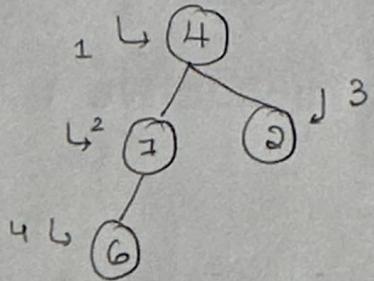


Brute force or O(n) Solution

BFS & count the nodes

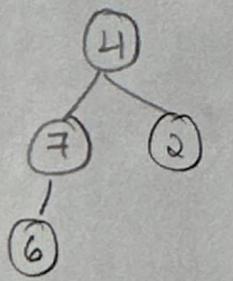


$\rightarrow O(\log_2)$ solution : (Using height of tree) $\rightarrow 2^h - 1$

Problem with using formula

$$1 + \max(\text{leftTree height}, \text{RightTree height})$$

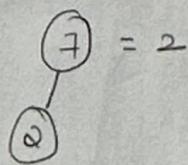
$$1 + \max(\text{leftTree height}, \text{RightTree height})$$



$$1 + \max(\text{leftTree height}, \text{RightTree height})$$

↓

$\textcircled{2} = 1$



$$= 1 + \max(2, 1) = 1 + 2 = 3$$

» Height of Tree = 3

$$\gg \text{NO of Nodes} = 2^h - 1 = 2^3 - 1 = 8 - 1 = \textcircled{7}$$

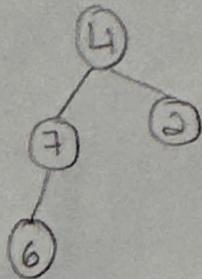
7 is completely wrong, the answer should be 4.

Why?

The formula $1 + \max(\text{leftTree height}, \text{RightTree height})$ assumed the tree is a balanced Tree

Solution

- For each Level check if the tree is balanced.
- If the tree is balanced return $(2^n - 1)$ nodes
- Else return $1 + \text{nodes on left subtree} + \text{nodes on right subtree}$



$$\text{root} = 4$$

$$\text{Left Tree height} = \begin{array}{c} 4 \\ | \\ 7 \\ | \\ 6 \end{array} = 3$$

$$\text{Right Tree height} = \begin{array}{c} 4 \\ | \\ 2 \end{array} = 2$$

left Tree height \neq right Tree height

↳ $\text{root} = 7$

$$\text{Left Tree height} = \begin{array}{c} 7 \\ | \\ 6 \end{array} = 2$$

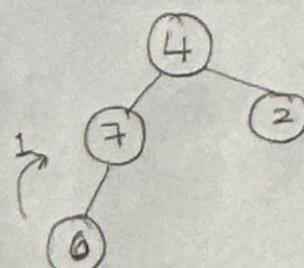
$$\text{right Tree height} = 0$$

The tree is imbalanced, ie LeftTree height \neq RightTree height

↳ $\text{root} = 6 \rightarrow \text{leaf node}$

$$\text{Left Tree} = \begin{array}{c} 6 \end{array}$$

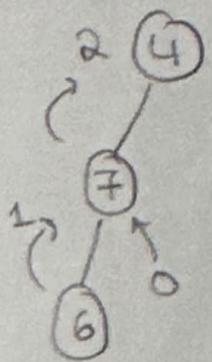
$$\text{Right Tree} = \begin{array}{c} 6 \end{array}$$



When there is 1 node, the height is balanced

$$\text{return } 2^h - 1 = 2^0 - 1 = 2 - 1 = 1$$

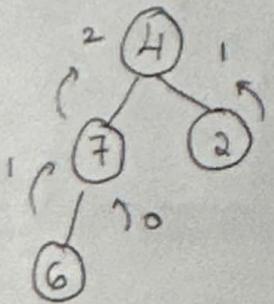
↳ Now node 7 will return 2



$$\begin{aligned} &= 1 + \text{leftTree height} + \text{rightTree height} \\ &= 1 + 1 + 0 = 2 \end{aligned}$$

↳ $\text{root} = 2$

since this is the Only node , the node will return 1



↳ $\text{root } 4 \text{ will return } 4$

$$\begin{aligned} &= 1 + \text{leftTree height} + \text{rightTree height} \\ &= 1 + 2 + 1 = 4 // \end{aligned}$$