

Lowest Common Ancestor ↳ in BT

236. Lowest Common Ancestor of a Binary Tree

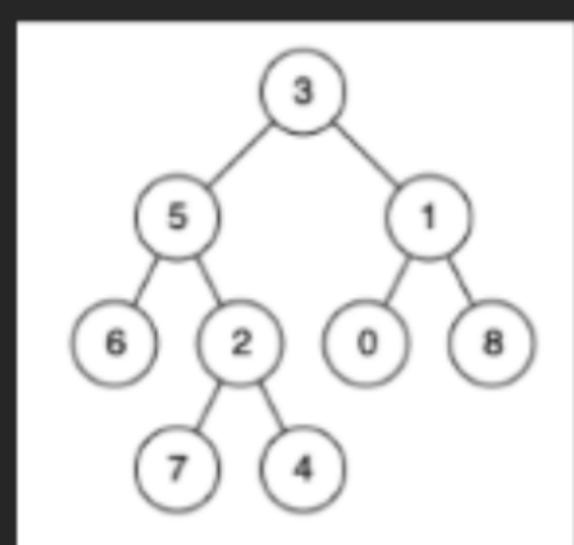
Solved

Medium Topics Companies

Given a binary tree, find the lowest common ancestor (LCA) of two given nodes in the tree.

According to the definition of LCA on Wikipedia: "The lowest common ancestor is defined between two nodes p and q as the lowest node in T that has both p and q as descendants (where we allow a node to be a descendant of itself)."

Example 1:

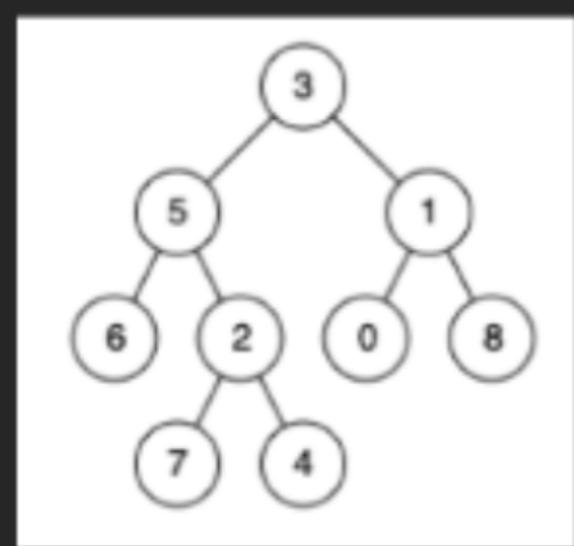


Input: root = [3,5,1,6,2,0,8,null,null,7,4], p = 5, q = 1

Output: 3

Explanation: The LCA of nodes 5 and 1 is 3.

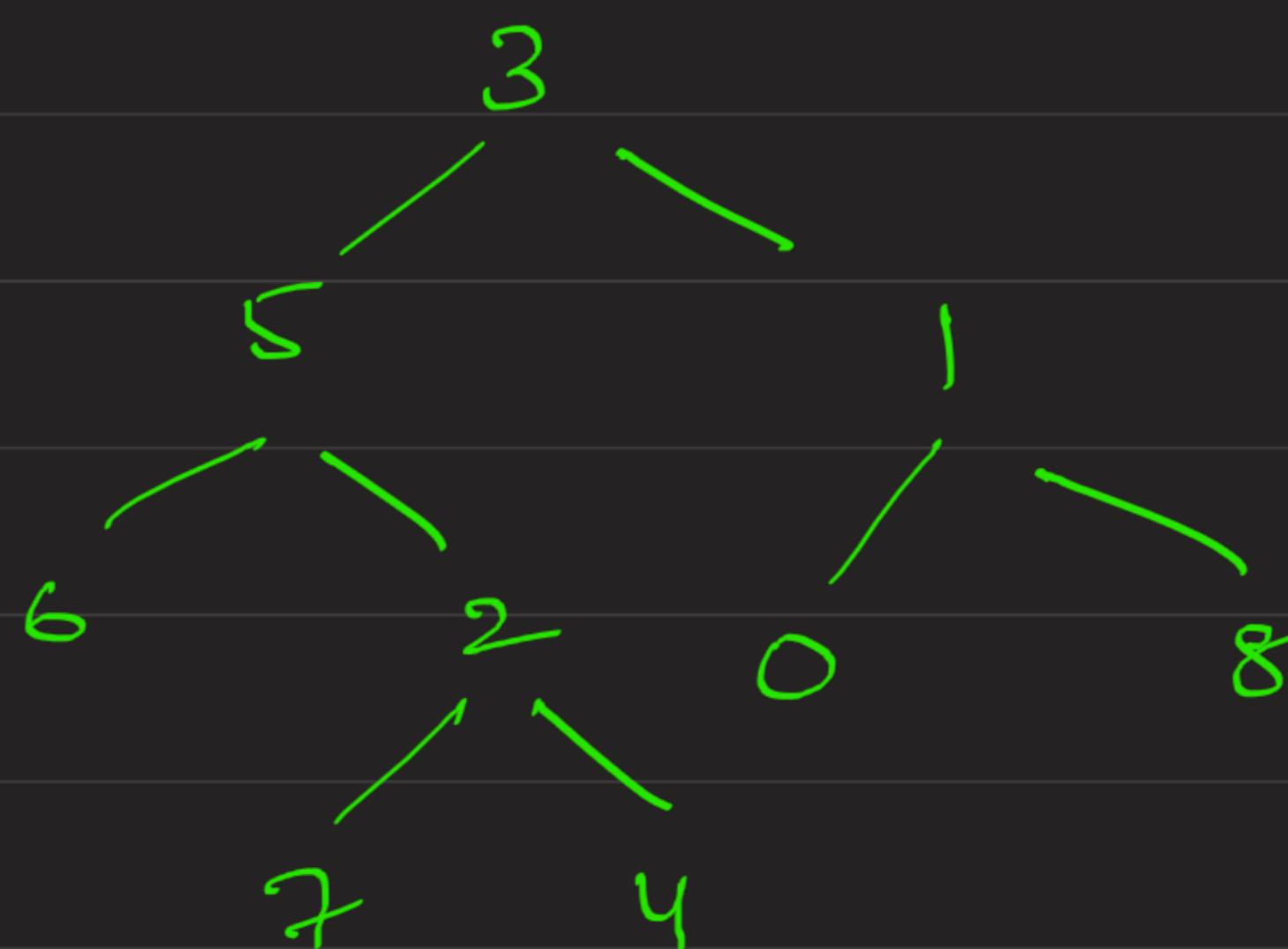
Example 2:



Input: root = [3,5,1,6,2,0,8,null,null,7,4], p = 5, q = 4

Output: 5

Explanation: The LCA of nodes 5 and 4 is 5, since a node can be a descendant of itself according to the LCA definition.

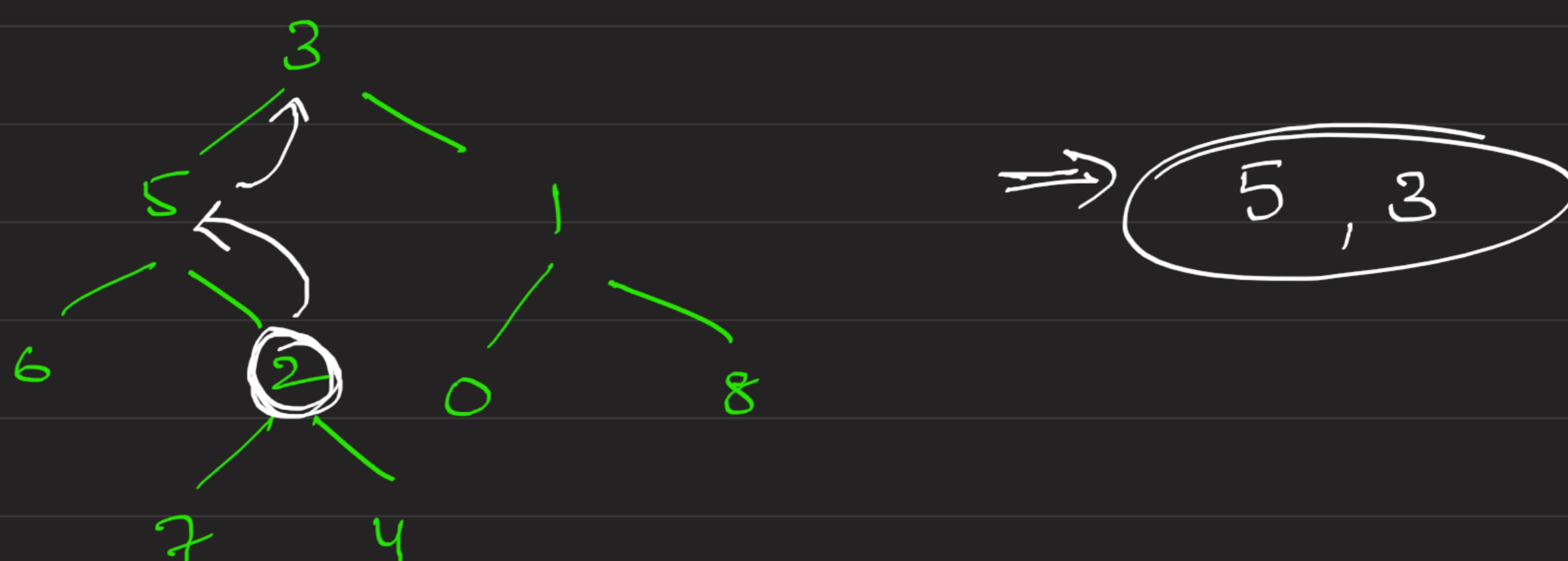


Before looking for Lowest common Ancestor

What is an Ancestor?

