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Finding the Predecessor and Successor Node of a Binary Search Tree

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Finding the Predecessor and Successor Node of a Binary Search Tree

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A Binary Search Tree (BST) is a commonly used data structure that can be used to search an item in $O(\log N)$ time. A BST should have the following characteristics: its left nodes are smaller than the root and its right nodes are larger than the root.

If we perform an **inorder traversal**: left nodes first, current node, and then right nodes – we will have a fully sorted sequence.

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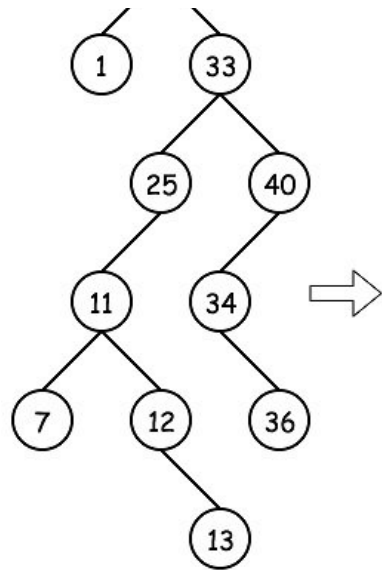
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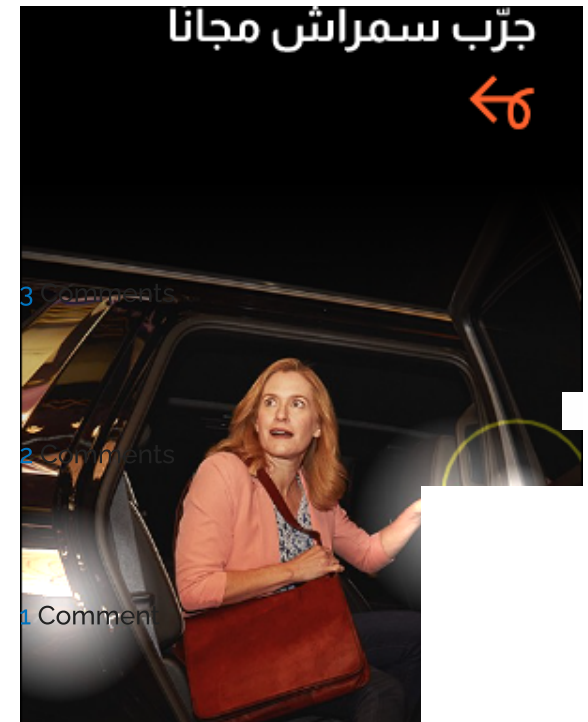
```

def inorder(root):
    if root:
        return inorder(root.left) + [root.val] + inorder(root.right)
    else:
        return []
  
```

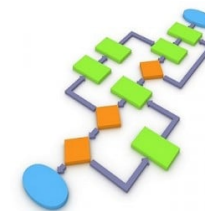
→ [1, 2, 7, 11, 12, 13, 25, 33, 34, 36, 40]

inorder-traversal-of-a-bst

To find the Predecessor or Successor Node of a BST – we can perform the following algorithms:



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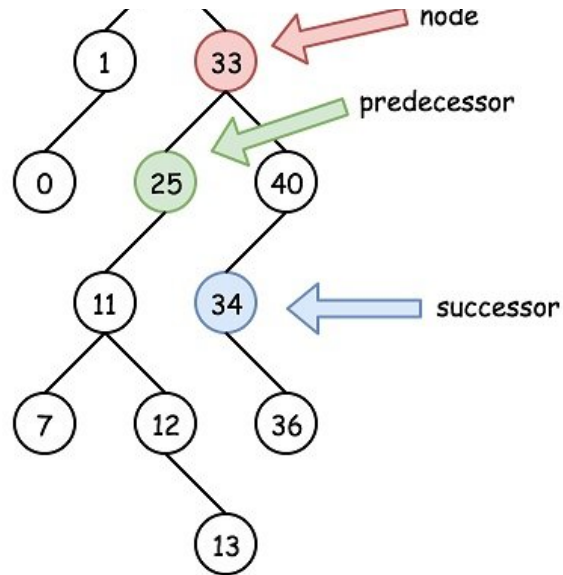
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predecessor =
one step left and then right till you can

