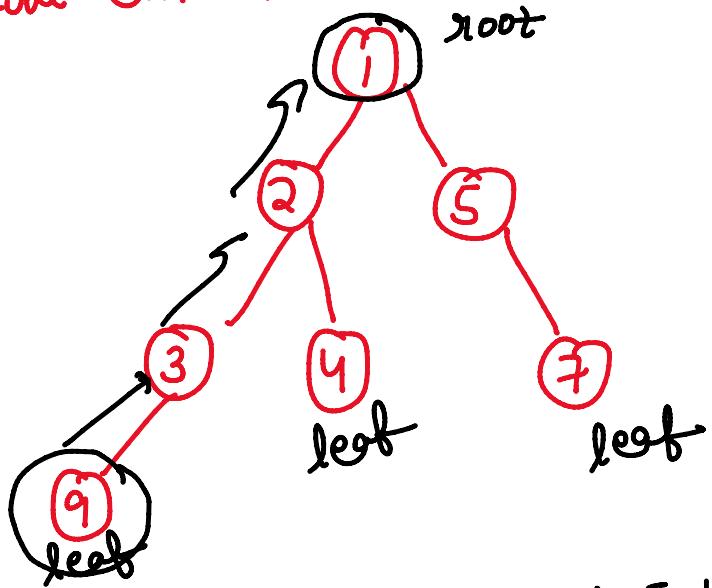


Binary Tree Intro

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Every node can have at max 2 children.

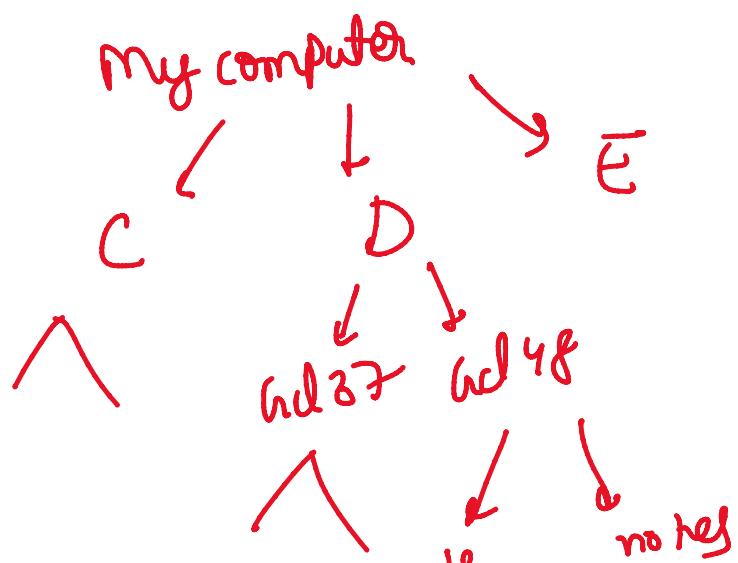
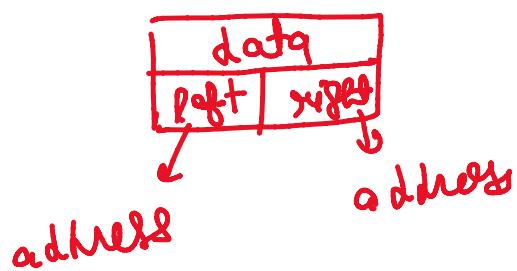


root
leaf
parent (2)(5)
children (3,4), (7)
sibling? (2,5)
(3,4)
(5,1)
(2,1)
Ancestors!
(3,2,1)

