Experiment3

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Subject Name :- AP2-LAB **Subject Code:- 22CSP-351**

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.

Objective:-The objective is to determine the maximum depth of a binary tree, which represents the longest path from the root to the deepest leaf node. This helps in understanding the tree's structure, height, and balance, which are essential in various applications like searching, sorting, and optimizing tree-based algorithms.

Apparatus Used:

1. **Software**:-Leetcode
2. **Hardware**:Computerwith4GBRAMand keyboard.

AlgorithmfortheTwoSumProblem:

1. **CheckBaseCondition**–Iftherootisnullptr,return0(emptytreehasdepth0).
2. **RecursivelyComputeLeftDepth**–CallmaxDepth(root->left)tocomputethedepthoftheleftsubtree.
3. **RecursivelyComputeRightDepth**–CallmaxDepth(root->right)tocomputethedepthoftherightsubtree.
4. **CompareDepths**–Takethemaximumoftheleftandrightsubtreedepths.
5. **IncrementDepth**–Add1toincludethecurrentrootnodeinthedepthcount.
6. **Return Result**–Returnthecomputeddepthvalue.

Code:

```
classSolution{
 public:
  intmaxDepth(TreeNode*root){ if
    (root == nullptr)
      return0;
    return1+max(maxDepth(root->left),maxDepth(root->right));
  }
};
```

TimeComplexity:O(N)–Eachnodeisvisitedonce.

SpaceComplexity:O(N)–Worstcase(skewedtree),O(logN)–Bestcase(balancedtree).

Output-Allthetestcases passed

Testcase | Test Result

• Case 1 • Case 2

Input

root =

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

Output

```
3
```

Expected

```
3
```

Testcase | Test Result

Input

root =

```
[1,null,2]
```

Output

```
2
```

Expected

```
2
```

Problem-2

Aim:-Giventherootofabinary tree, return*itsmaximumdepth*.Abinarytree's maximumdepth isthenumber ofnodes along the longest path from the root node down to the farthest leaf node.

Objective-The objective is to determine whether a given binary tree is a valid binary search tree (BST).Avalid BST ensures that foreachnode,itsleft subtreecontainsonlysmallervalues,anditsright subtreecontainsonlylargervalues.Thisvalidation is crucial for efficient searching, sorting, and maintaining ordered data structures.

Apparatus Used:

1. **Software**:-Leetcode
2. **Hardware**:Computerwith4GBRAMand keyboard.

AlgorithmtoCheckifaBinaryTreeisaValidBST

1. **InitializeFunction**–Callvalid(root,LONG_MIN,LONG_MAX)tostartvalidation.
2. **CheckBaseCondition**–Ifthecurrentnodeisnullptr,returntrue(emptysubtreeis valid).
3. **ValidateNodeValue**–Ensurethenode'svalueiswithinthegivenrange(minimum<node->val<maximum).
4. **ReturnFalseifInvalid**–IfthenodeviolatestheBSTproperty,returnfalse.
5. **RecursivelyCheckLeftSubtree**–Callvalid(node->left,minimum,node->val).
6. **RecursivelyCheckRightSubtree**–Callvalid(node->right,node->val,maximum)andreturnthecombinedresult.

