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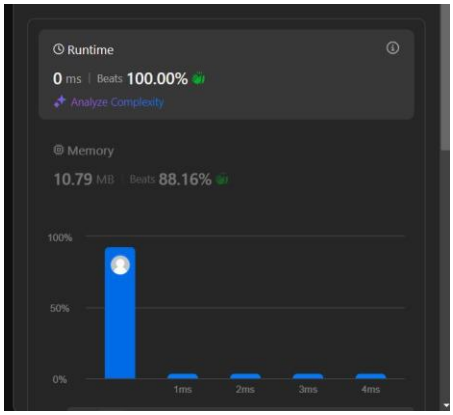
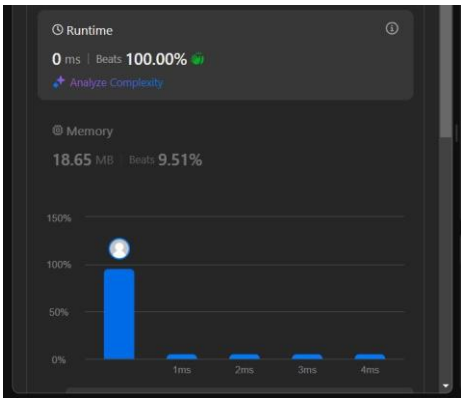
1. Binary Tree Inorder Traversal

```
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

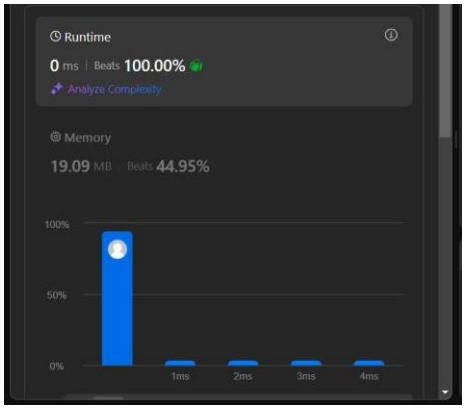
```
class Solution { public:
    bool isSymmetric(TreeNode* root) { return
        isSymmetric(root, root);
    }

  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

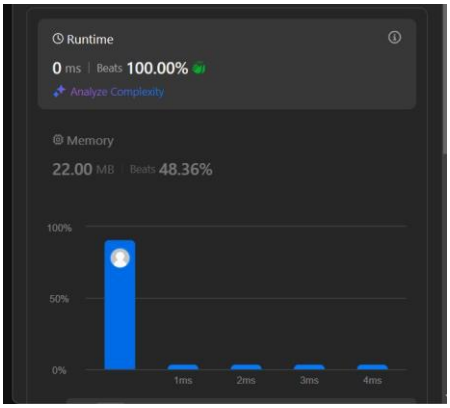
```
class Solution
 { public:
  int maxDepth(TreeNode* root)
   { if (root == nullptr)
     return 0;
   return 1 + max(maxDepth(root->left), maxDepth(root->right));
```

};



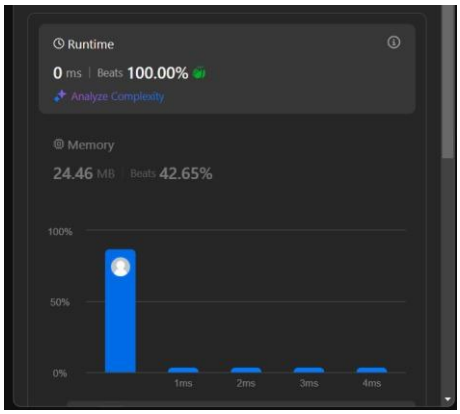
4. Validate Binary Search Tree

```
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);
  }
};
```



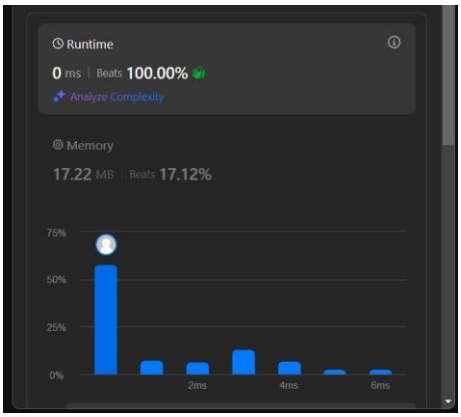
5. Kth Smallest Element in a BST

```
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

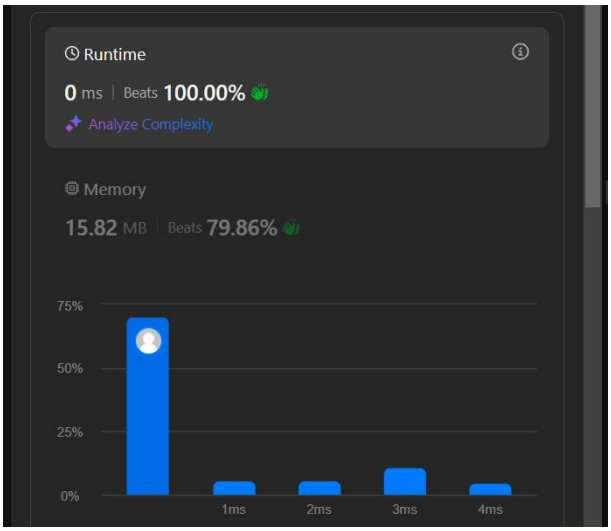
```
class Solution
 { public:
  vector<vector<int>> levelOrder(TreeNode*
    root) { if (root == nullptr)
      return {};
    vector<vector<int>> ans;
    queue<TreeNode*> q{{root}};
    while (!q.empty()) {
      vector<int> currLevel;
      for (int sz = q.size(); sz > 0; --sz)
       { TreeNode* 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

```
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);
    }
```

