Skilling 7

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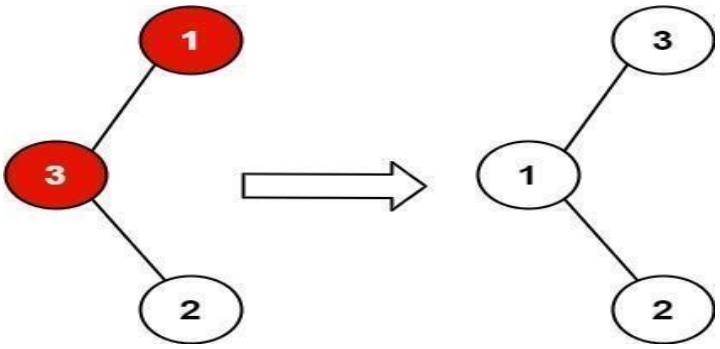
Binary Search Tree problems

1. Recover Binary Search Tree

You are given the root of a binary search tree (BST), where the values of **exactly** two nodes of the tree were swapped by mistake. *Recover the tree without changing its structure*.

Example 1:

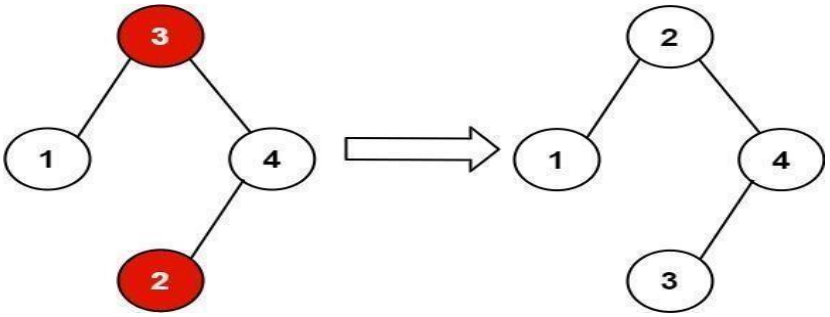


Input: root = [1,3,null,null,2]

Output: [3,1,null,null,2]

Explanation: 3 cannot be a left child of 1 because 3 > 1. Swapping 1 and 3 makes the BST valid.

Example 2:



Input: root = [3,1,4,null,null,2]

Output: [2,1,4,null,null,3]

Explanation: 2 cannot be in the right subtree of 3 because 2 < 3. Swapping 2 and 3 makes the BST valid.

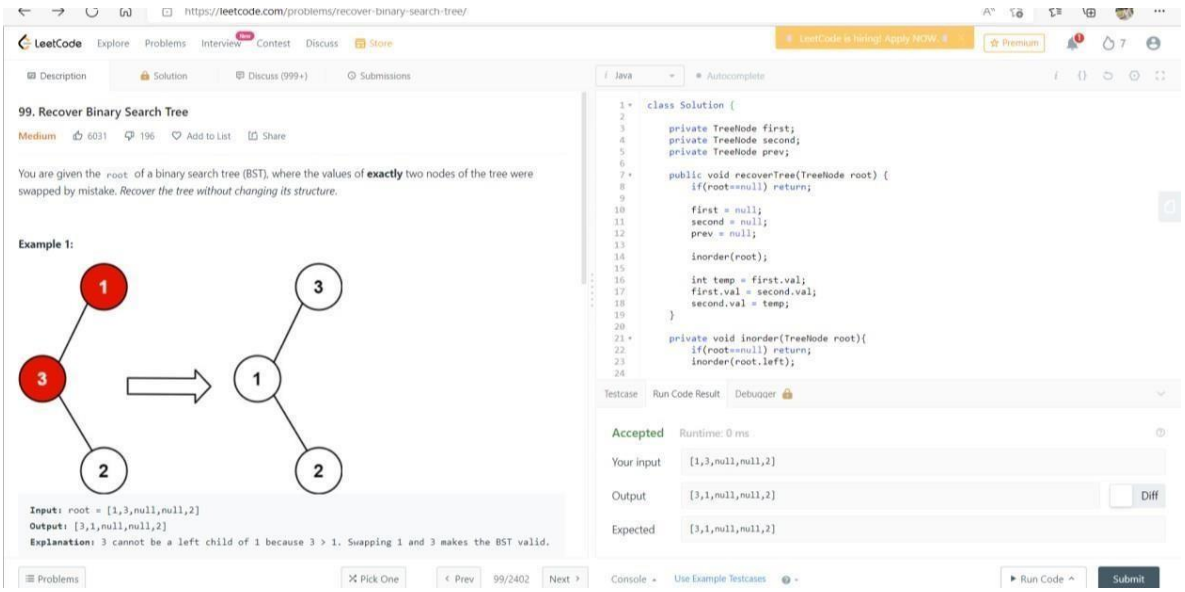
Constraints:

- The number of nodes in the tree is in the range [2, 1000].
- $-2^{31} <= Node.val <= 2^{31} - 1$