Unfilled Node



TreeNode

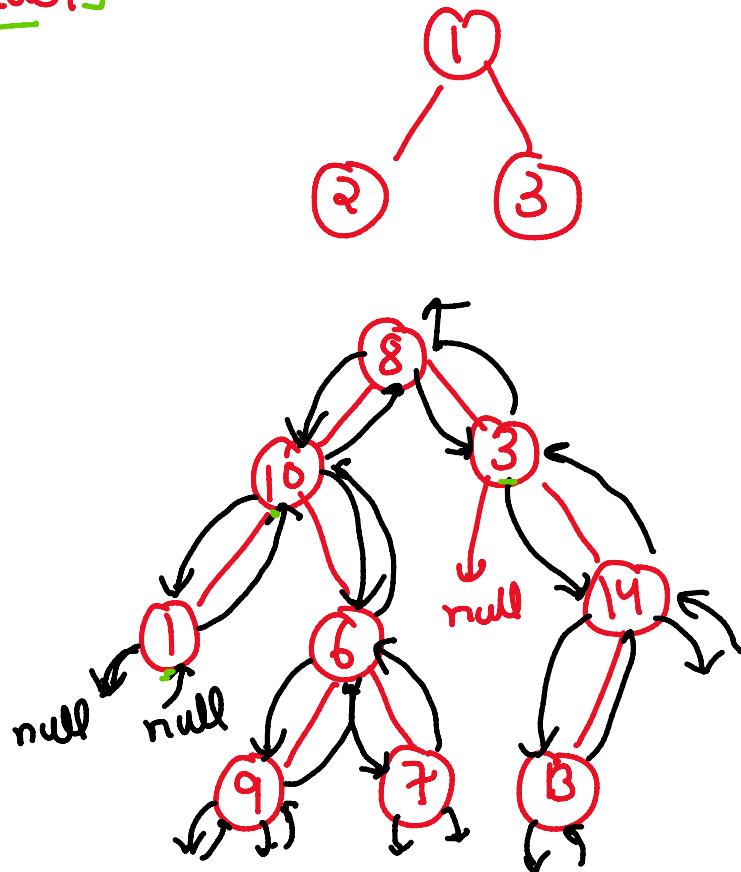




Tree Traversals

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- Inorder (`left, root, right`) → 2, 1, 3
- Preorder (`root, left, right`) → 1, 2, 3
- Postorder (`left, right, root`) → 2, 3, 1
- Level order }



(`root, left, right`)

preorder :- 8, 10, 1, 6, 9, 7, 3, 14, 13 } }

inorder :-

(`left, root, right`)

postorder :-

(`left, right, root`)

1, 10, 9, 6, 7, 8, 3, 13, 14 } }

1, 9, 7, 6, 10, 13, 14, 3, 8 } }

1, 9, 7, 6, 10, 13, 14, 3, 8 } }

r++

Jav9

C++

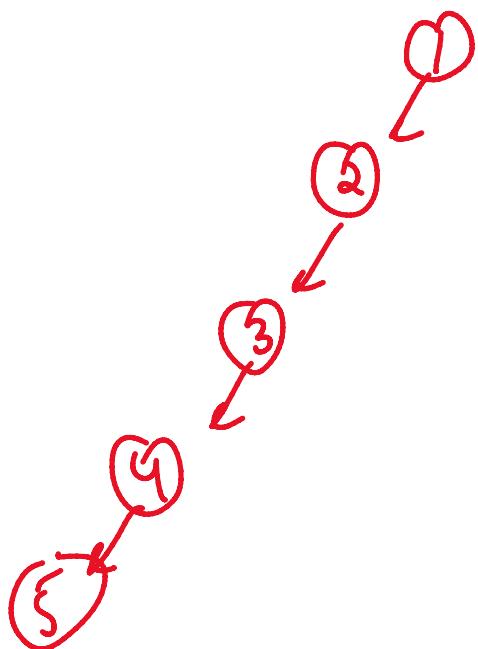
root → left
root → right
root → val
NULL
vector

