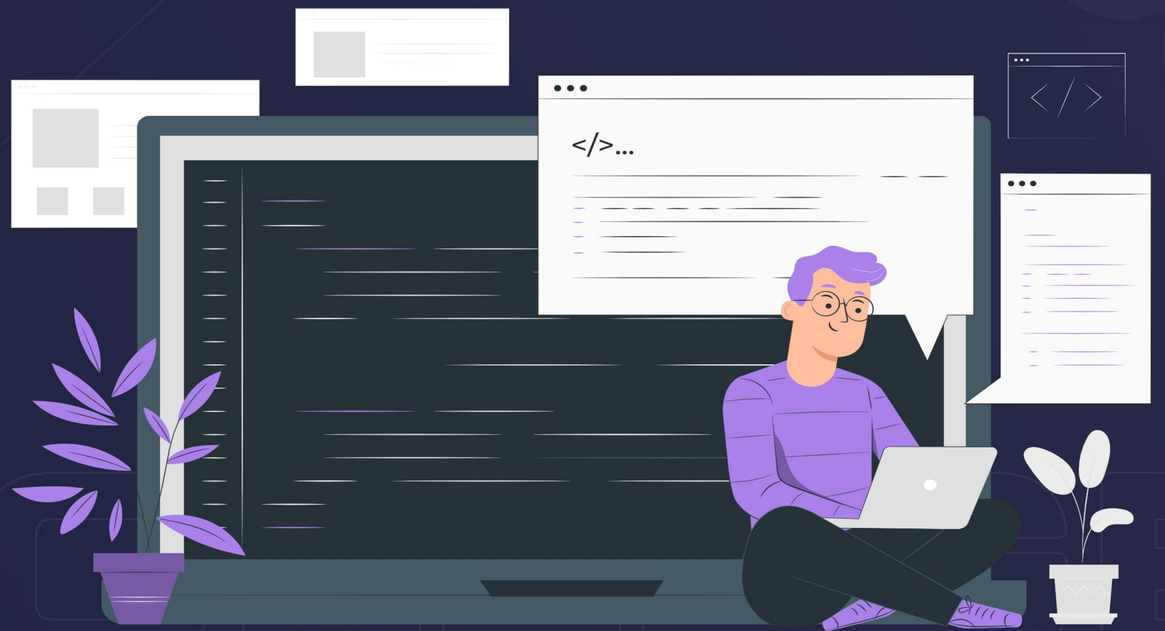
PW SKILLS

Lecture - 52

Binary Trees

[Basics]



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Prerequisites

- Recursion → must
- Linked List

↓

trees will become easy

```
void pip(int n){
    Kaam → pre
    pip(n-1);
    Kaam → in
    pip(n-1);
    Kaam → post
}
3
```

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Today's Checklist

- What is a Tree data structure
- Representation
- Terminology
- Important properties of trees
- Types of Trees
- Applications of tree data structure
- What is a Binary Tree?
- Implementation
- Traversals → Next Lecture
- Problems
- Types of Binary Trees

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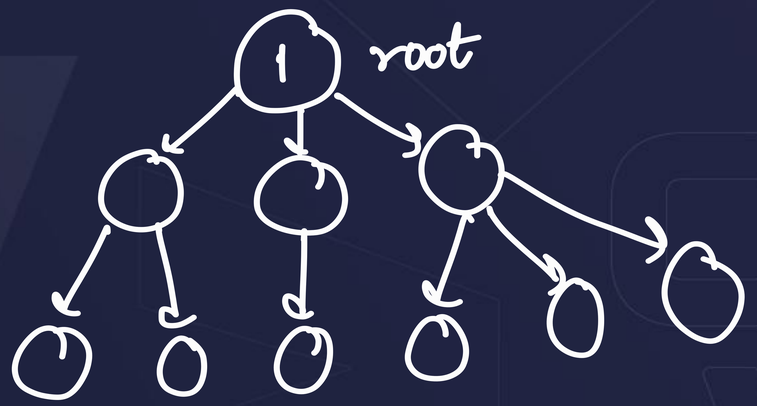
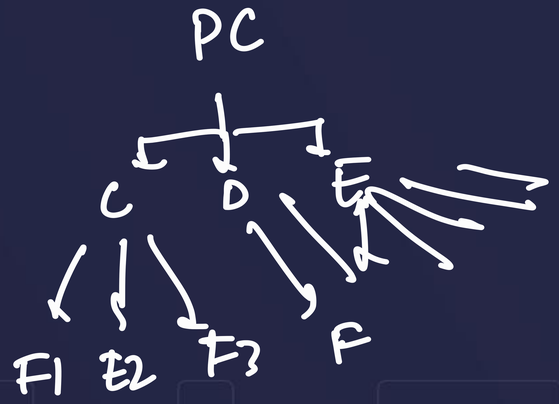
What is a Tree data structure