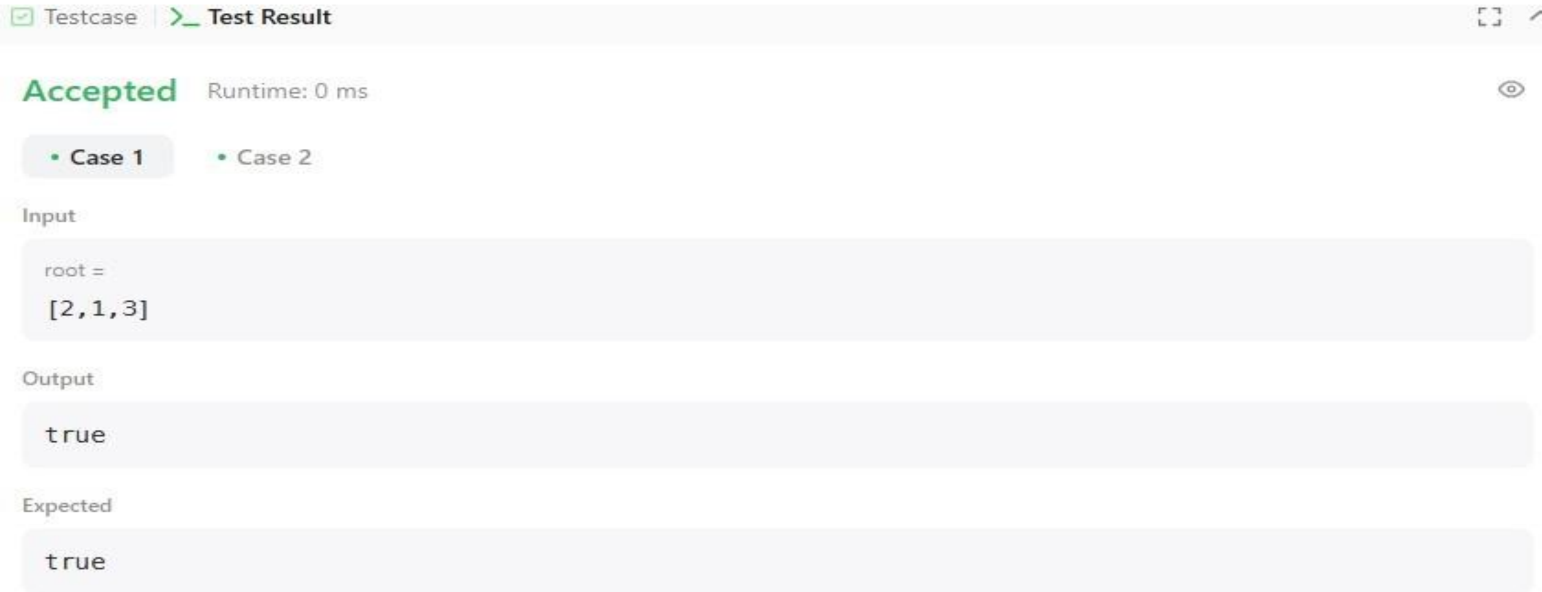
Code-

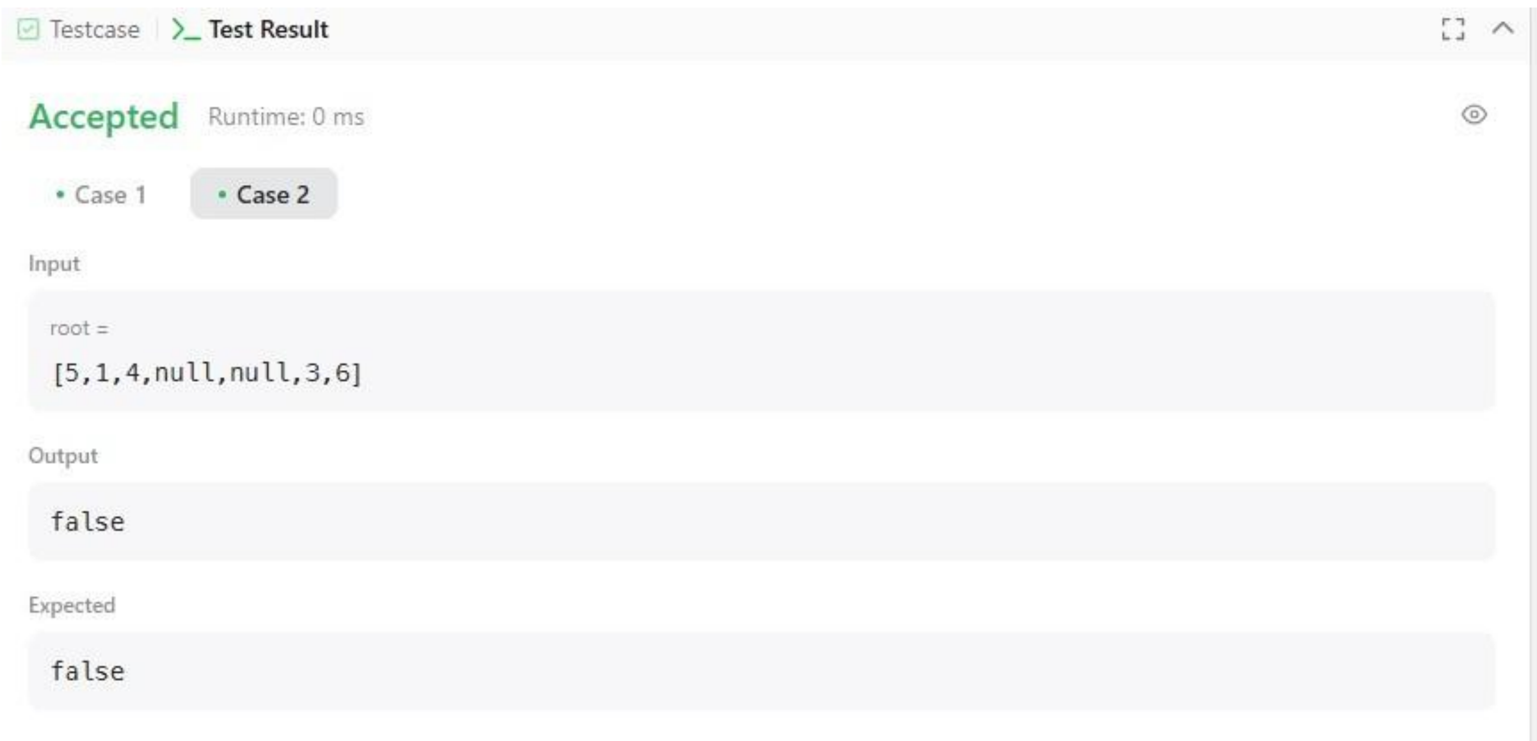
```
classSolution{
public:
   boolisValidBST(TreeNode*root){
      returnvalid(root,LONG_MIN,LONG_MAX);
   }

private:
   boolvalid(TreeNode*node,longminimum,longmaximum){ if
      (!node) return true;
      if(!(node->val>minimum&&node->val<maximum))returnfalse;
      returnvalid(node->left,minimum,node->val)&&valid(node->right,node->val,maximum);
   }
};
```