Jav9

root.left
root.right
root.val
null
arraylist

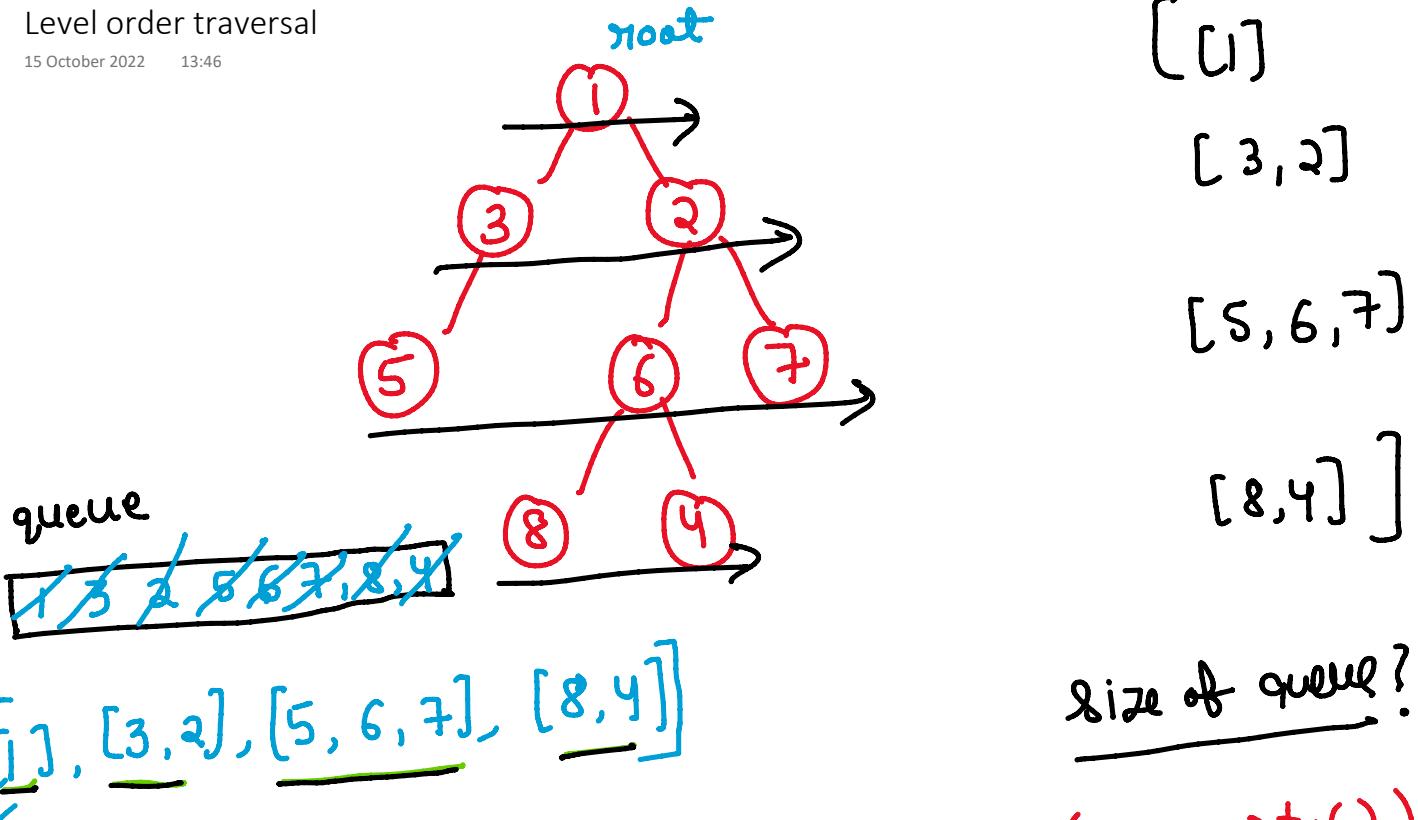
recusive

iterative } stack



Level order traversal

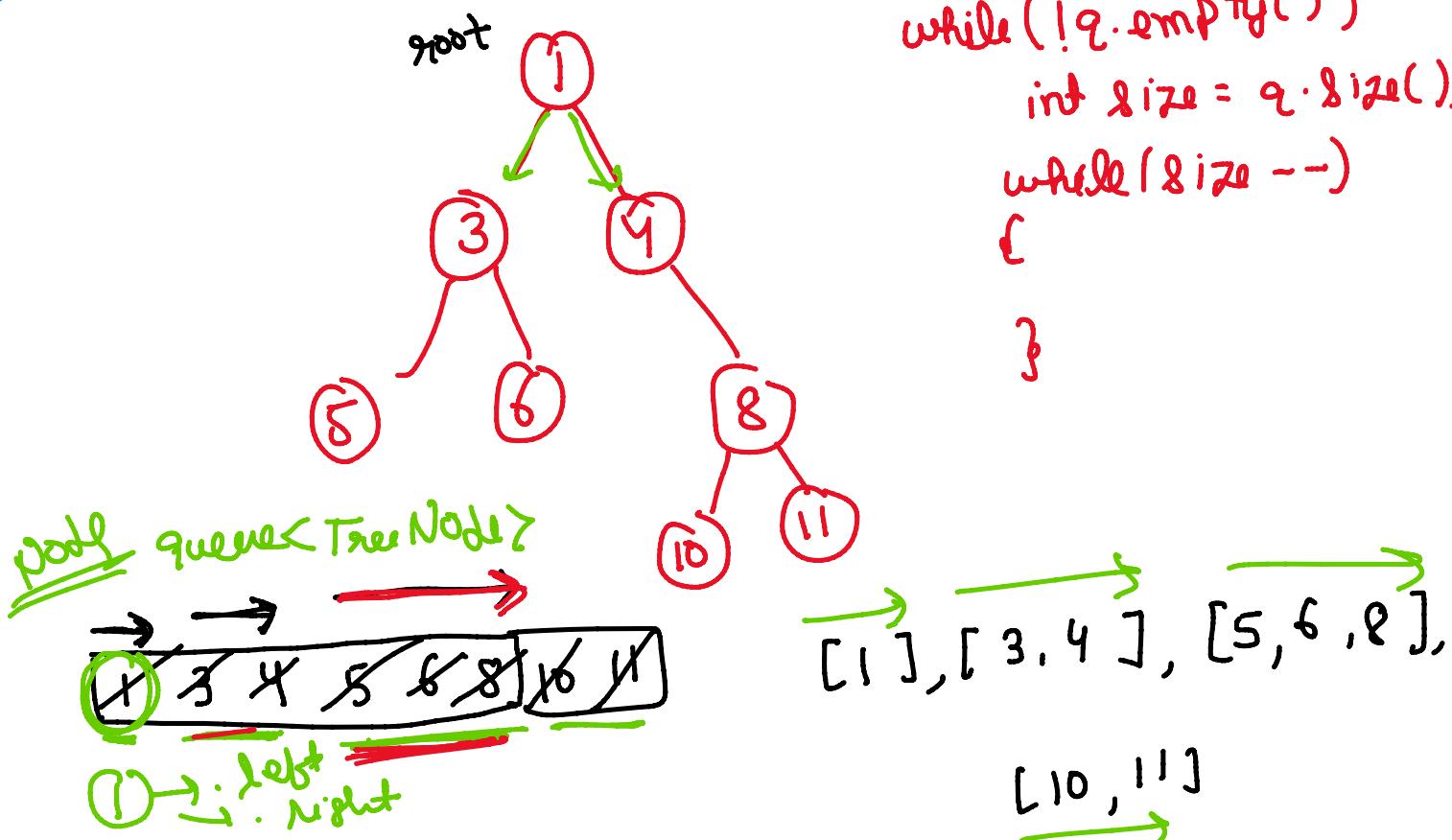