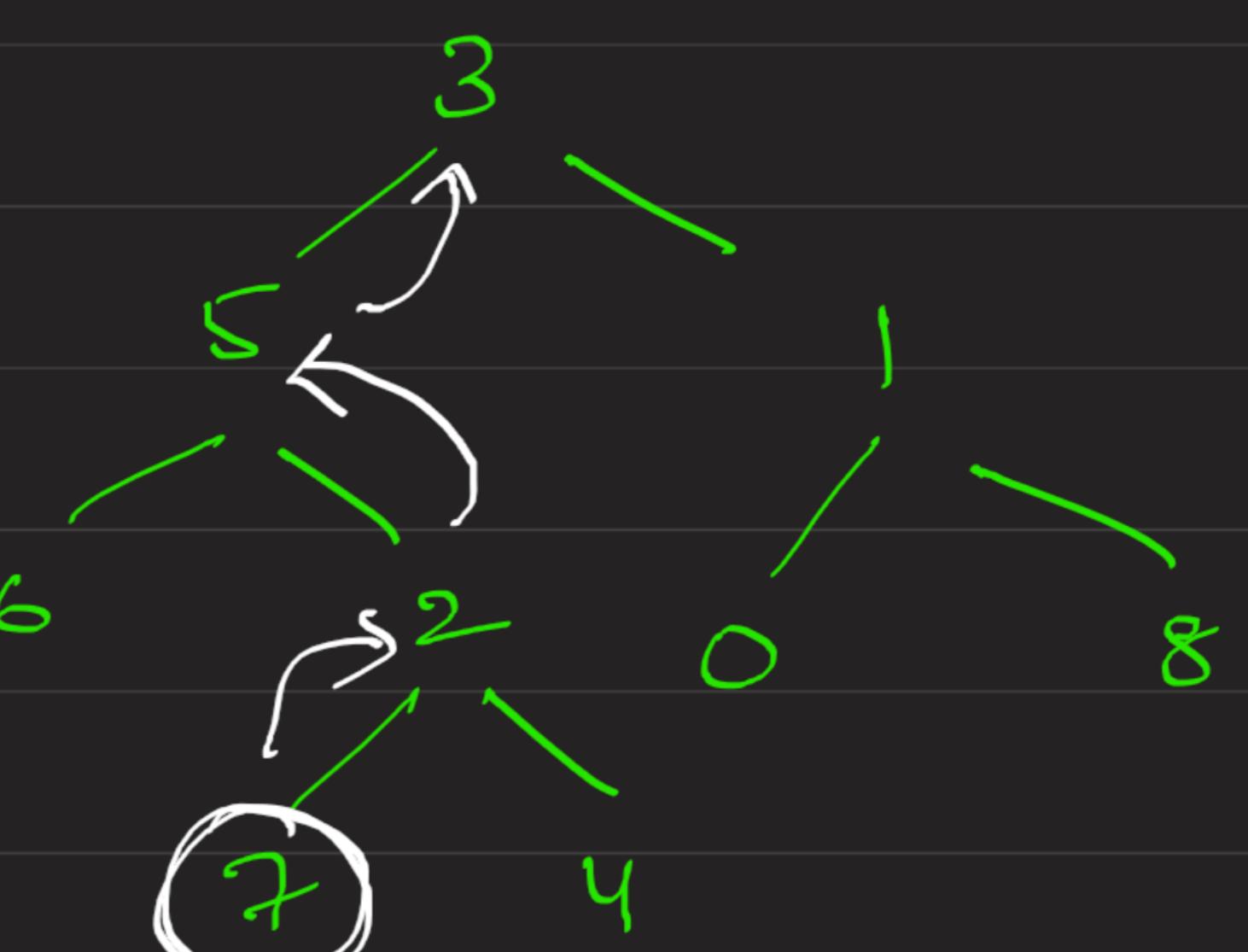
* For a particular node (X) , all the connected upper nodes till root are ancestors of (X)

What are the Ancestors for (2) ?

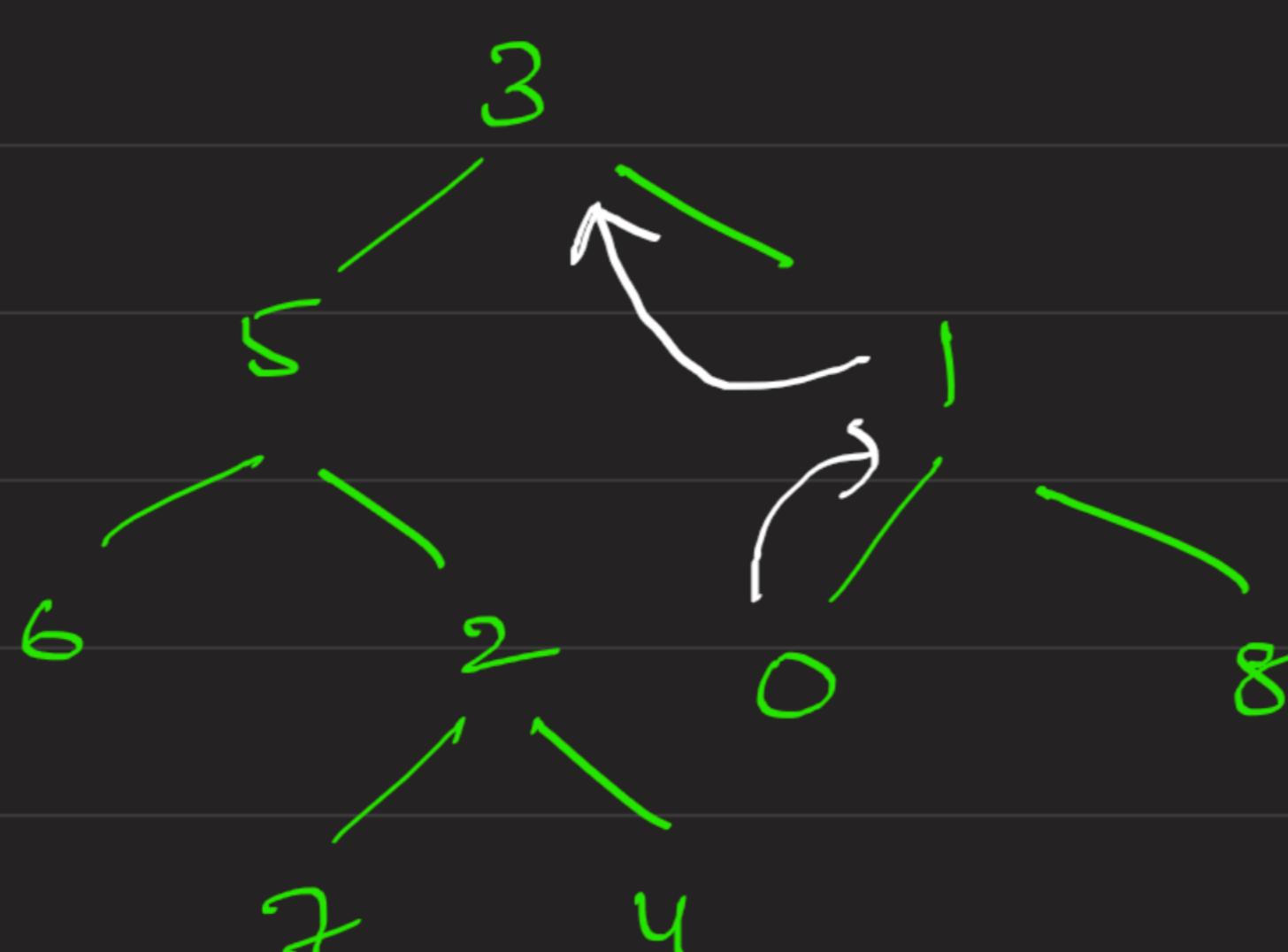


What are the Ancestors for (7) ?