successor =
one step right and then left till you can

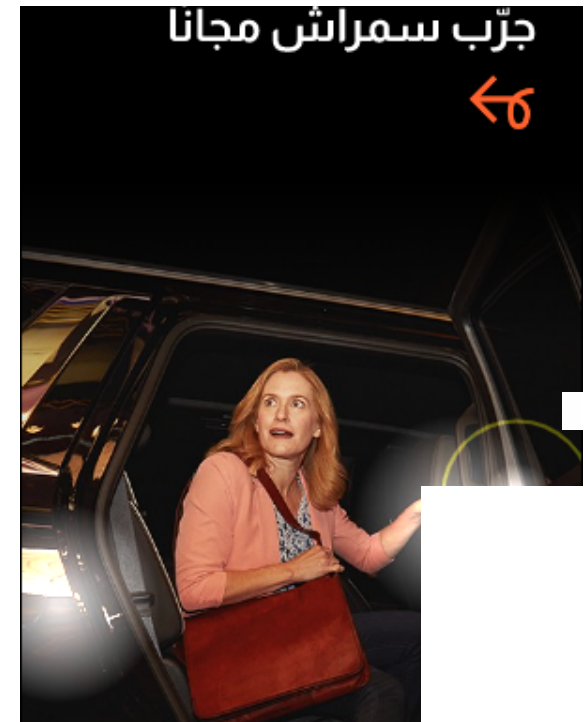
predecessor-and-successor-of-a-bst

FIND THE PREDECESSOR NODE OF A BINARY SEARCH TREE

The predecessor node is the largest node that is smaller than the root (current node) – thus it is on the left branch of the [Binary Search Tree](#), and the rightmost leaf (largest on the left branch).

The C++ function to find the predecessor node of a BST node:

```
1 | TreeNode* predecessor(TreeNode* root) {
2 |     if (!root) return nullptr;
3 |     root = root->left;
4 |     while (root->right) root = root->right;
5 |     return root;
}
```



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```

1 public int predecessor(TreeNode root) {
2     if (root == null) return null;
3     root = root.left;
4     while (root.right != null) root = root.right;
5     return root;
6 }

```

Python function to get the predecessor of a BST:

```

1 def predecessor(root):
2     if root is None:
3         return None
4     root = root.left
5     while root.right:
6         root = root.right
7     return root

```

FIND THE SUCCESSOR NODE OF A BINARY SEARCH TREE

On the other hand, the successor node is the smallest node that is bigger than the root/current – thus it is on the right branch of the BST, and also on the leftmost leaf (smallest on the right branch).

The C++ function to get the successor node of a Binary Search Tree.

```

1 TreeNode* successor(TreeNode* root) {
2     if (!root) return nullptr;
3     root = root->right;
4     while (root->left) root = root->left;
5     return root;
6 }

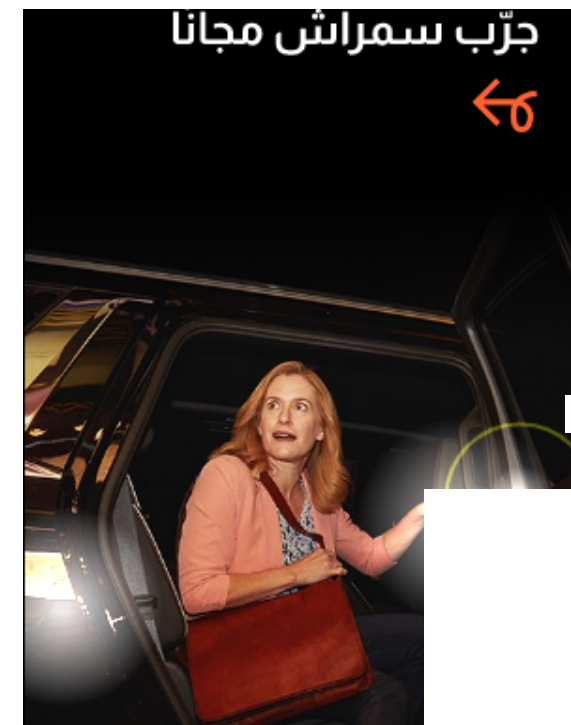
```

Java method to get the successor:

