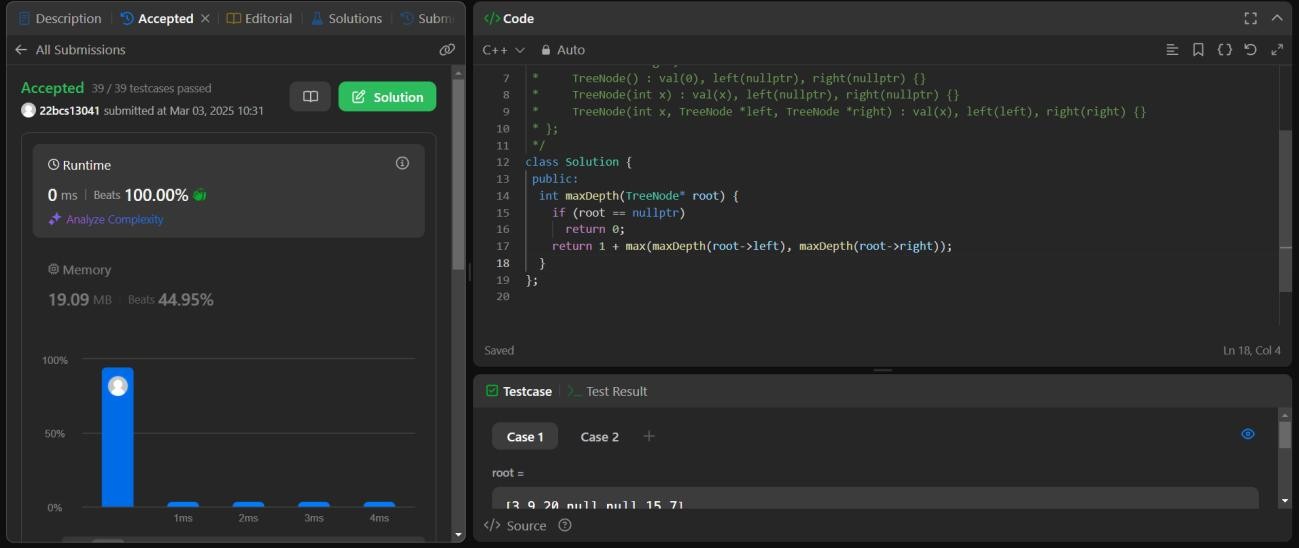
q.push(node->left);

}

return node->val;

}

};



12.  [Binary Tree Maximum Path Sum](https://leetcode.com/problems/binary-tree-maximum-path-sum/description/)

class Solution { public:

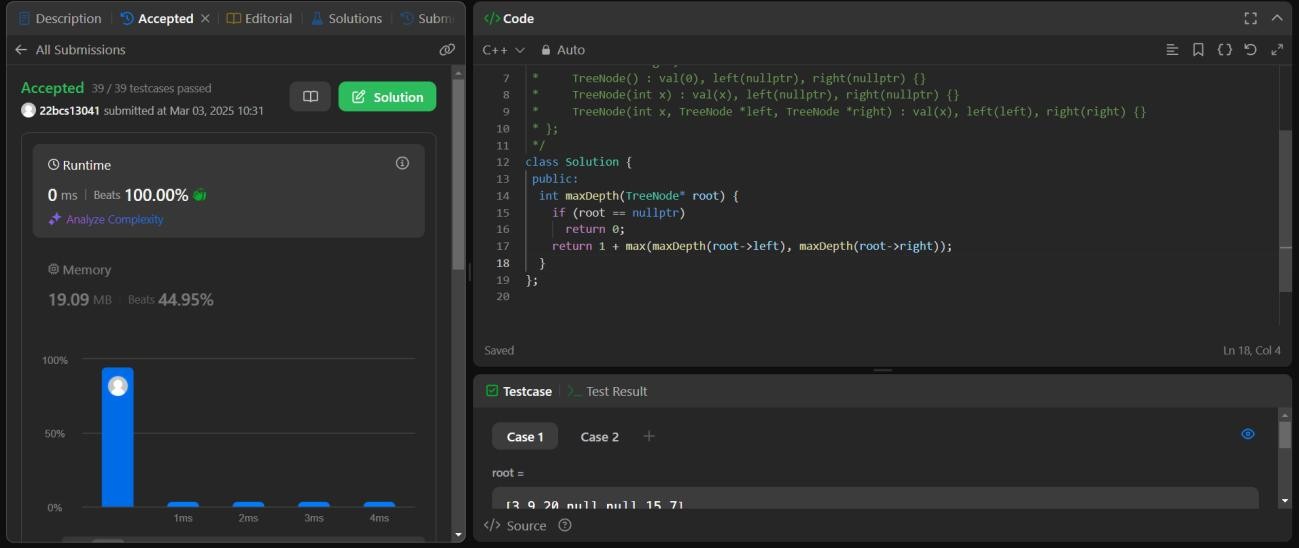
int maxPathSum(TreeNode\* root) { int ans = INT\_MIN; maxPathSumDownFrom(root, ans); return ans;

} private:

int maxPathSumDownFrom(TreeNode\* root, int& ans) { if (root == nullptr) return 0;

const int l = max(0, maxPathSumDownFrom(root->left, ans)); const int r = max(0, maxPathSumDownFrom(root->right, ans)); ans = max(ans, root->val + l + r); return root->val + max(l, r);

} };



13. [.Vertical Order Traversal of a Binary Tree](https://leetcode.com/problems/vertical-order-traversal-of-a-binary-tree/description/)

class Solution { public:

vector<vector<int>> verticalTraversal(TreeNode\* root) { vector<vector<int>> ans; map<int, multiset<pair<int, int>>> xToSortedPairs;

dfs(root, 0, 0, xToSortedPairs); for (const auto& [\_, pairs] : xToSortedPairs) { vector<int> vals; for (const pair<int, int>& pair : pairs) vals.push\_back(pair.second); ans.push\_back(vals);

} return ans;

} private:

void dfs(TreeNode\* root, int x, int y, map<int, multiset<pair<int, int>>>& xToSortedPairs) { if (root == nullptr) return;

xToSortedPairs[x].emplace(y, root->val); dfs(root->left, x - 1, y + 1, xToSortedPairs); dfs(root->right, x + 1, y + 1, xToSortedPairs);

} };