$3, 5, 3$

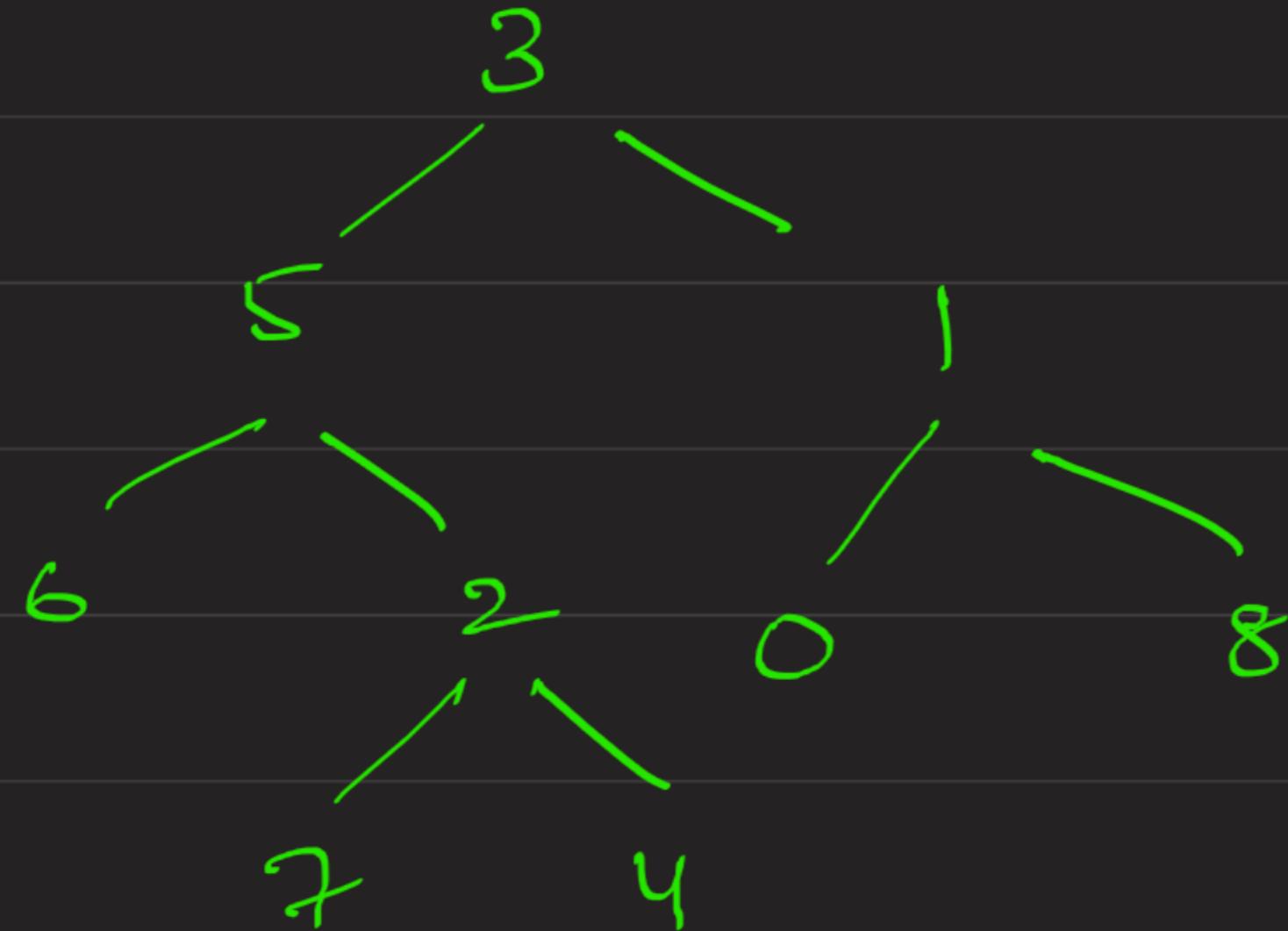


What are the Ancestors for (0) ?



$1, 3$

* Node itself can be an ancestor of the node



Now, think of Lowest Common Ancestor

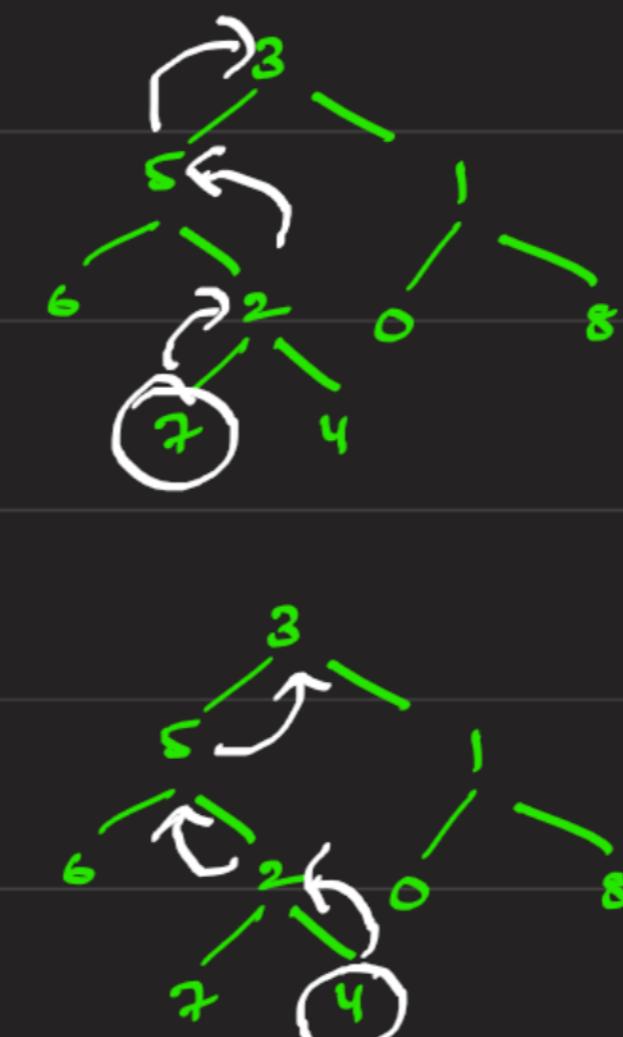
We will be given 2 nodes $\textcircled{7}$ & $\textcircled{4}$

\rightarrow we need to return a node which is common ancestor for both and it needs to be the closest node to the given nodes

LCA for $\textcircled{7}$ & $\textcircled{4}$
(lowest common ancestor)

Ancestors of $\textcircled{7}$: $\textcircled{7}, \textcircled{2}, \textcircled{5}, \textcircled{3}$

Ancestors of $\textcircled{4}$: $\textcircled{4}, \textcircled{2}, \textcircled{5}, \textcircled{3}$



what is the closest common node for $\textcircled{7}$ and $\textcircled{4}$ = 2

\therefore LCA of $\textcircled{7}, \textcircled{4} = 2$

LCA for $\textcircled{6}$ & $\textcircled{8}$
(lowest common ancestor)

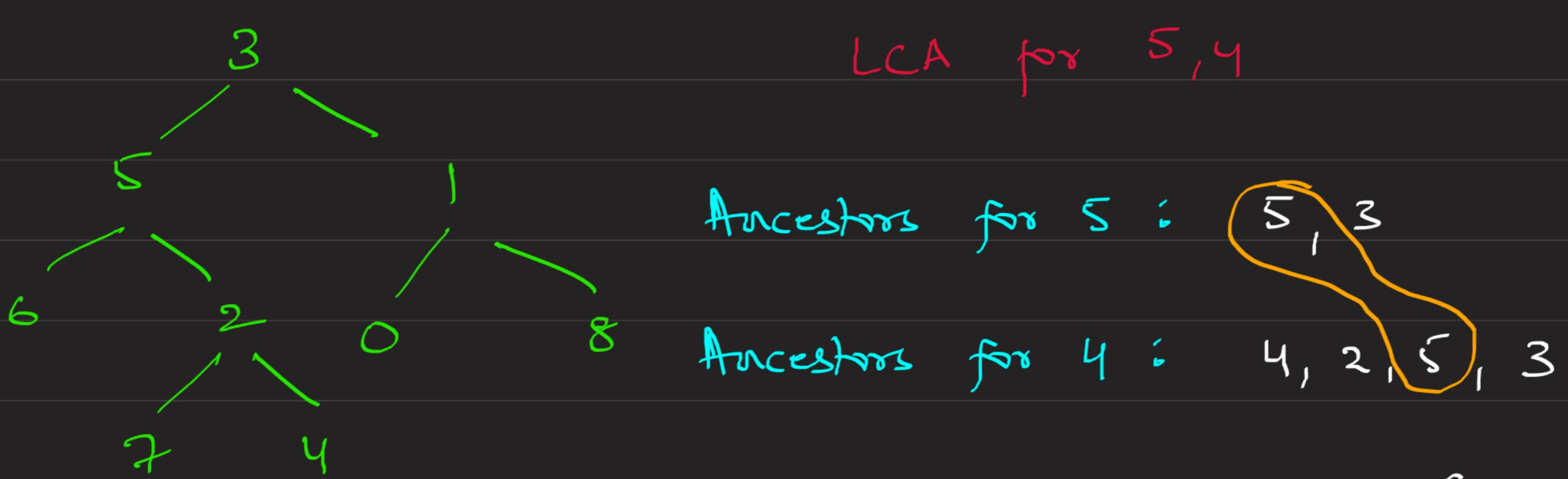
Ancestors of $\textcircled{6}$: $\textcircled{6}, \textcircled{5}, \textcircled{3}$

Ancestors of $\textcircled{8}$: $\textcircled{8}, \textcircled{1}, \textcircled{3}$