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[1], [3, 2], [5, 6, 7], [8, 4]

size of queue?

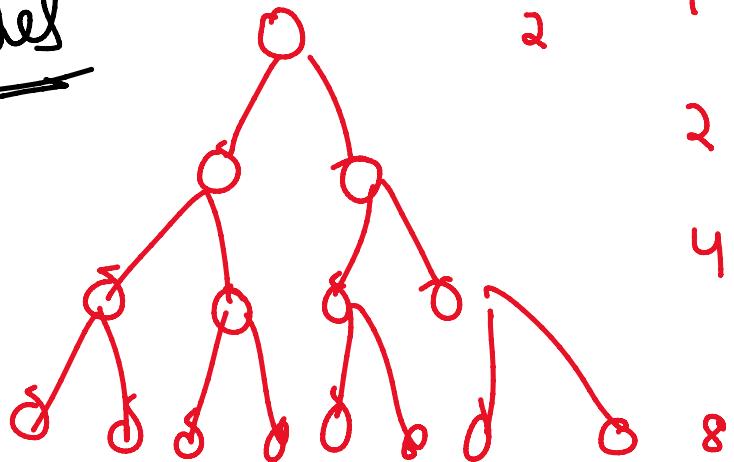
```
while(!q.empty())
    int size = q.size();
    while(size--)
    {
    }
```