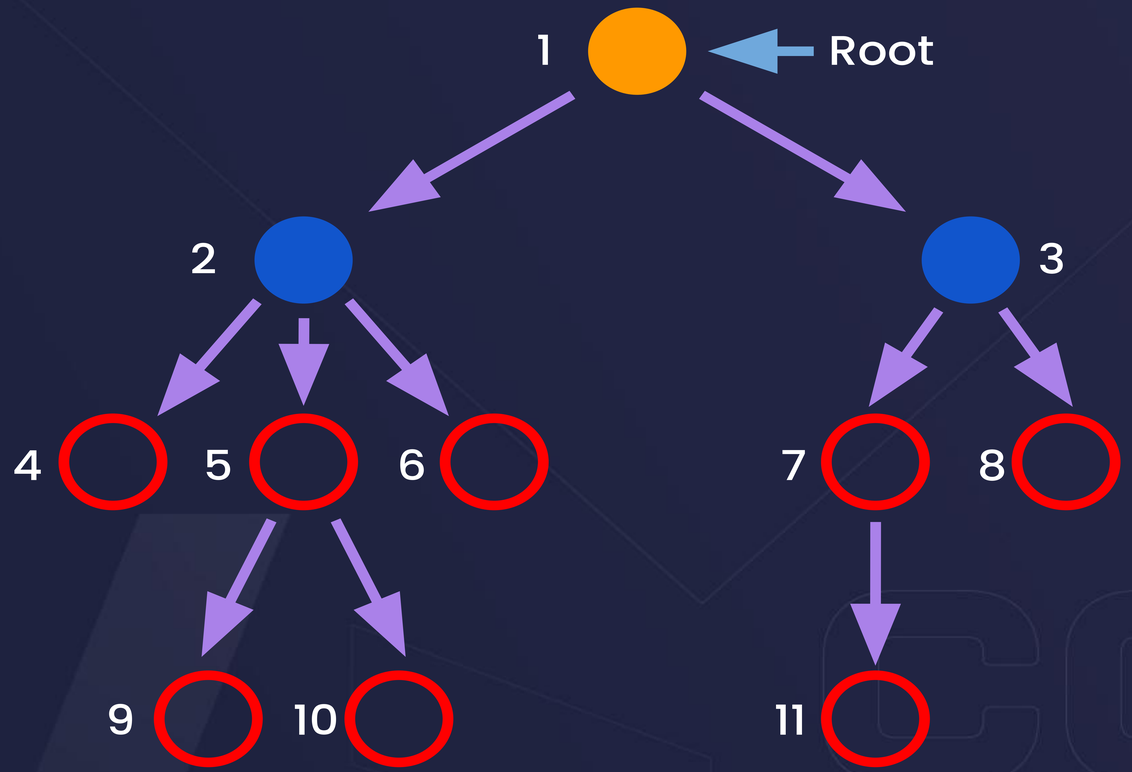
Array , LL, stack, queues → Linear Data Structure

Trees, graphs → non linear D.S.