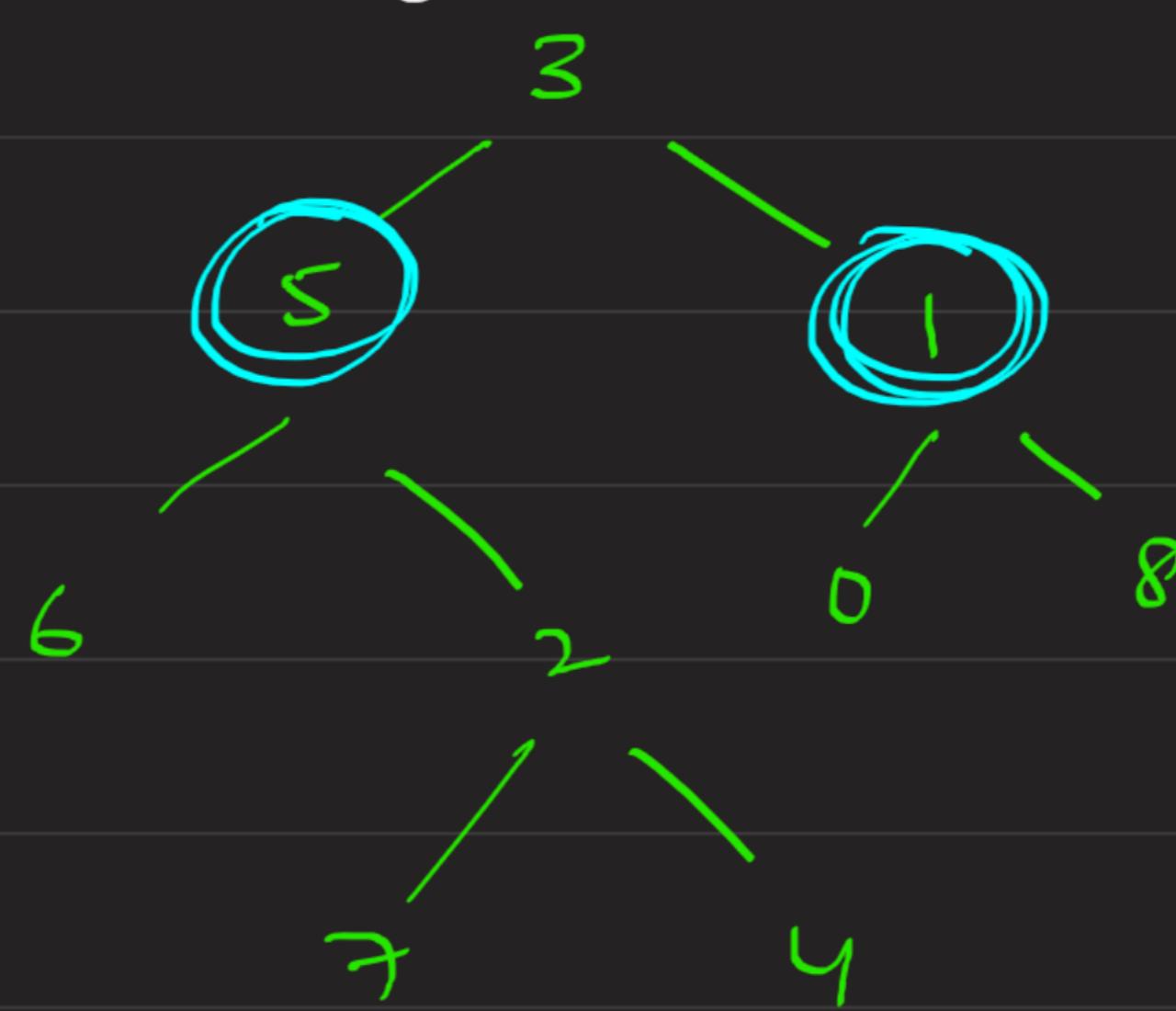


what is the closest common node for $\textcircled{6}$ and $\textcircled{8}$ = 3

\therefore LCA of $\textcircled{6}, \textcircled{8} = 3$

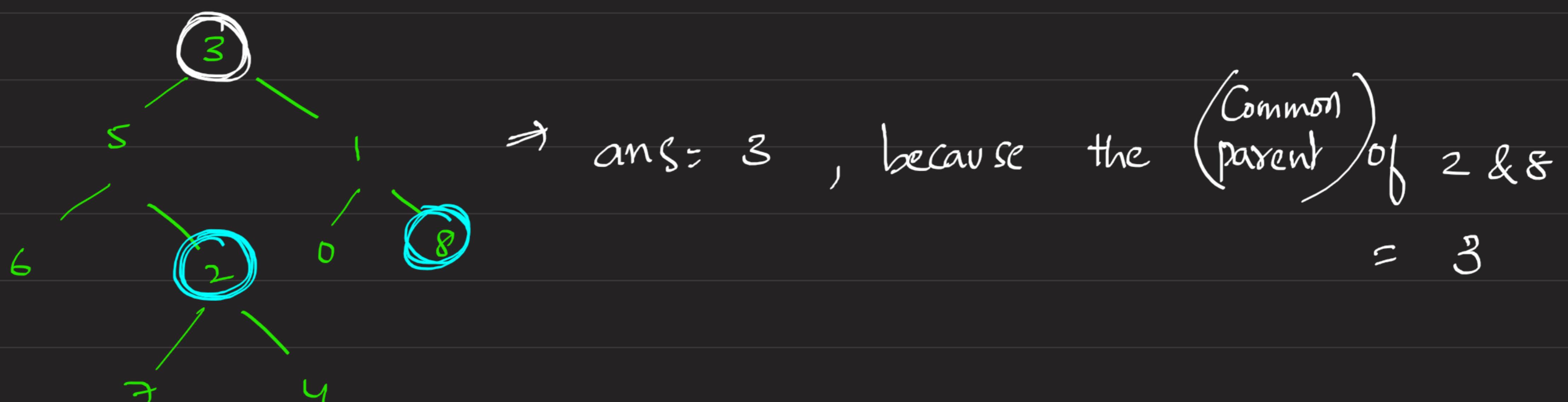
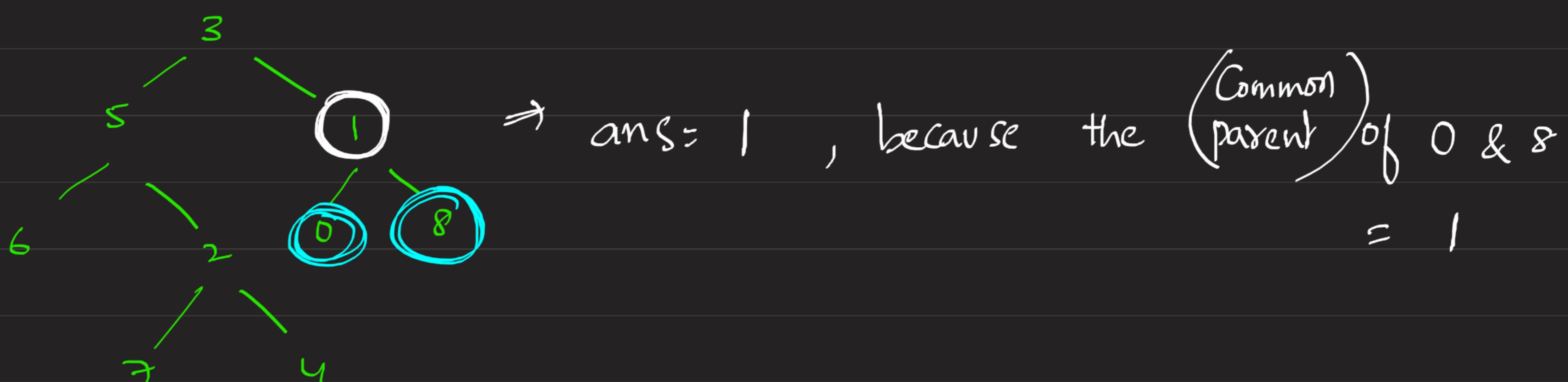
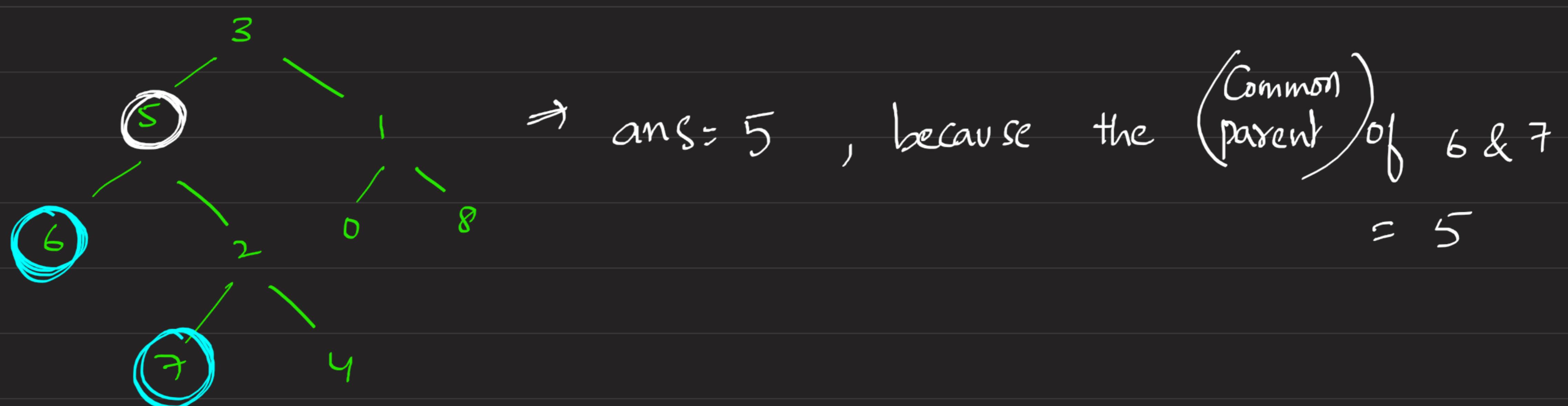


∴ LCA can be any of the given nodes as well (It is possible)



The Lowest Common Ancestor = 3

Ancestor (parent or grand parents)



If you observe carefully,

We can find LCA of 2 given nodes from

① Left subtree

(or)

② Right subtree

(or)