$O(N)$
 $(O(N)) + O(N) \approx O(N)$

$$O(N) + O(N) = O(N)$$

no. of nodes



2

1

2

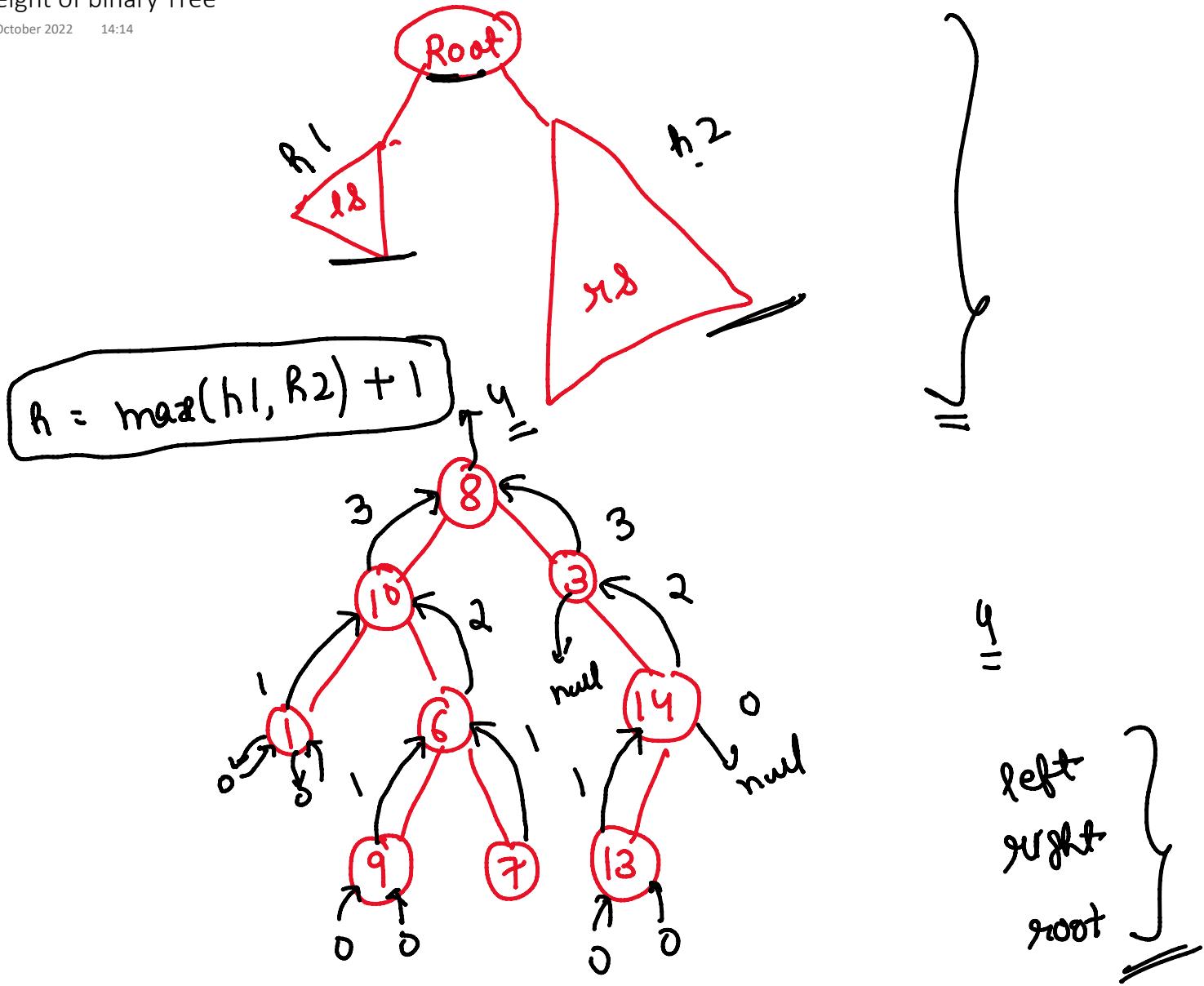
4

8

$$\begin{aligned} & 2^0 \\ & 2^1 \\ & 2^2 \\ & 2^3 \\ & \vdots \\ & 2^{N-1} \end{aligned}$$