SOLUTION

```
class Solution {


    private TreeNode first;

    private TreeNode second;

    private TreeNode prev;


    public void recoverTree(TreeNode root) {

        if(root==null) return;


        first = null;

        second = null;

        prev = null;


        inorder(root);


        int temp = first.val;

        first.val = second.val;
```

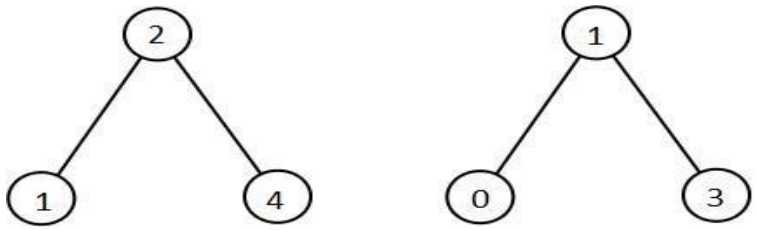
```
        second.val = temp;
    }
    private void inorder(TreeNode root){
        if(root==null) return;
        inorder(root.left);

        if(first==null && (prev != null && prev.val>=root.val)){
            first = prev;
        }
        if(first!=null && prev.val>=root.val){
            second = root;
        }
        prev = root;
        inorder(root.right);
    }
}
```



2. All Elements in Two Binary Search Trees

Given two binary search trees `root1` and `root2`, return *a list containing all the integers from both trees sorted in* ***ascending*** *order*.

Example 1:



Input: root1 = [2,1,4], root2 = [1,0,3]

Output: [0,1,1,2,3,4]

Example 2:

Input: root1 = [1,null,8], root2 = [8,1]

Output: [1,1,8,8]

Constraints:

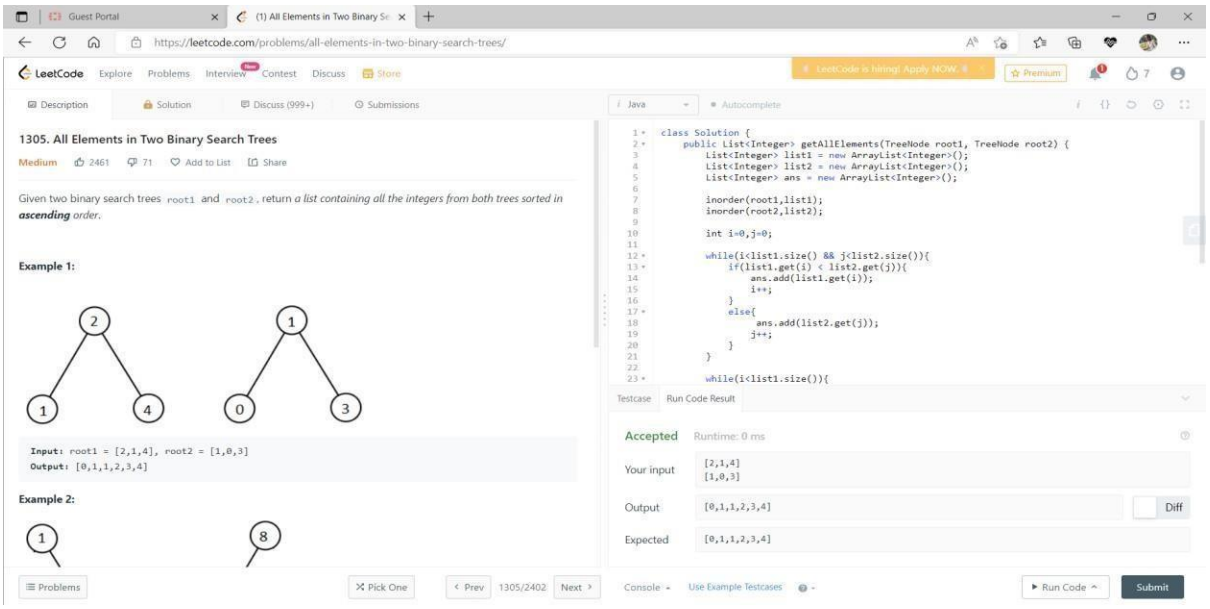
- The number of nodes in each tree is in the range [0, 5000].
- -10^5 <= Node.val <= 10^5

SOLUTION

```
class Solution {
    public List<Integer> getAllElements(TreeNode root1, TreeNode root2) {


                List<Integer> list1 = new
ArrayList<Integer>();
        List<Integer> list2 = new ArrayList<Integer>();


        List<Integer> ans = new ArrayList<Integer>();
    inorder(root1,list1);
                inorder(root2
,list2);
          int i=0,j=0;
```

```
 while(i<list1.size() && j<list2.size()){
                    if(list1.get(i) <
  list2.get(j)){

                  ans.add(list1.get(i));

                  i++;

            }

            else{

                   ans.add(list2.get(j));

                  j++;

            }

                   }
while(i<list1.size()){
            ans.add(list1.get(i));

            i++;

         }

                    while(j<list2.si
ze()){
            ans.add(list2.get(j));

            j++;

         }

          return ans;
  public void inorder(TreeNode root, List<Integer> list){
if(root       ==       null)return;       inorder(root.left,list);
list.add(root.val);
         inorder(root.right,list);
```

}



}3.Findeftmo L st and Rightmost nodes for a given node:

Given a preorder sequence of the binary search tree of **N** nodes. The task is to find its leftmost and rightmost nodes.

