543. Diameter of Binary Tree

Dec. 10, 2017 | 279.6K views

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Given a binary tree, you need to compute the length of the diameter of the tree. The diameter of a binary tree is the length of the **longest** path between any two nodes in a tree. This path may or may not pass through the root.

Example:
Given a binary tree

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

Return **3**, which is the length of the path [4,2,1,3] or [5,2,1,3].

Note: The length of path between two nodes is represented by the number of edges between them.

Approach #1: Depth-First Search [Accepted]

Intuition

Any path can be written as two *arrows* (in different directions) from some node, where an arrow is a path that starts at some node and only travels down to child nodes.

If we knew the maximum length arrows `L, R` for each child, then the best path touches `L + R + 1` nodes.

Algorithm

Let's calculate the depth of a node in the usual way: max(depth of node.left, depth of node.right) + 1. While we do, a path "through" this node uses 1 + (depth of node.left) + (depth of node.right) nodes. Let's search each node and remember the highest number of nodes used in some path. The desired length is 1 minus this number.

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```python
class Solution(object):
    def diameterOfBinaryTree(self, root):
        self.ans = 1
        def depth(node):
            if not node: return 0
            L = depth(node.left)
            R = depth(node.right)
            self.ans = max(self.ans, L+R+1)
            return max(L, R) + 1

        depth(root)
        return self.ans - 1
```

Complexity Analysis

- Time Complexity: $O(N)$. We visit every node once.
- Space Complexity: $O(N)$, the size of our implicit call stack during our depth-first search.

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mbowen13 ★ 372 February 21, 2019 7:24 AM
It is arbitrary to add 1 to the path and subtract from the return answer. You know that the path is the depth of the left subtree plus the depth of the right subtree, so that is all you have to know.

```
self.ans = 0
```

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alex_xu ★ 64 January 14, 2018 9:45 PM
Why u call "Depth" here? Should we call it as the "height"?
https://stackoverflow.com/questions/2603692/what-is-the-difference-between-tree-depth-and-height
https://en.wikipedia.org/wiki/Tree_(data_structure)

Correct me if I am wrong.

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cissyyao ★ 69 June 22, 2018 11:23 AM
My explaination for +1, -1 quesition like this:
just simply change name of "ans" to "number_of_nodes", then read the code, you will understand it easily why the code is doing this.
It simply count the number of nodes and return diameter, which is number of nodes -1. So everything reads simpler after this name exchange.

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user8920 ★ 25 June 15, 2018 9:07 AM
Why do the +1 in the depth method, when you just -1 in the main method anyways?

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harshaks152 ★ 66 June 22, 2018 1:23 AM
u dont need to do minus 1
if Math.max(ans, L+R); and set ans=0

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grijesh ★ 10 February 26, 2019 10:29 AM
Shouldn't it be called height rather than depth?

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Albert2522 ★ 31 January 3, 2018 3:38 AM
Why the solution with global variable is welcome on leetcode?
Everyone know, it's a bad practice. And at the real interview, is better to think about code design and good practices as well, besides time and space complexity.
Here is the solution without recursion and global variable:

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parate ★ 5 April 22, 2018 11:19 PM
Instead of global variable ans, one can pass the as additional parameter

```
int ans[] = new int[]{Integer.MIN_VALUE};
```

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jocelynayoga ★ 438 December 27, 2017 11:03 AM
I think the space complexity is O(H), H is the height of the binary tree

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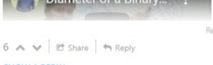
john1jan ★ 9 June 12, 2019 6:55 AM
https://www.youtube.com/watch?v=ey7DYc9OANo



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