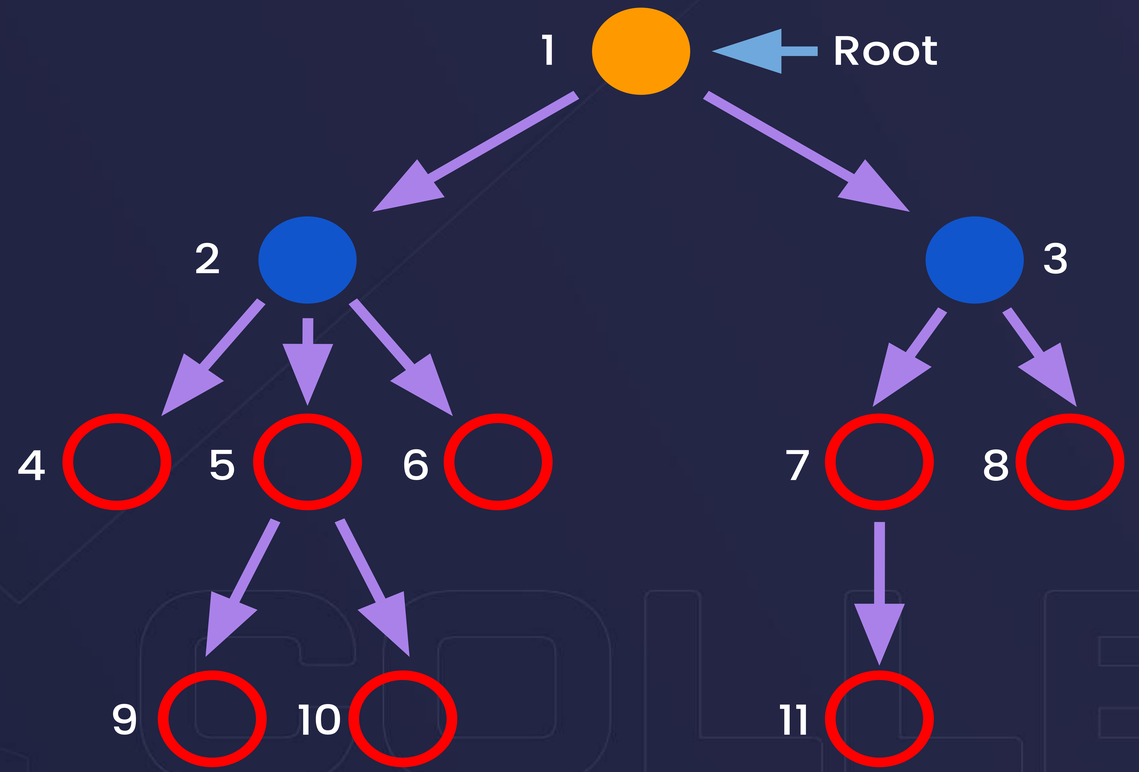


Representation



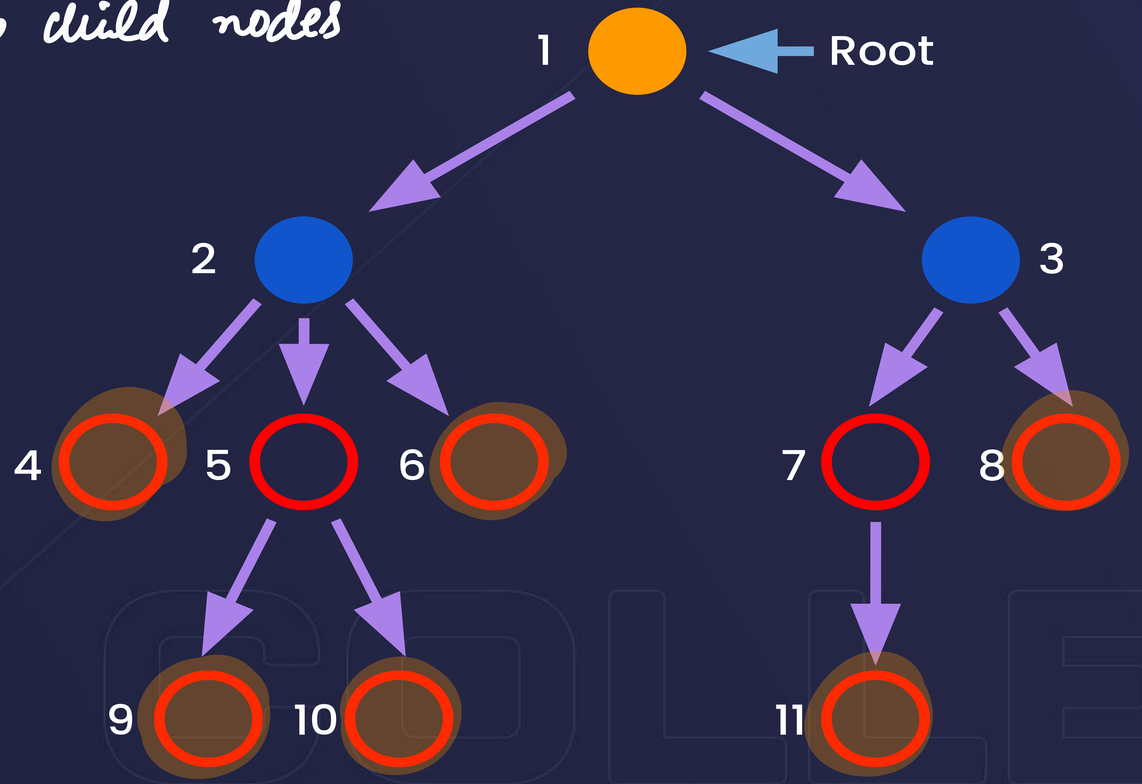
Terminology

1. Root
2. Child Node
3. Parent Node
4. Sibling Nodes



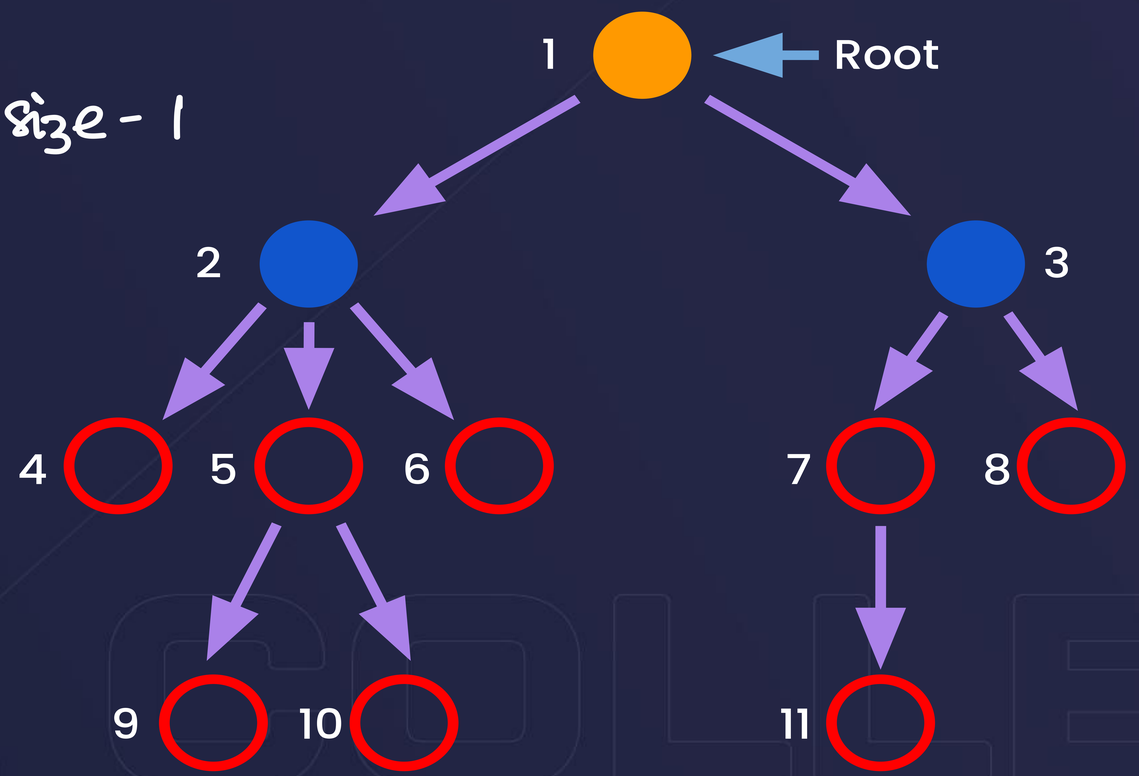
Terminology

5. Leaf Node → with no child nodes
6. Internal Node
7. Ancestor Node
8. Descendant Node



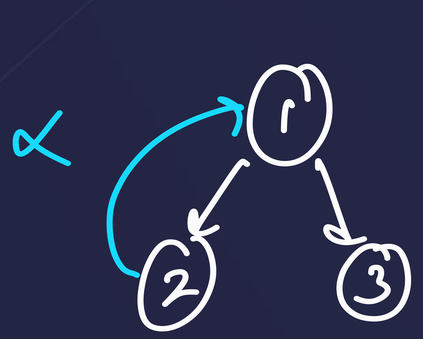
Terminology

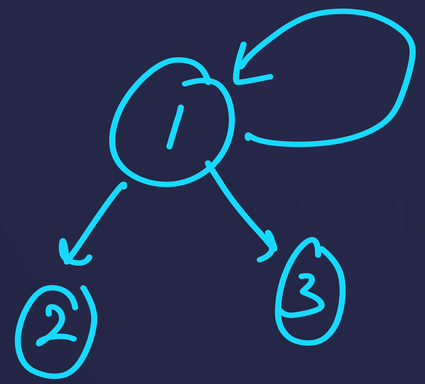
9. Level
10. Number of edges = size - 1
11. Height = level - 1
12. Size = no. of nodes