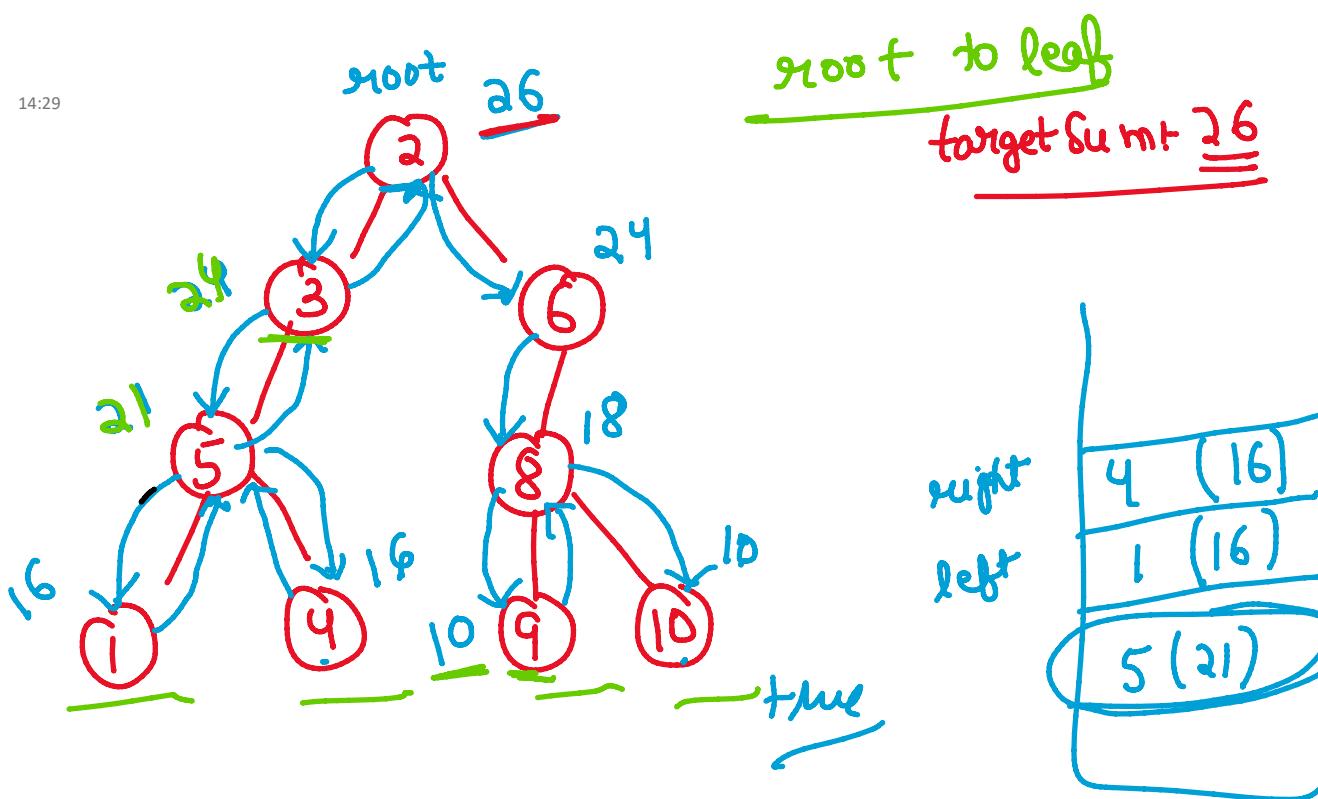
Height of binary Tree

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Path Sum

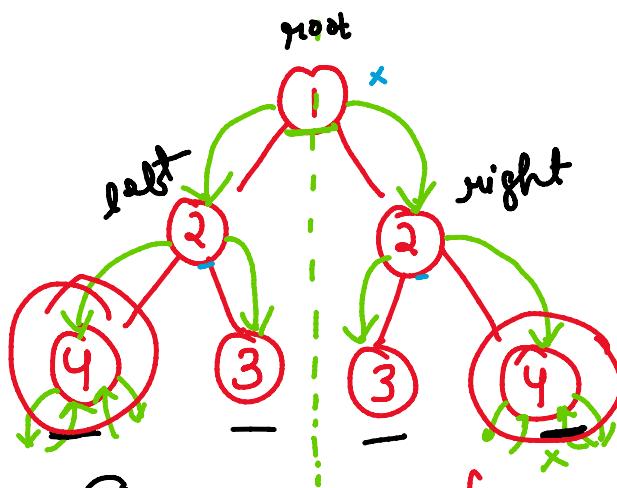
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Symmetric Tree

