

Experiment 6

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Subject Code: 22ITP-351

PROBLEM 1:

Aim:

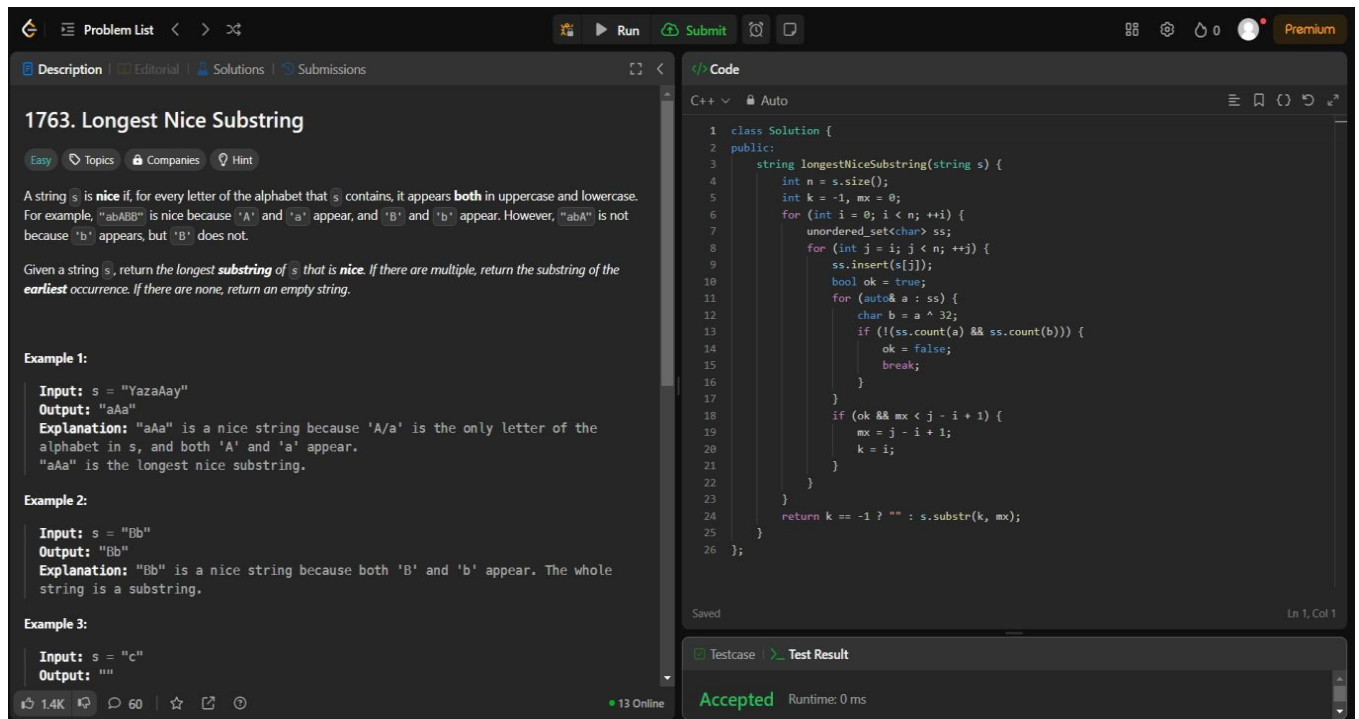
Given the root of a binary tree, return *its maximum depth*.

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:

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

Output:



The screenshot displays a coding interface for the problem "1763. Longest Nice Substring". The problem description states: "A string *s* is **nice** if, for every letter of the alphabet that *s* contains, it appears **both** in uppercase and lowercase. For example, "aABb" is nice because 'A' and 'a' appear, and 'B' and 'b' appear. However, "aBA" is not because 'b' appears, but 'B' does not. Given a string *s*, return the **longest substring** of *s* that is **nice**. If there are multiple, return the substring of the **earliest** occurrence. If there are none, return an empty string.

Examples:

- Example 1: Input: *s* = "YazaAay", Output: "aAa". Explanation: "aAa" is a nice string because 'A/a' is the only letter of the alphabet in *s*, and both 'A' and 'a' appear. "aAa" is the longest nice substring.
- Example 2: Input: *s* = "Bb", Output: "Bb". Explanation: "Bb" is a nice string because both 'B' and 'b' appear. The whole string is a substring.
- Example 3: Input: *s* = "c", Output: "".