③ Root

So, we will recursively ask answers from left subtree & right subtree

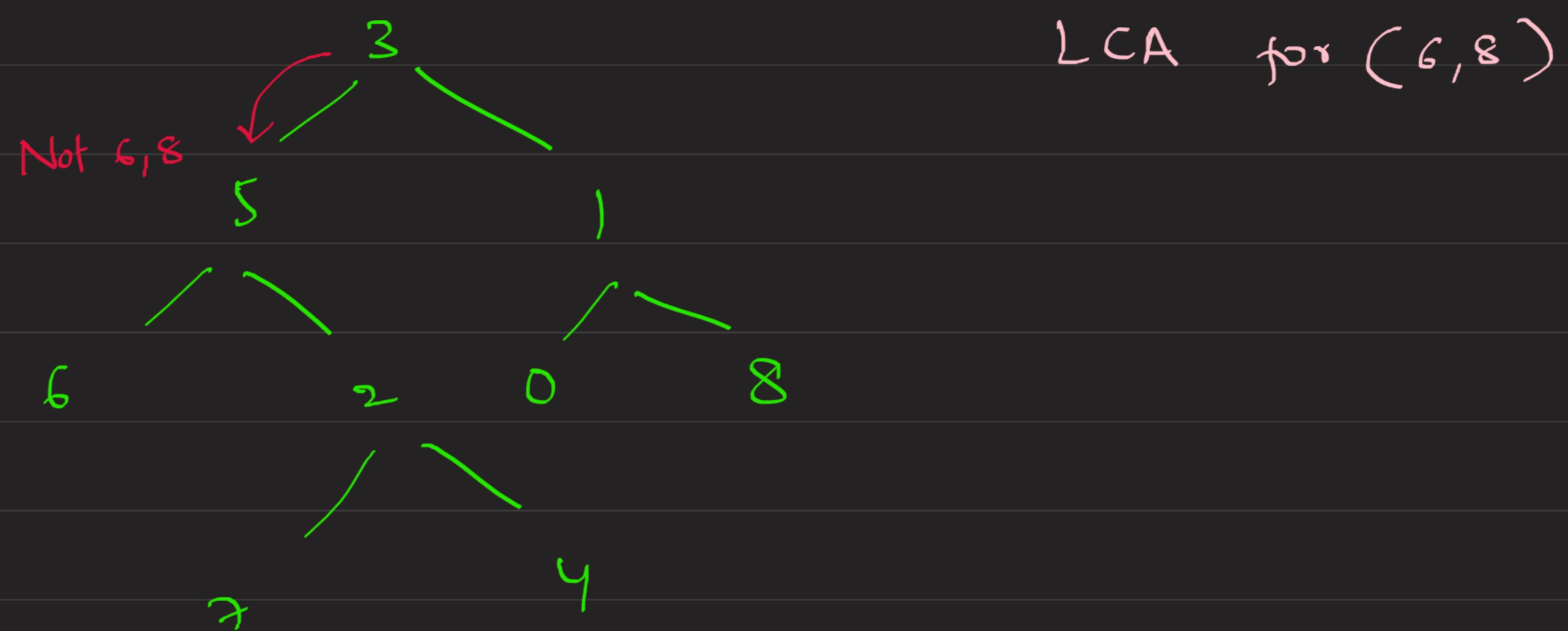
if none of them give an answer, then root will be our answer

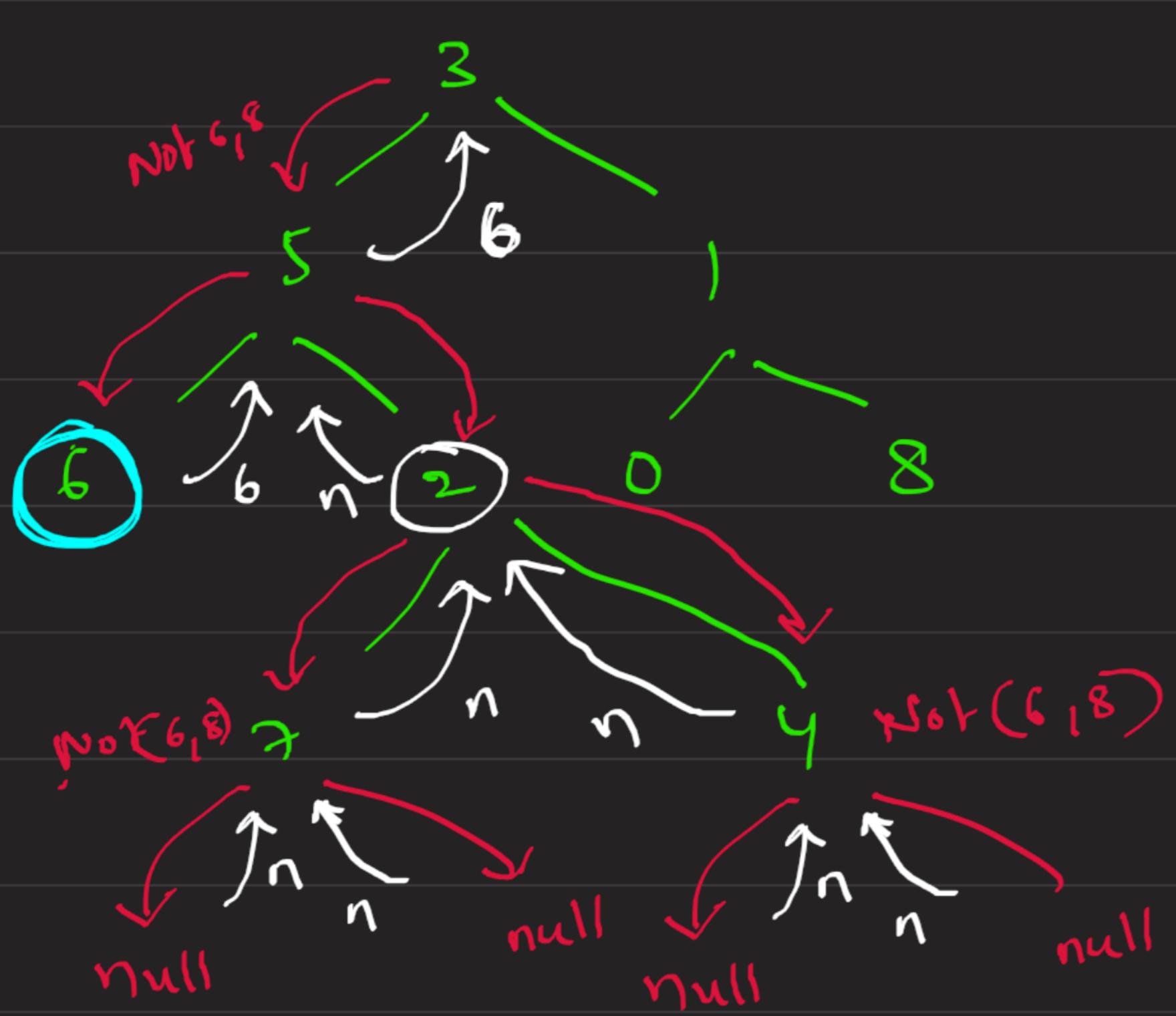
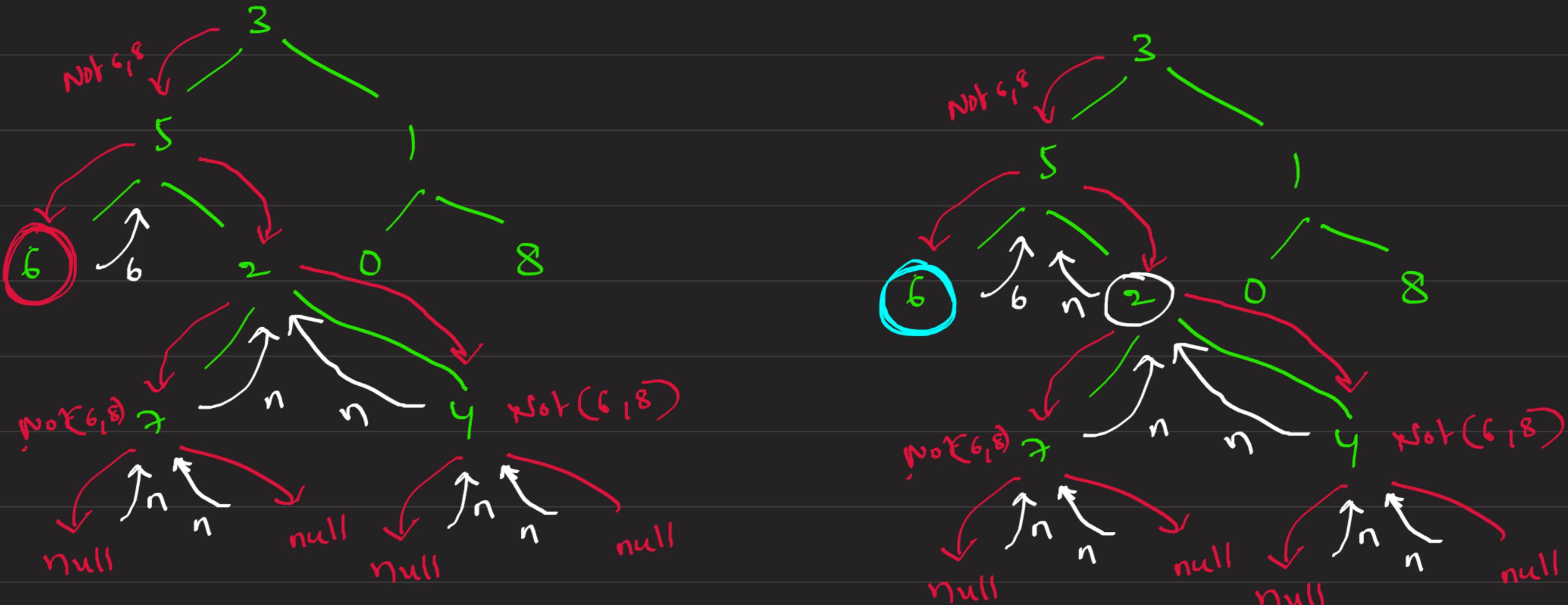
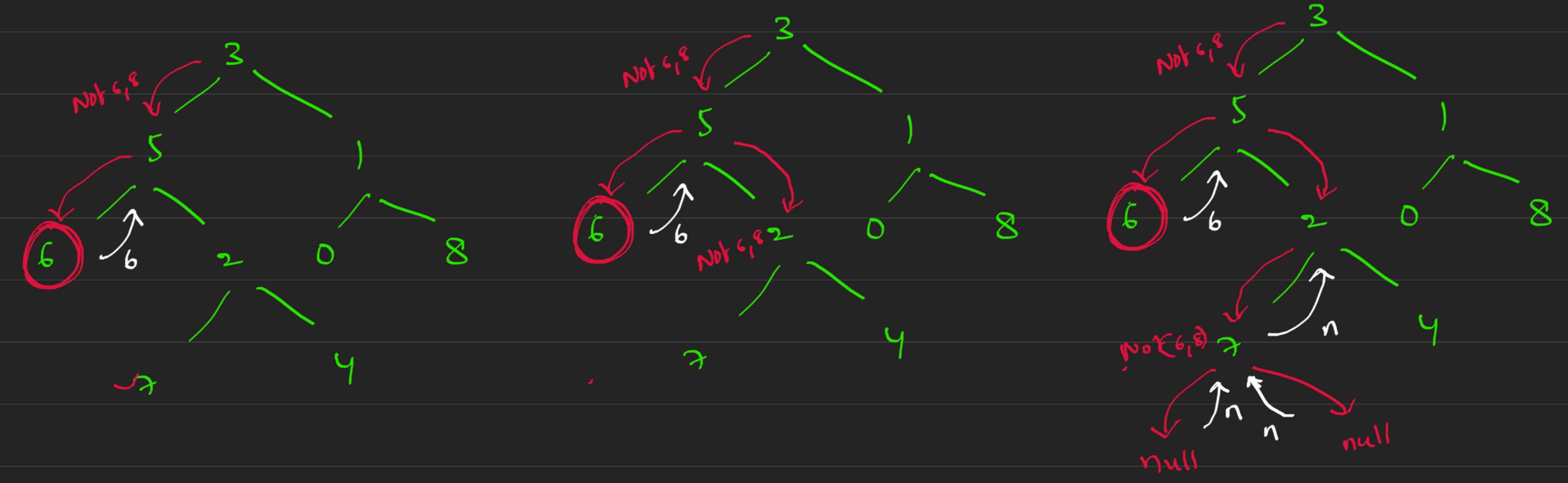
* if left subtree recursive call gives you a null value that means we haven't found LCA in left subtree