```

1 public int successor(TreeNode root) {

```



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```

1 def successor(root):
2     if root is None:
3         return None
4     root = root.right
5     while root.left:
6         root = root.left
7     return root

```

</>

All implementation of finding **successor** or predecessor takes $O(1)$ constant space and run $O(N)$ time (when BST is just a degraded linked list) – however, on average, the complexity is $O(\log N)$ where the binary tree is balanced.

Finding successor or predecessor is very useful – for example, we can use this to **delete a node in a binary search tree**.



See also: [Compute the Inorder Successor of a Binary Tree](#)

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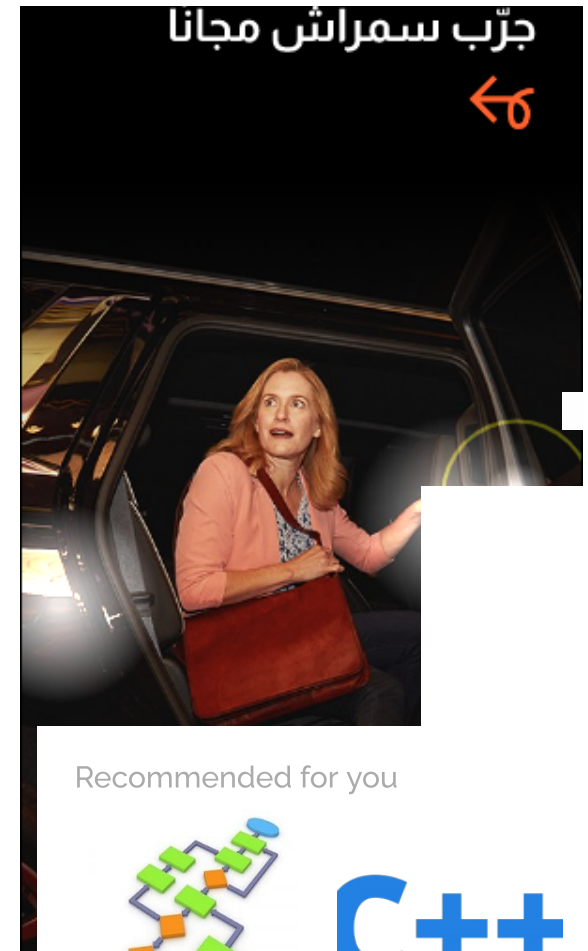
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The...



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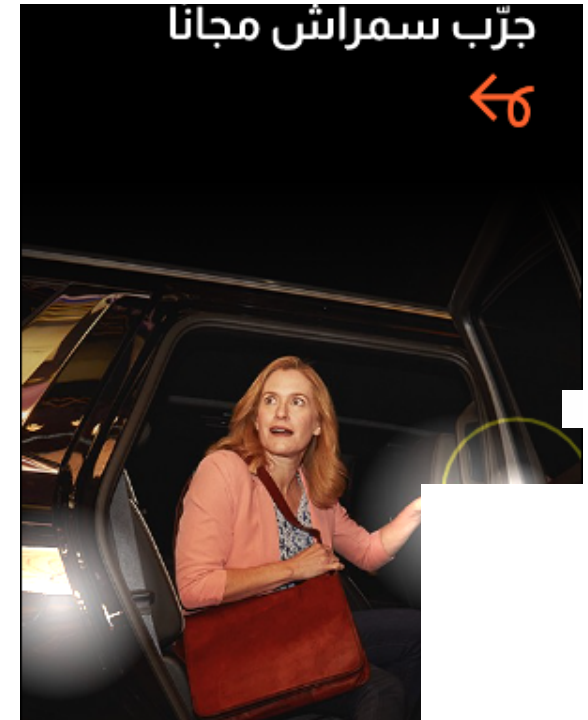
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Xav

Your algorithms doesn't work when a node is a leaf, and it also has no predecessor (if you're looking for the predecessor), like the MIN(tree).