The solution code in C++ is as follows:

```
1 class Solution {
2 public:
3     string longestNiceSubstring(string s) {
4         int n = s.size();
5         int k = -1, mx = 0;
6         for (int i = 0; i < n; ++i) {
7             unordered_set<char> ss;
8             for (int j = i; j < n; ++j) {
9                 ss.insert(s[j]);
10                bool ok = true;
11                for (auto& a : ss) {
12                    char b = a ^ 32;
13                    if (!ss.count(a) && ss.count(b)) {
14                        ok = false;
15                        break;
16                    }
17                }
18                if (ok && mx < j - i + 1) {
19                    mx = j - i + 1;
20                    k = i;
21                }
22            }
23        }
24        return k == -1 ? "" : s.substr(k, mx);
25    }
26 };
```

The solution is marked as "Accepted" with a runtime of 0 ms.



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PROBLEM 2:

Aim: 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 {
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);
    }
};
```

Output:

Description
Editorial
Solutions
Submissions

98. Validate Binary Search Tree

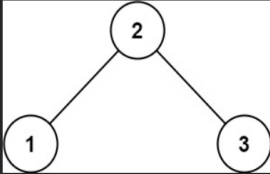
Medium Topics Companies

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.

Example 1:



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

Example 2:

Code

```

1 class Solution {
2 public:
3     bool isValidBST(TreeNode* root) {
4         return isValidBST(root, nullptr, nullptr);
5     }
6
7 private:
8     bool isValidBST(TreeNode* root, TreeNode* minNode, TreeNode* maxNode) {
9         if (root == nullptr)
10            return true;

```

Saved Ln 2, Col 9

Testcase

Test Result


Case 1

Case 2

+

root =

[2,1,3]



PROBLEM 3:

Aim: 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 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 && //
```



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```
isSymmetric(p->left, q->right) && //
```

```
isSymmetric(p->right, q->left);
```

```
}
```

```
};
```

Output:

Description | Editorial | Solutions | Submissions

101. Symmetric Tree

Easy | Topics | Companies

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:

Solved

15.9K | 197 | 129 Online

Code

C++ | Auto

```
1 class Solution {
2 public:
3     bool isSymmetric(TreeNode* root) {
4         return isSymmetric(root, root);
5     }
6
7 private:
8     bool isSymmetric(TreeNode* p, TreeNode* q) {
9         if (!p || !q)
10            return p == q;
11     }
12 }
```

Saved | Ln 16, Col 3

Testcase | Test Result

Accepted | Runtime: 0 ms

Case 1 | Case 2

Input

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

Output

true

Expected

true

PROBLEM 4:

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).

Code:

```
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;
    }
};
```

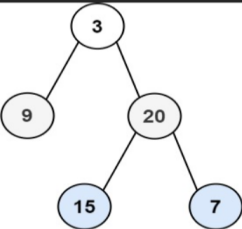
OUTPUT:

102. Binary Tree Level Order Traversal

Medium

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).

Example 1:



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

Example 2:

Code

```
1 class Solution {
2 public:
3     vector<vector<int>> levelOrder(TreeNode* root) {
4         if (root == nullptr)
5             return {};
6
7         vector<vector<int>> ans;
8         queue<TreeNode*> q{{root}};
9
10        while (!q.empty()) {
```

Testcase Test Result

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:

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

Code:

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

private:
    TreeNode* build(const vector<int>& nums, int l, int r) {
        if (l > r)
            return nullptr;
        const int m = (l + r) / 2;
        return new TreeNode(nums[m], build(nums, l, m - 1), build(nums, m + 1, r));
    }
};
```

Output:

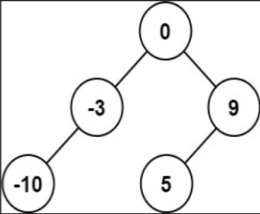
Description Editorial Solutions Submissions

108. Convert Sorted Array to Binary Search Tree


Easy Topics Companies

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

Example 1:



Input: `nums = [-10,-3,0,5,9]`
Output: `[0,-3,9,-10,null,5]`
Explanation: `[0,-10,5,null,-3,null,9]` is also accepted:



11.3K 124 69 Online

Code

```

6
7
8 private:
9     TreeNode* build(const vector<int>& nums, int l, int r) {
10         if (l > r)
11             return nullptr;
12         const int m = (l + r) / 2;
13         return new TreeNode(nums[m], build(nums, l, m - 1), build(nums, m + 1, r));
14     }
15 }

```

Saved Ln 13, Col 4

Testcase Test Result

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:

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

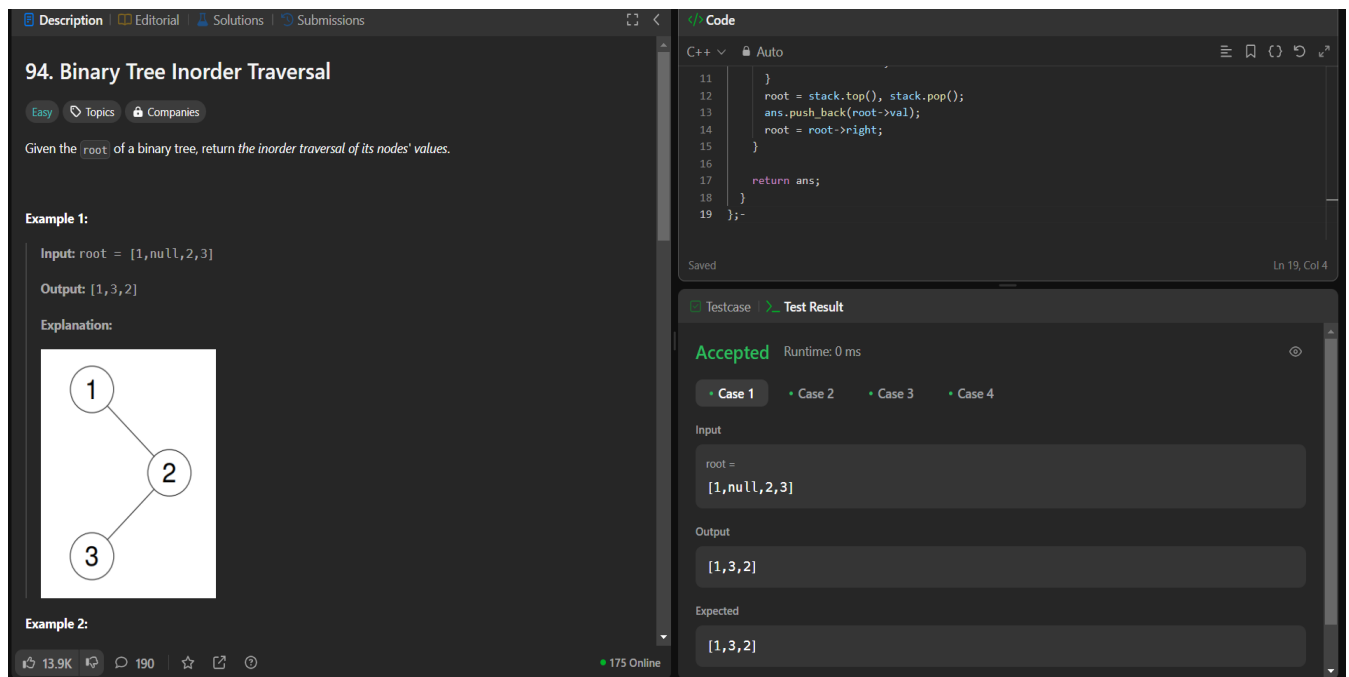
Code:

```
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;
    }
};
```

Output:



The screenshot displays a coding platform interface for the problem "94. Binary Tree Inorder Traversal". The problem description states: "Given the `root` of a binary tree, return the *inorder traversal of its nodes' values*." Example 1 shows the input `root = [1,null,2,3]` and the output `[1,3,2]`. An explanation diagram shows a binary tree with root 1, left child 3, and right child 2. The code editor on the right shows a C++ solution using a stack to simulate the recursive process. The test result section indicates the solution is "Accepted" with a runtime of 0 ms.

94. Binary Tree Inorder Traversal

Easy Topics Companies

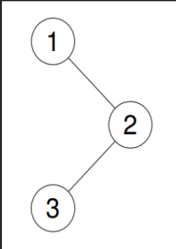
Given the `root` of a binary tree, return the *inorder traversal of its nodes' values*.

Example 1:

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

Output: `[1,3,2]`

Explanation:



Example 2:

13.9K 190 175 Online

Code

```
C++ Auto
11     }
12     root = stack.top(), stack.pop();
13     ans.push_back(root->val);
14     root = root->right;
15 }
16
17     return ans;
18 }
19 };
```

Saved Ln 19, Col 4

Testcase Test Result

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:

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*.

Code:

```
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;
    }
};
```

Output:

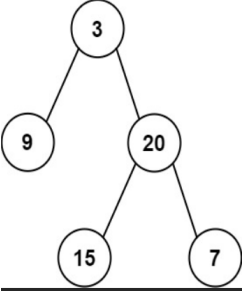
Description | Editor | Solutions | Submissions

106. Construct Binary Tree from Inorder and Postorder Traversal

Medium | Topics | Companies

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*.