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2 cells



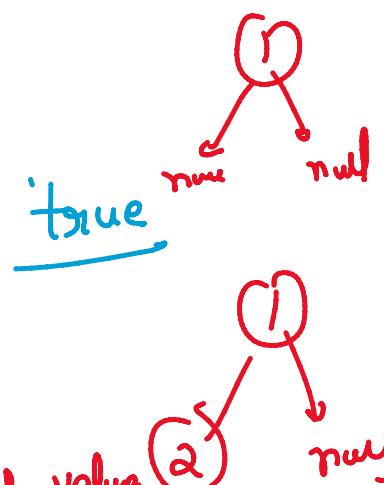
if both are null
→ true

if anyone is null
→ false

they have diff value
→ false.

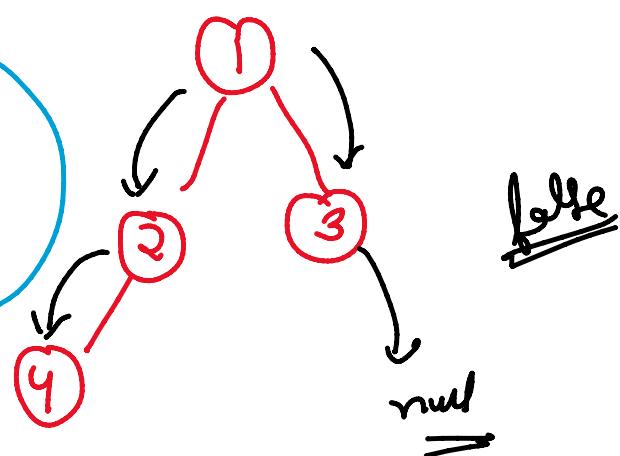
(left → left , right → right)

& & (left → right , right → left)