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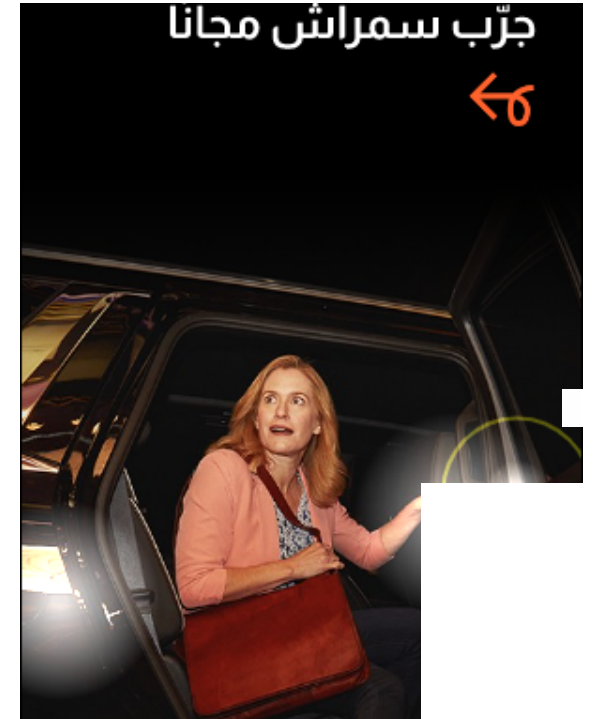
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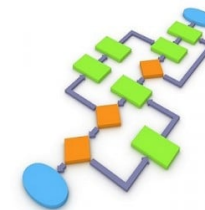
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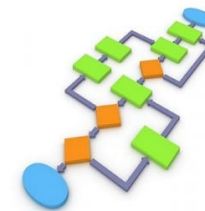
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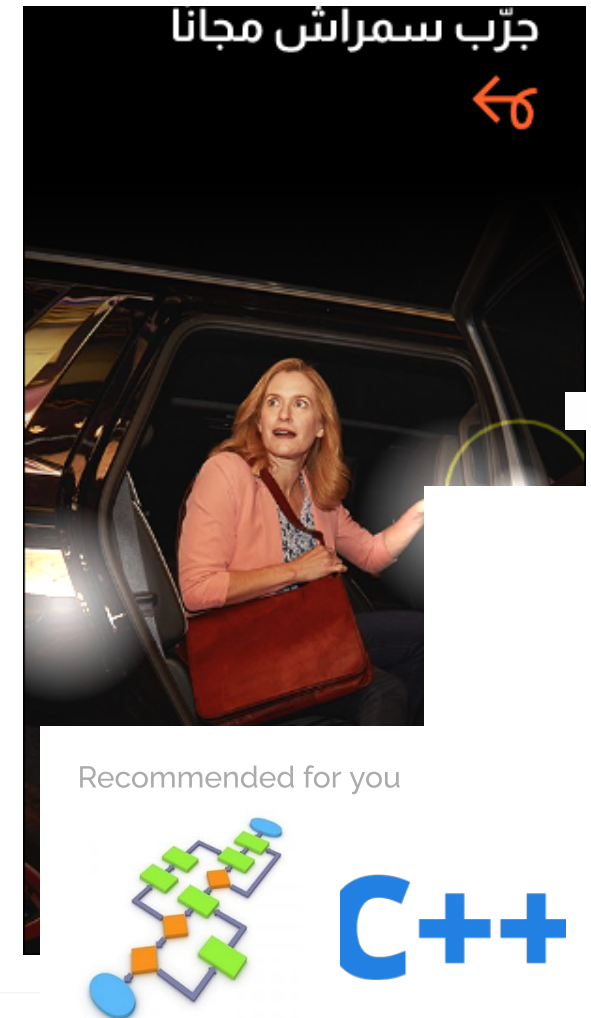
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