* go to every node, check if it is the part of our LCA Nodes,

if yes \rightarrow return the node ,

else \rightarrow return null while coming back

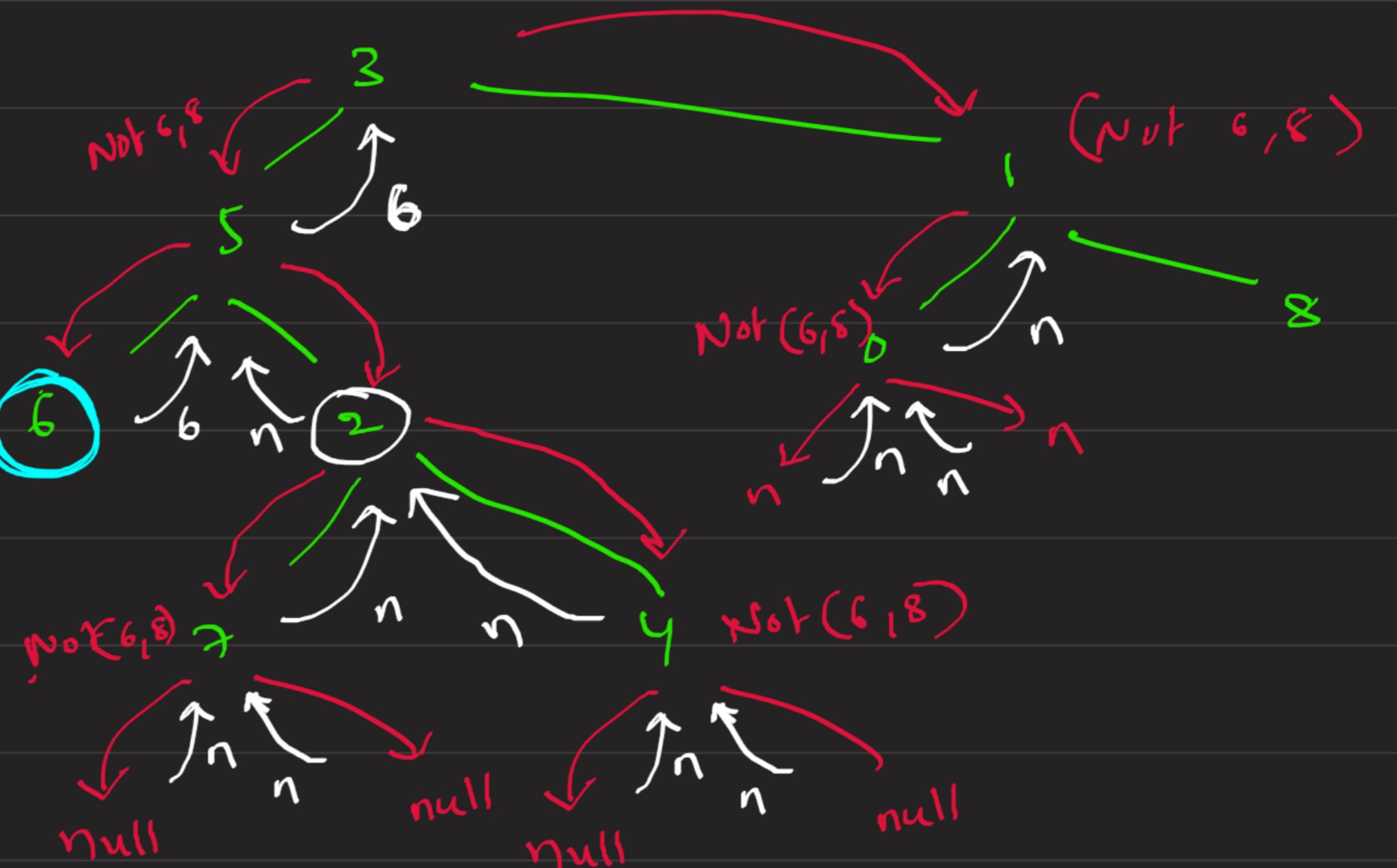
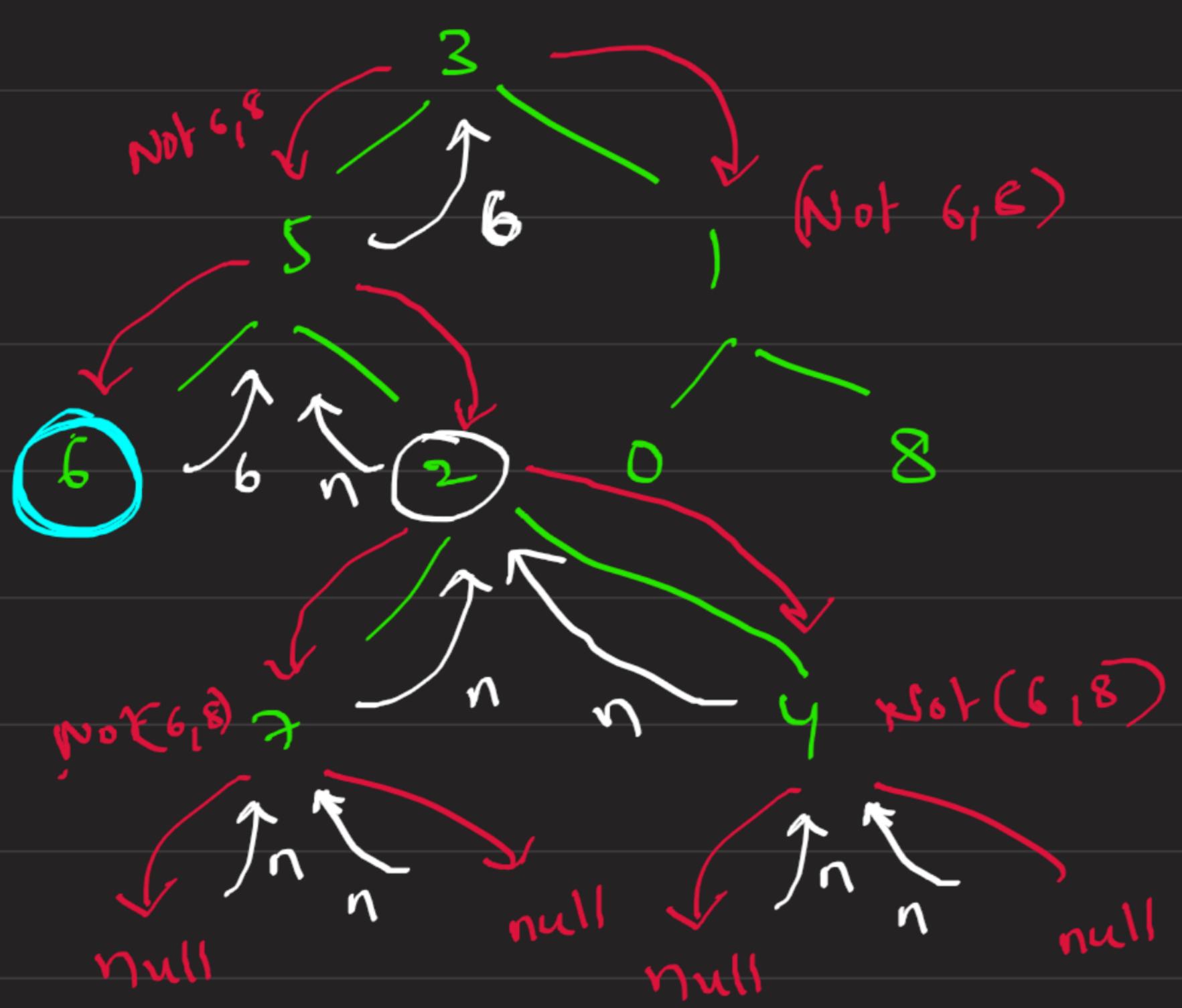