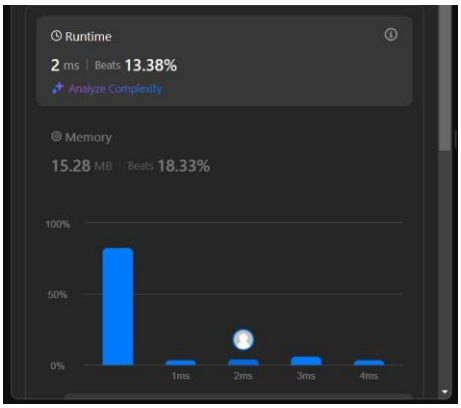
```
    ranges::reverse(ans);
    return ans;
  }
};
```



8. .Binary Tree Zigzag Level Order Traversal

```
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);
```

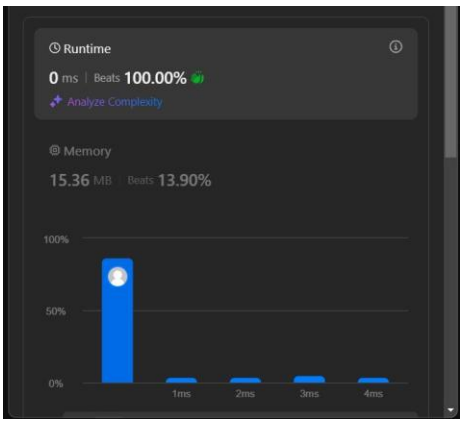
```
        if (node->left)
          dq.push_back(node-
        >left); if (node->right)
          dq.push_back(node->right);
       } else {
        TreeNode* node = dq.back();
        dq.pop_back();
        currLevel.push_back(node-
        >val); if (node->right)
        dq.push_front(node->right);
        if (node->left)
          dq.push_front(node-
          >left);
       }
     ans.push_back(currLevel);
     isLeftToRight = !isLeftToRight;
    }

    return ans;
  }
};
```



9. Binary Tree Right Side View

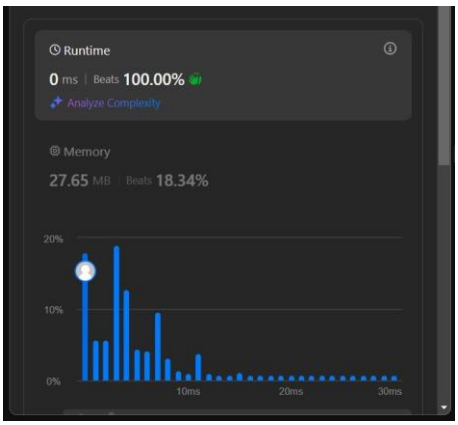
```
class Solution
 { public:
  vector<int> rightSideView(TreeNode* root)
    { if (root == nullptr)
```

```
    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;
 }

};
```



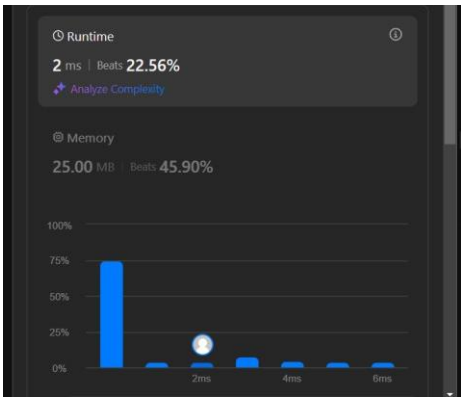
10. Construct Binary Tree from Inorder and Postorder Traversal

```
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;
  }
};
```



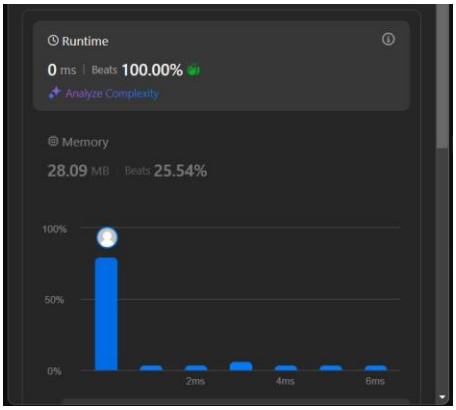
11. Find Bottom Left Tree Value

```
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;
  }
};
```



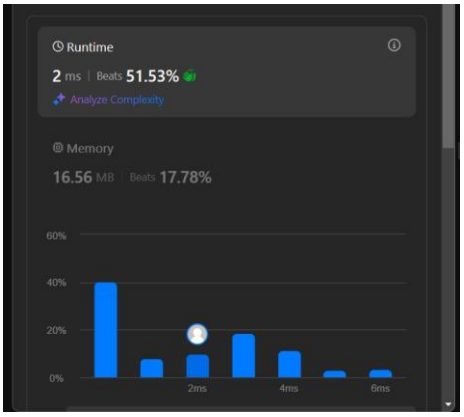
12. Binary Tree Maximum Path Sum

```
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

```
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);
    }
};
```


Runtime
2 ms | Beats 51.53%
Analyze Complexity
Memory
16.56 MB | Beats 17.78%
60%
40%
20%
0%
2ms
4ms
6ms