Tree [CO2]

Instructions for students:

- Complete the following methods on Tree.
- You may use any language to complete the tasks.
- All your methods must be written in one single .java or .py or .pynb file. DO NOT CREATE separate files for each task.
- If you are using JAVA, you must include the main method as well which should test your other methods and print the outputs according to the tasks.
- If you are using PYTHON, then follow the coding templates shared in this

folder.

NOTE:

- **YOU CANNOT USE ANY BUILT-IN FUNCTION EXCEPT len IN PYTHON. [negative indexing, append is prohibited]**
- **YOU HAVE TO MENTION SIZE OF ARRAY WHILE INITIALIZATION**
- **YOUR CODE SHOULD WORK FOR ALL RELEVANT SAMPLE INPUTS**
- **DO NOT USE LIST, QUEUE**

You may use default parameter or util function if needed.

1. Mirror Mirror: [6 Marks]

Given a binary tree, convert it into its mirror.

Sample Input:

```
     10
     / \
   20   30
   / \
 40   60
```

Sample Output:

```
     10                    10
     / \       Mirror     / \
   20   30      —>      30  20
   / \                       / \
 40   60                   60  40
```

Inorder Traversal of mirror: 30 10 60 20 40

2. Level Max: [7 Marks]

Given a binary tree, find the smallest value in each level.

Sample Input: [You can use dictionary/list here.]

```
      4
     / \
    2   9
   /   / \
  7   3   -5
```

Sample Output: 4 2 -5

Explanation:

There are 3 levels in the tree

Level 0: {4}, min= 4

Level 1: {2, 9}, min= 2

Level 2: {7, 3, -5}, max = -5

3. Inorder Predecessor: [4 Marks]

Given a BST, and a reference to a Node x in the BST, find the Inorder Predecessor of the given node in the BST.

DO NOT USE LIST

Sample Input:

```
        20
      /    \
     8      22
    / \
   4   12
      / \
    10   14
```

x = reference of the node containing 20

Sample Output: reference of the node 14

Explanation:

The inorder predecessor of a parent node is the largest (rightmost) node in the left subtree. The rightmost node in the left subtree of parent node 20 is 14.

Another explanation is that, the inorder traversal of the given tree:

4 8 10 12 14 20 22

Hence, the inorder successor of 20 is 14.

Sample Input 2:

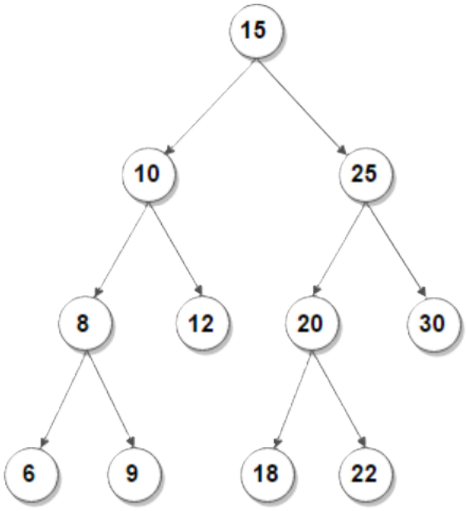
x = reference of the node containing 8

Sample Output: reference of the node 4

4. Find the Lowest Common Ancestor (LCA) of two nodes in a BST [8 Marks]

The lowest common ancestor (LCA) of two nodes x and y in the BST is the lowest (i.e., deepest) node that has both x and y as descendants. In other words, the LCA of x and y is the shared ancestor of x and y that is located farthest from the root.

Corner Case: if y lies in the subtree rooted at node x, then x is the LCA; otherwise, if x lies in the subtree rooted at node y, then y is the LCA.

	LCA(6,12) = 10 LCA(20,6) = 15 LCA(18,22) = 20 LCA(20,25) = 25 LCA(10,12) = 10

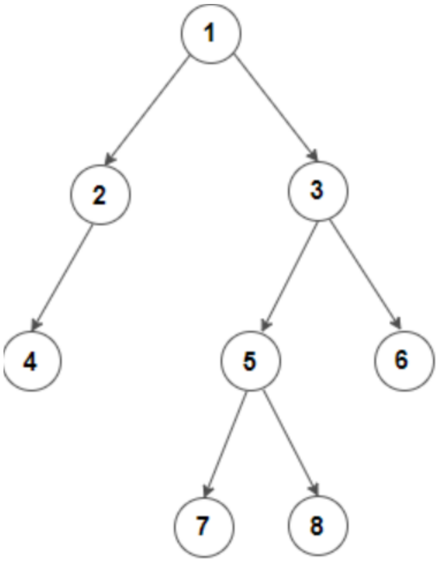
Graded Bonus Task 1: [2 Marks]

Given a Binary Tree, Write a function that finds if the given Binary Tree is SumTree. A SumTree is a Binary Tree where the value of a node is equal to the sum of the nodes present in its left subtree and right subtree. An empty tree is SumTree and the sum of an empty tree can be considered as 0. A leaf node is also considered as SumTree.

Sample Input:	Sample Output
26 / \ 10 3 / \ \ 4 6 3	True

Graded Bonus Task 2: [3 Marks]

Given a Binary Tree, Write a function that finds the difference between sum of all nodes present at odd and even levels in a binary tree, i.e. sum of all odd level nodes - sum of all even level nodes.

Sample Input:	Sample Output	Explanation
	4	-1+2+3-4-5-6+7+8 = 4