true

null

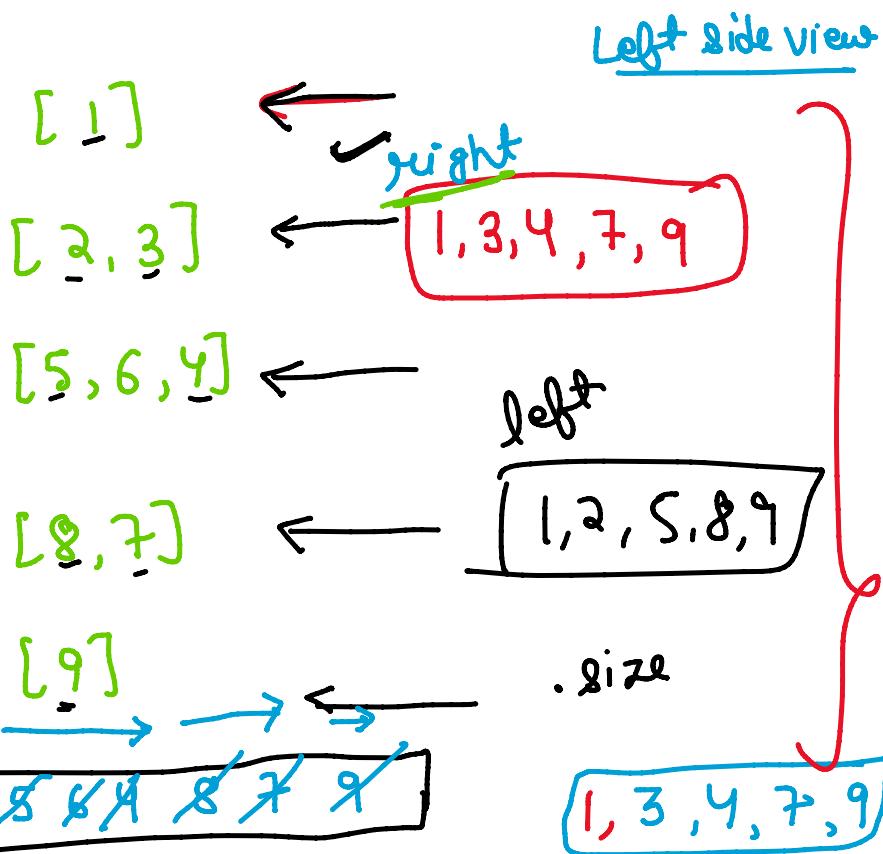
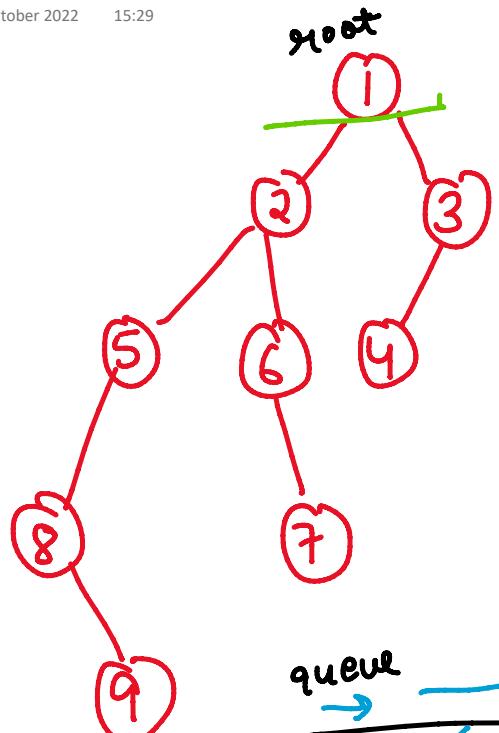


false

null

Right side view of binary tree

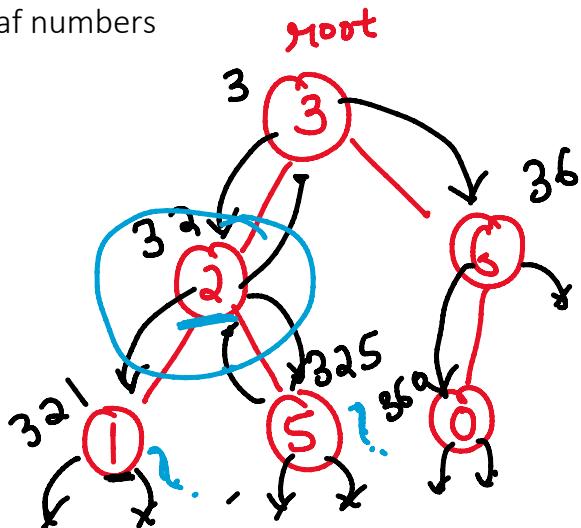
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revision

Sum root to leaf numbers

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$$\begin{aligned} & 321 + 325 + 360 \\ & = 682 \end{aligned}$$

$$\begin{aligned} & 3 \times 10 + 2 = 32 \\ & 32 \times 10 + 1 = 321 \end{aligned}$$

$$rsl = 321 + 325 + 360 =$$

preorder

root
left
right

Zig-zag level order traversal

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