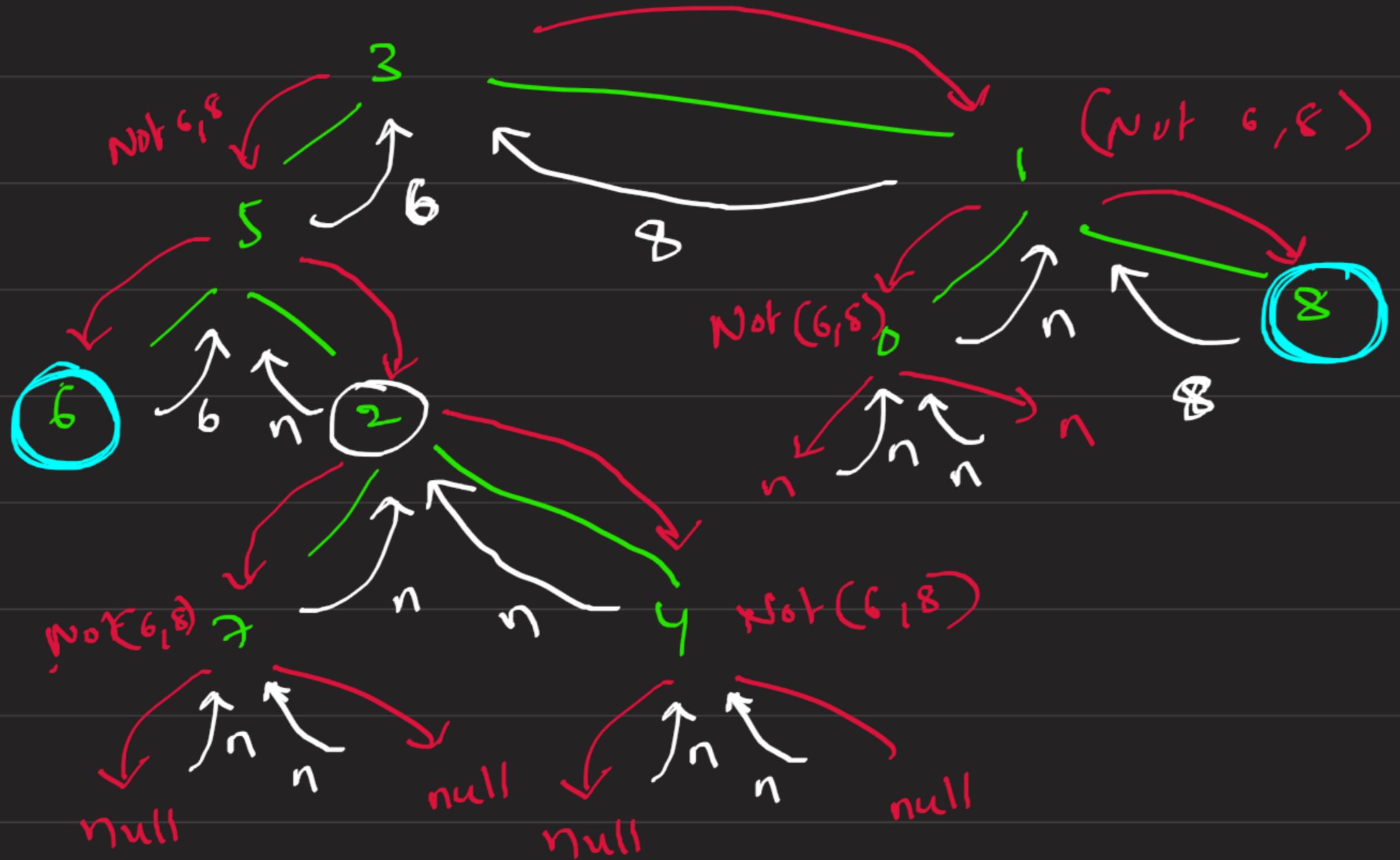


for node 5, left subtree said i found
⑥

right subtree said i found
none of them (6, 8)

so, we pick ⑥ at least we found one
and return that to our parent

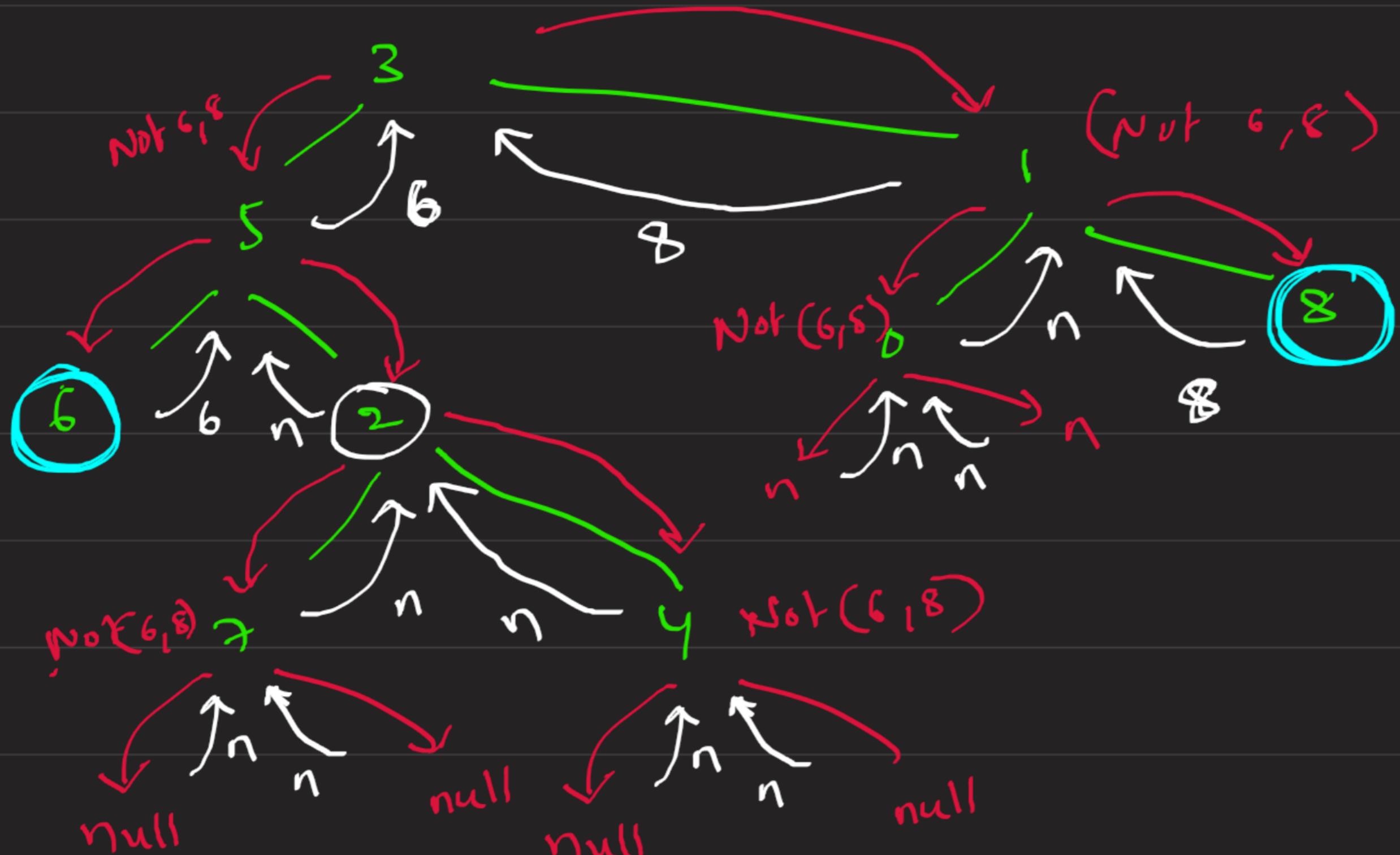




Now, left subtree of 1 said,
i found none of them

right subtree of 1, said
i found 8

So, we return 8 to the parent



∴ Now, left subtree of 3, said

i found 6

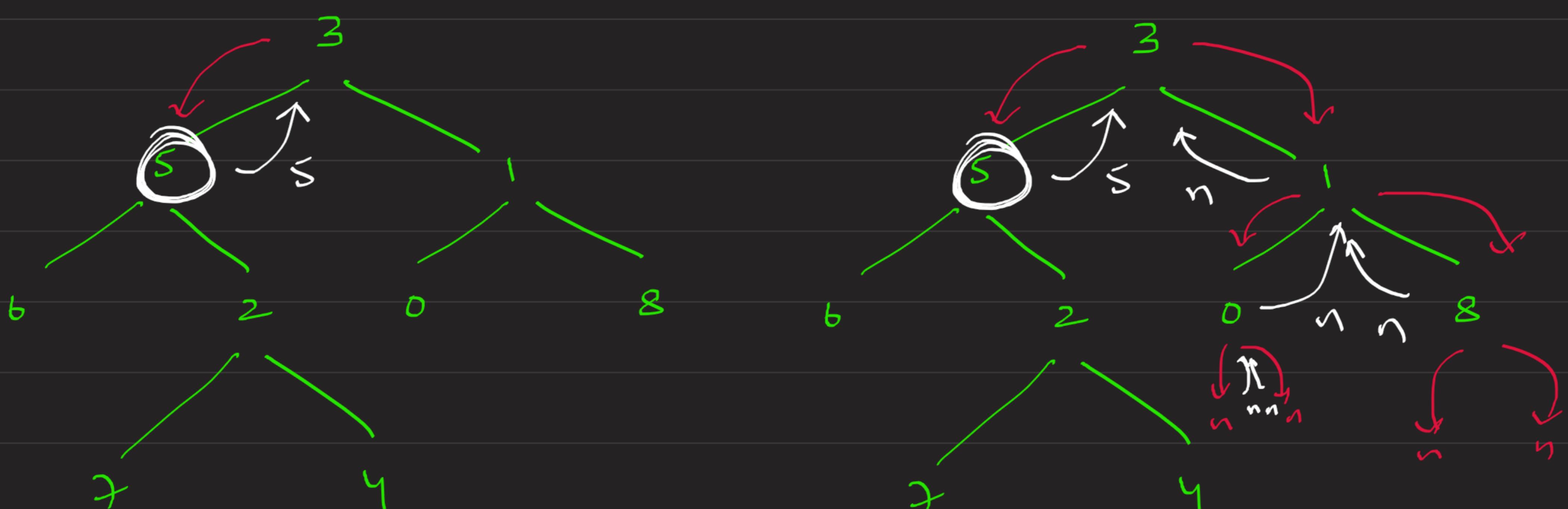
right subtree of 3, said

i found 8

* The first ever node, where we found both nodes is our LCA

Here 2 is our LCA for (6, 8)