Example 1:



```

graph TD
    3((3)) --- 9((9))
    3 --- 20((20))
    20 --- 15((15))
    20 --- 7((7))
  
```

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

Example 2:

8.3K | 78 | 47 Online

Code

```

1 class Solution {
2 public:
3     TreeNode* buildTree(vector<int>& inorder, vector<int>& postorder) {
  
```

Saved | Ln 30, Col 4

Testcase | Test Result

Accepted Runtime: 0 ms

Case 1 | Case 2

Input

`inorder =`
`[9,3,15,20,7]`

`postorder =`
`[9,15,7,20,3]`

Output

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

Expected

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

Contribute a testcase

PROBLEM 9:

Aim: 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.*

Code:

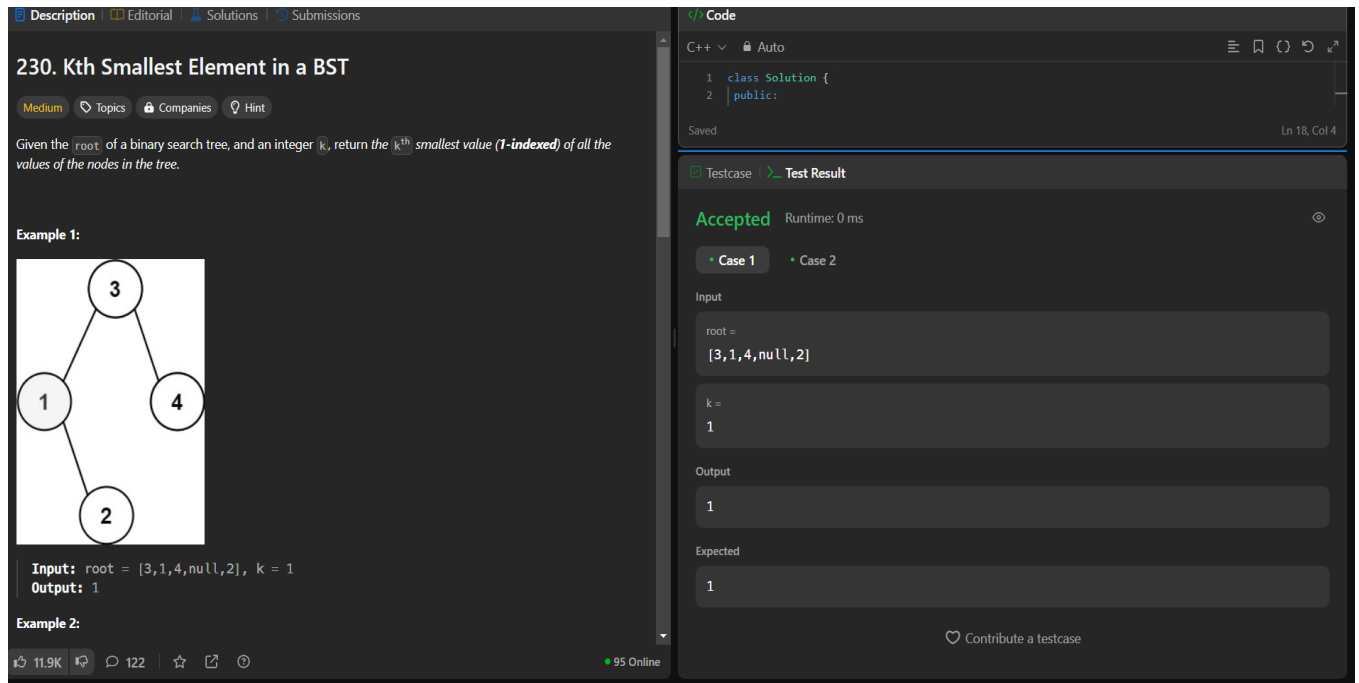
```

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);
    }
};
  
```

Output:



The screenshot shows a coding problem interface. On the left, the problem description for '230. Kth Smallest Element in a BST' is visible, including a diagram of a binary search tree with nodes 1, 2, 3, and 4. The input is root = [3,1,4,null,2] and k = 1, with the output being 1. On the right, the 'Code' editor shows a C++ solution with a class Solution and a public method. Below the code, the 'Testcase' section shows 'Accepted' status with a runtime of 0 ms. The input fields show root = [3,1,4,null,2] and k = 1, and the output field shows 1.

PROBLEM 9:

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.

Code:

```
class Solution {
public:
    Node* connect(Node* root) {
        if (root == nullptr)
            return nullptr;
        connectTwoNodes(root->left, root->right);
        return root;
    }

private:
    void connectTwoNodes(Node* p, Node* q) {
        if (p == nullptr)
```



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```
return;  
p->next = q;  
connectTwoNodes(p->left, p->right);  
connectTwoNodes(q->left, q->right);  
connectTwoNodes(p->right, q->left);  
}  
};
```

Output:

Description

Editorial

Solutions

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116. Populating Next Right Pointers in Each Node

Medium

Topics

Companies

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:

Figure 1: A perfect binary tree with 7 nodes. The root is 1, children are 2 and 3, and leaves are 4, 5, 6, 7. Red arrows indicate the next pointers: 1 points to NULL, 2 points to 3, 3 points to NULL, 4 points to 5, 5 points to 6, 6 points to 7, and 7 points to NULL.

Code

C++

Auto

Ln 18, Col 3

18 }
19 };

Saved

Testcase

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

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

Contribute a testcase



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