CS 61B Spring 2021

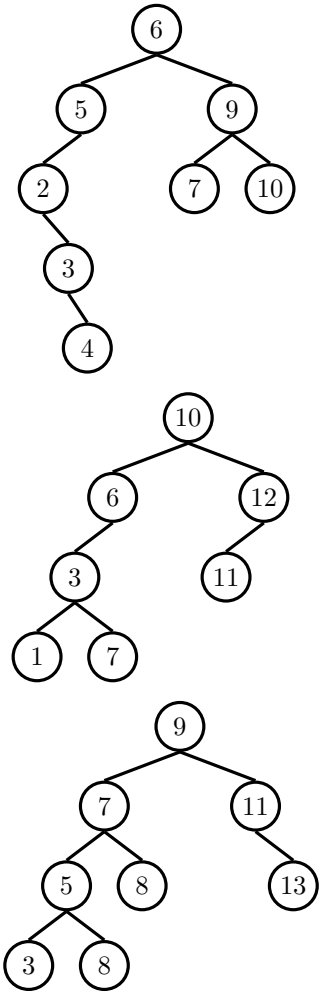
Trees

Topical Review Section 5: March 7, 2021

1 Is BST?

(a) Given the following binary trees, determine if each is a binary search tree, and whether the height of the tree is the same as the height of the optimal binary search tree containing the given elements.

Note: Height of a tree is calculated by counting number of edges from the root to the furthest leaf node.



(b) The following method `isBSTGood` is supposed to return `False` if a given tree is not a BST. Unfortunately it is returning the wrong answer when given some binary trees. Think about an example of a binary tree for which `isBSTGood` fails. The `TreeNode` class is defined as follows. Assume that there are never any duplicate elements.

```
class TreeNode {
    int val;
    TreeNode left;
    TreeNode right;
}
```

Hint: You will find `Integer.MIN_VALUE` and `Integer.MAX_VALUE` helpful when writing `isBSTGood`.

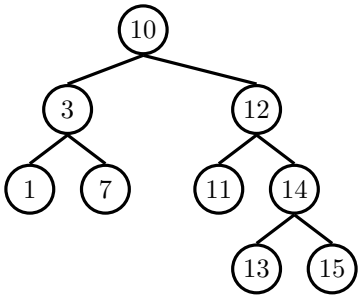
```
public static boolean isBSTGood(TreeNode T) {
    if (T == null) {
        return true;
    } else if (T.left != null && T.left.val > T.val) {
        return false;
    } else if (T.right != null && T.right.val < T.val) {
        return false;
    } else {
        return isBSTGood(T.left) && isBSTGood(T.right);
    }
}
```

(c) Rewrite `isBSTGood` so that it returns true then the given tree is a BST and false otherwise.

```
public static boolean isBSTGood(TreeNode T) {



}

public static boolean isBSTGoodHelper(_____________________________________) {









}
```

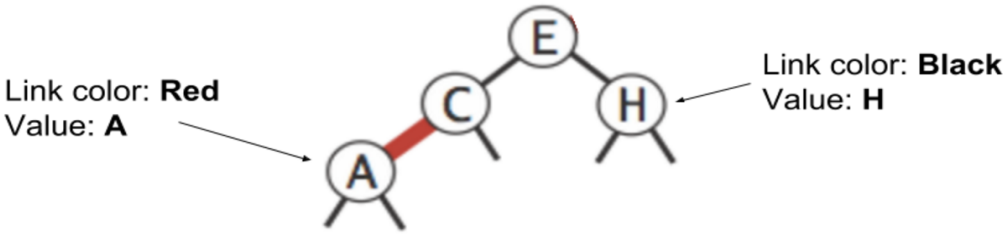
2 Tree Traversals

Write the pre-order, in-order, post-order, and level-order traversals of the above binary search tree.



3 What color am I?

For each of the situations below in a valid LLRB tree, indicate whether the node's link to its parent is red, black, or either.



Questions:

(a) _____ The largest value in a valid B-tree with more than one node.

(b) _____ The smallest value in a valid B-tree with more than one node.

(c) _____ A node whose parent is red (parent's link color is red).

(d) _____ A node whose children are the same color.

(e) _____ A freshly inserted node after the insertion operation is completed.

4 Balanced Search Tree Mechanisms

(a) Insert the following numbers in order into a 2-3 tree: 20, 10, 35, 40, 50, 5, 25, 15, 30, 60.

(b) Draw a red-black tree that corresponds to the 2-3 tree you drew in (a).