LCA for 5, 4

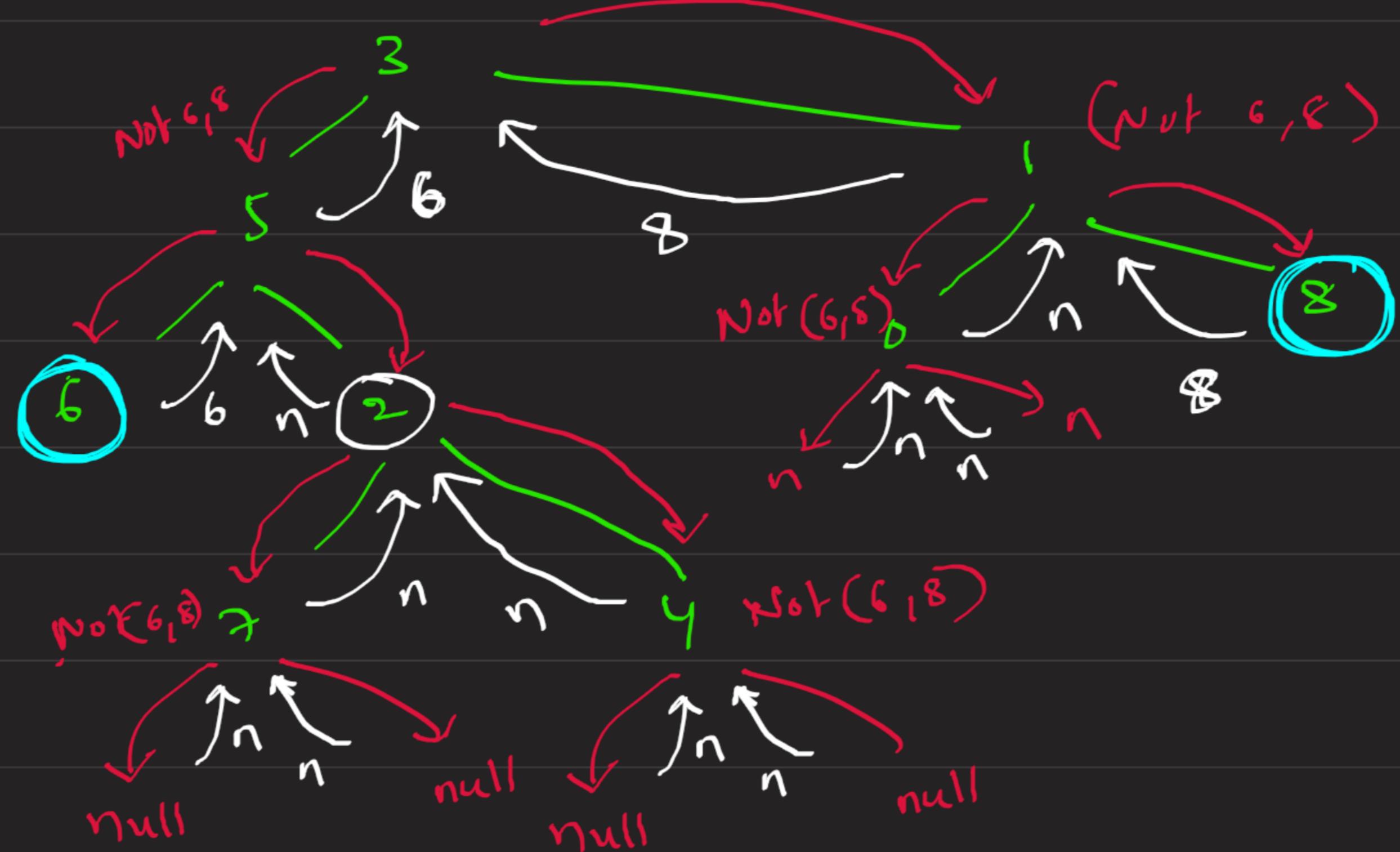


∴ Here 3's left subtree is saying i found 5
right subtree is saying i found null

$\therefore \text{leftAns} = 5$
 $\text{rightAns} = \text{null}$

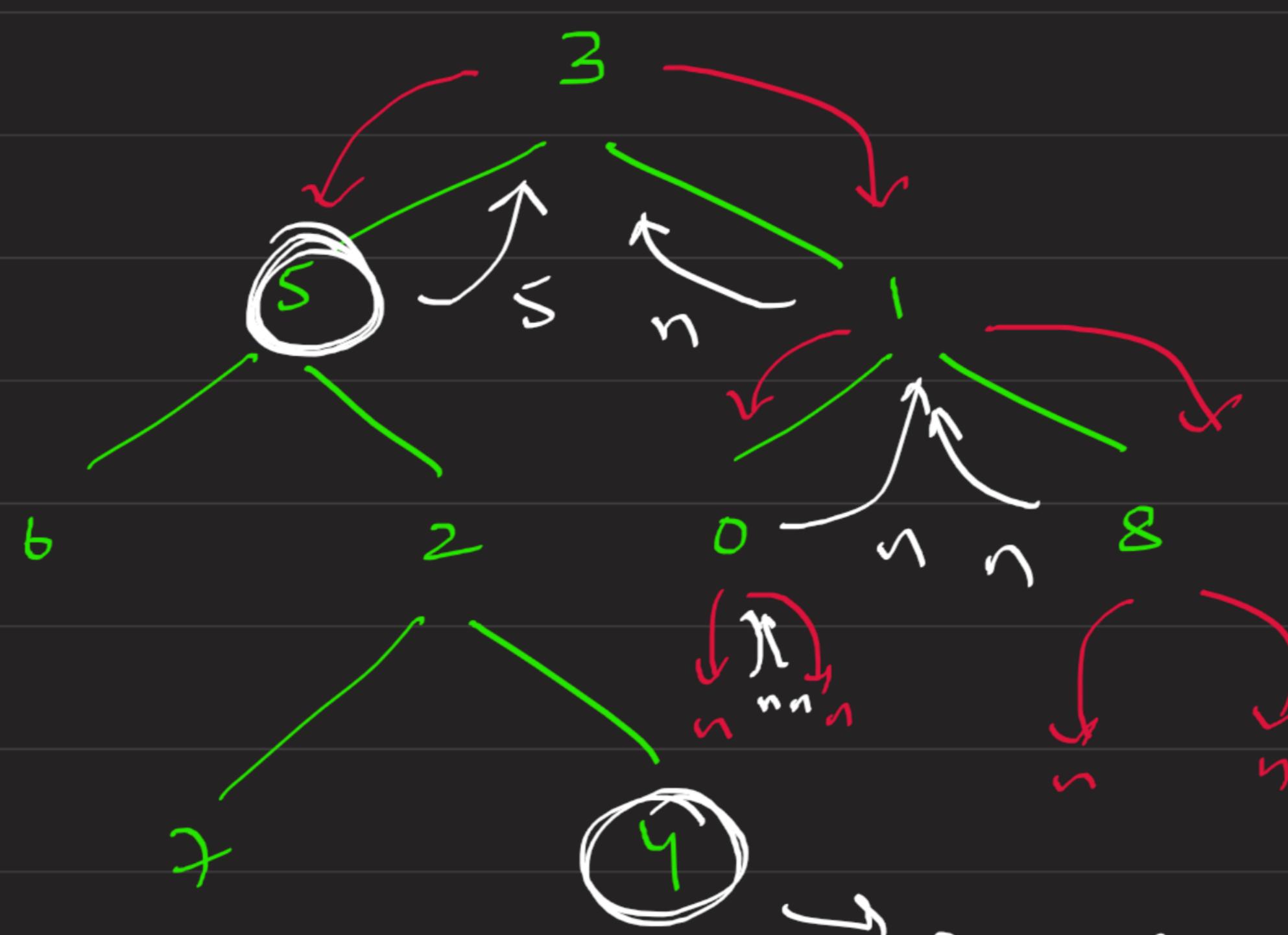
figure out some cases

- ① $\text{leftAns} = p$
 - ② $\text{RightAns} = q$
- } then Our ans is current Node



Case-2

- ① $\text{leftAns} = p$
 - ② $\text{RightAns} = N$
- } then Our ans is leftAns



Our Ans lies in 5 only, so 5
is first common value for 5, 1, 0, 4, 7

case-3

- $\text{leftAns} = \text{null}$
 - $\text{rightAns} = q$
- } $\text{Ans} = q$

```

class Solution {
    public TreeNode helper(TreeNode root,TreeNode p,TreeNode q){
        if(root == null) return null;
        if(root.val == p.val || root.val == q.val) return root;
        TreeNode leftAns = helper(root.left,p,q);
        TreeNode rightAns = helper(root.right,p,q);

        if(leftAns != null && rightAns != null) return root;
        else if(leftAns != null) return leftAns;
        else if(rightAns != null) return rightAns;
        else return null;
    }

    public TreeNode lowestCommonAncestor(TreeNode root, TreeNode p, TreeNode q) {
        return helper(root,p,q);
    }
}

```

→ if any of the node is our question node, then this will be our required node.