TimeComplexity:O(N)–Eachnodeisvisited once.

SpaceComplexity:O(N)–Worstcase(skewedtree),O(logN)–Bestcase(balancedtree).

Result-Alltestcasespasses





Problem-3

Aim-Giventherootofabinarytree,*checkwhetheritisamirrorofitself*(i.e.,symmetricarounditscenter).

Objective-Theobjectiveistodeterminewhetheragivenbinarytreeissymmetricarounditscenter.Thisinvolvescheckingifthe left and right subtrees are mirror images of each other. The solution should efficiently compare corresponding nodes using recursion or iteration to verify structural and value-based symmetry.

Apparatus Used:

1. **Software**:-Leetcode
2. **Hardware**:Computerwith4GBRAMand keyboard.

AlgorithmtoCheckifaBinaryTreeisSymmetric

1. BaseCaseCheck:Iftherootisnullptr,returntrue(anemptytreeissymmetric).
2. CallHelperFunction:UseahelperfunctionisMirror()tocheckiftheleftandrightsubtreesaremirrorimages.
3. CheckNullNodes: Ifbothnodesarenullptr,returntrue.Ifonlyoneisnullptr,return false.
4. CompareValues:Ifthevaluesofthetwonodesdonotmatch,returnfalse.
5. RecursiveCheck:Recursivelycheckiftheleft subtreeofonetreematchestherightsubtreeoftheotherandviceversa.
6. ReturnResult:Returnthefinalresultafterallrecursivecomparisons.

Code-

```
classSolution{ public:
   boolisSymmetric(TreeNode*root){
      return isMirror(root->left, root->right);}       }
private:    boolisMirror(TreeNode*n1,TreeNode*n2){
      if(n1==nullptr&&n2==nullptr){ return
         true; }
            if(n1==nullptr||n2==nullptr){ return
         false; }
            returnn1->val==n2->val&&isMirror(n1->left,n2->right)&&isMirror(n1->right,n2->left);
   }};
```

Result-Alltestcases passes

Testcase | >_ Test Result

Accepted Runtime: 0 ms

• Case 1 • Case 2

Input

root =

```
[1,2,2,3,4,4,3]
```

Output

```
true
```

Expected

```
true
```

Testcase | >_ Test Result

Accepted Runtime: 0 ms

• Case 1 • Case 2

Input

root =

```
[1,2,2,null,3,null,3]
```

Output

```
false
```

Expected

```
false
```

LearningOutcomes:

1. **UnderstandingTreeSymmetry:**Learnedhowtocheckifabinarytreeissymmetricbycomparingleftandrightsubtrees recursively.

2. **ValidatingBinarySearchTrees:**GainedknowledgeofverifyingwhetherabinarytreefollowsBSTpropertiesusing recursion and value constraints.

3. **ComputingTreeDepth:**Exploredrecursivedepthcalculationtodeterminetheheightofabinarytreeefficiently.

4. **RecursiveProblem-Solving:**Developedskillsinsolvingtree-relatedproblemsusingrecursionandunderstandingbase cases.

5. **HandlingEdgeCases:** Improvedunderstandingofhandling nullptrscenariostoensurerobustnessintreetraversal algorithms.