Monday, March 14, 2022 7:11 PM

Find median of BST in O(n) time and O(1) space

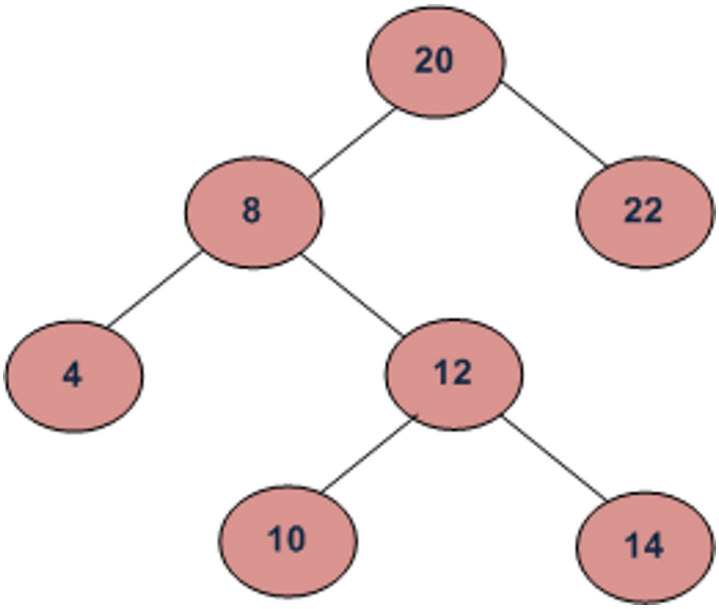
- Difficulty Level : Hard
- Last Updated : 26 Oct, 2021

Given a Binary Search Tree, find median of it.

If no. of nodes are even: then median = ((n/2th node + (n+1)/2th node) /2

If no. of nodes are odd : then median = (n+1)/2th node.

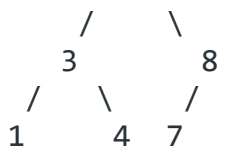
For example, median of below BST is 12.



More Examples:

```
 Given BST(with odd no. of nodes) is :
                    6
                  /    \
                 3       8
               /   \    /  \
              1     4  7    9
Inorder of Given BST will be : 1, 3, 4, 6, 7, 8, 9
So, here median will 6.

Given BST(with even no. of nodes) is :
                    6
```



```
Inorder of Given BST will be : 1, 3, 4, 6, 7, 8
So, here median will  (4+6)/2 = 5.
```

Asked in: Google

Recommended: Please solve it on "***PRACTICE***" first, before moving on to the solution.

To find the median, we need to find the Inorder of the BST because its Inorder will be in sorted order and then find the median i.e.

The idea is based on K'th smallest element in BST using O(1) Extra Space

The task is very simple if we are allowed to use extra space but Inorder traversal using recursion and stack both use Space which is not allowed here. So, the solution is to do Morris Inorder traversal as it doesn't require any extra space.

Implementation:

```
1- Count the no. of nodes in the given BST
   using Morris Inorder Traversal.
2- Then Perform Morris Inorder traversal one
   more time by counting nodes and by checking if
   count is equal to the median point.
   To consider even no. of nodes an extra pointer
   pointing to the previous node is used.
```

From <https://www.geeksforgeeks.org/find-median-bst-time-o1-space/>