Examples:
Input : N = 5, preorder[]={ 3, 2, 1, 5, 4 }
Output : Leftmost = 1, Rightmost = 5
The BST constructed from this preorder sequence would be:

```
    3
   / \
  2   5
 /   /
1   4
```

Leftmost Node of this tree is equal to 1
Rightmost Node of this tree is equal to 5

Input : N = 3 preorder[]={ 2, 1, 3}
Output : Leftmost = 1, Rightmost = 3

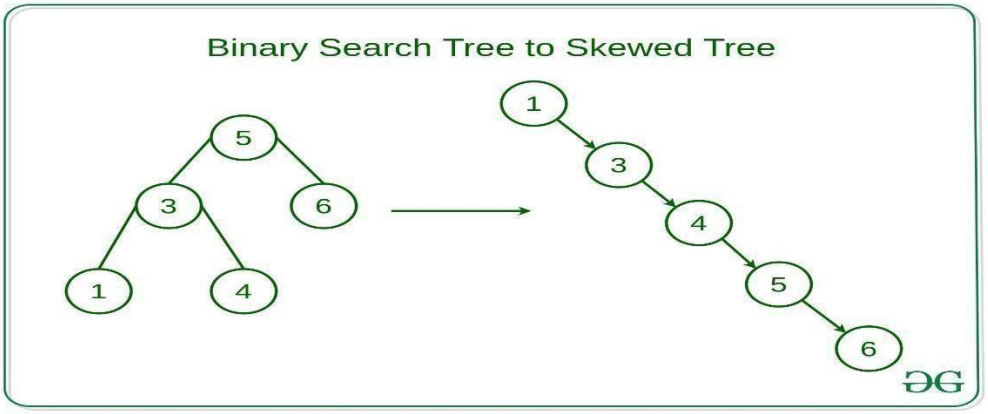
SOLUTION

```
class GFG
{ static void LeftRightNode(int preorder[], int n)
{
int min = Integer.MAX_VALUE, max = Integer.MIN_VALUE;
    for (int i = 0; i < n; i++)
    {
```

```
        if (min > preorder[i])
min = preorder[i]; if (max <
preorder[i]) max = preorder[i];
     }

     System.out.println("Leftmost node is " + min);
     System.out.println("Rightmost node is " + max);
 } public static void main(String[]
  args)
 {
 int preorder[] = { 3, 2, 1, 5, 4 }; int n =
         5;
         LeftRightNode(preorder, n);

 }
 }
```

4. Convert BST into Skewed Tree:

Given a Binary Search Tree and a binary integer **K**, the task is to convert Binary search tree into a Skewed Tree in increasing order if **K = 0** or in decreasing order if **K = 1**.



Examples:

Input: K = 0,

```
    5
   / \
  3 6 Output:
 3
  \
  5
   \
   6
```

Input: K = 1,

```
    2
```

/ \
1 3 **Output:**
3
\
2
\
1

SOLUTION

```
package p10;
import java.io.*;
public class Binarysearchtree {
class Node
      { int val;
          Node left, right;


          Node(int item)
          { val = item; left =
              right = null;
          }
      } class
      GFG
      { public static Node node;
          static Node prevNode =
          null; static Node headNode
          = null;

static void flattenBTToSkewed(Node root,
                                        int order)
          {


              if(root == null)
              { return;
              }

if(order > 0)
              { flattenBTToSkewed(root.right, order);
              } else
              { flattenBTToSkewed(root.left, order);
              }
              Node rightNode = root.right;
              Node leftNode = root.left;

if(headNode == null) { headNode =
              root; root.left =
              null; prevNode =
              root;
              } else
              { prevNode.right = root;
                  root.left = null;
                  prevNode = root;
              }

if (order > 0)
```

```
                { flattenBTToSkewed(leftNode, order);
                } else
                { flattenBTToSkewed(rightNode, order);
                }
            }

static void traverseRightSkewed(Node root)
            { if(root == null)
                { return;
                }
                System.out.print(root.val + " ");
                traverseRightSkewed(root.right);
            }

public static void main (String[] args)
            {
                GFG tree = new GFG;
              tree.node = new Node(5);
                tree.node.left = new Node(3);
                tree.node.right = new Node(6);

int order = 0; flattenBTToSkewed(node,
                order);
                traverseRightSkewed(headNode);
            }
        }
    }
```

Reference links:

1. https://leetcode.com/problems/recover-binary-search-tree/
2. https://leetcode.com/problems/all-elements-in-two-binary-search-trees/
3. https://www.geeksforgeeks.org/find-leftmost-and-rightmost-node-of-bst-from- its-given-preorder-traversal/
4. https://www.geeksforgeeks.org/convert-a-binary-search-tree-into-a-skewed-tree-in-increasing-or-decreasing-order/