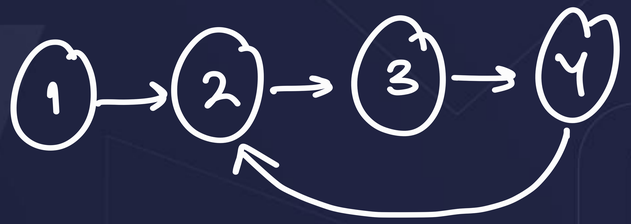


Important Properties of trees

1. Traversing in a tree is done by depth first search and breadth first search algorithm.
2. It has no loop and no circuit.
3. It has no self-loop.







Types of Trees

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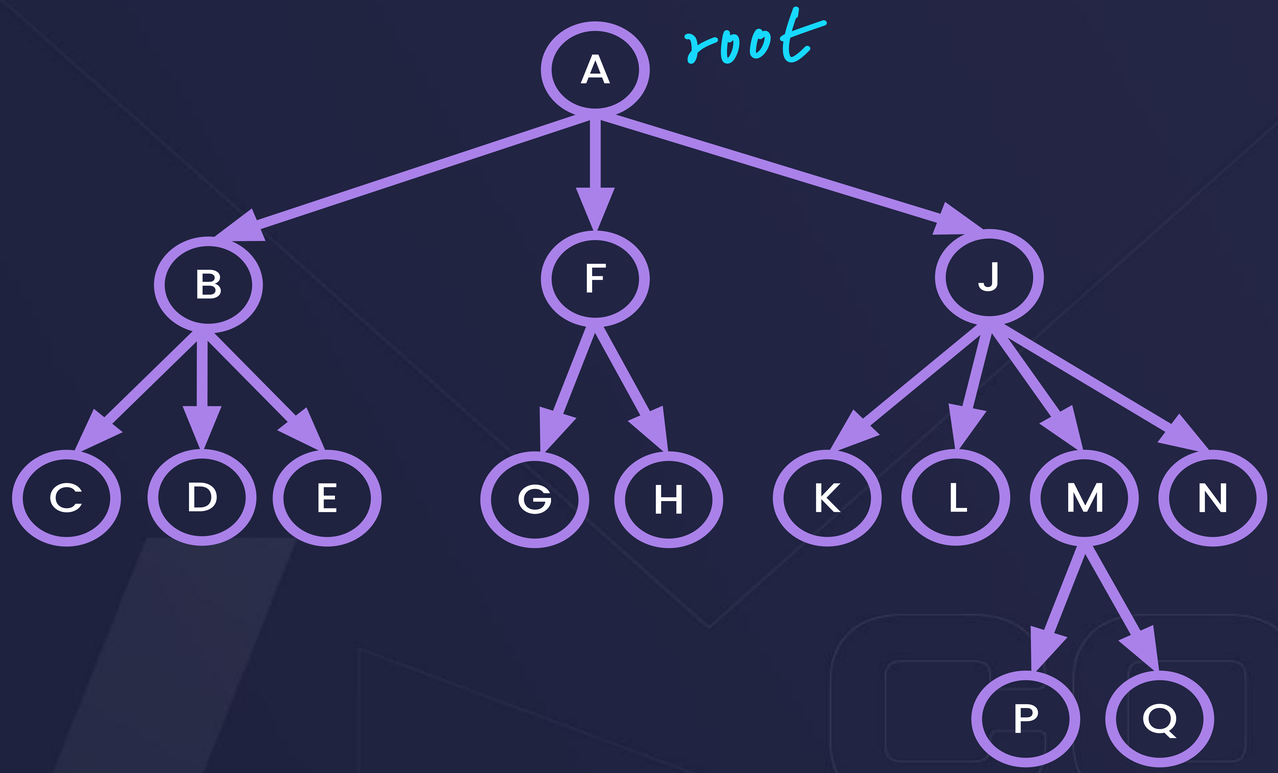
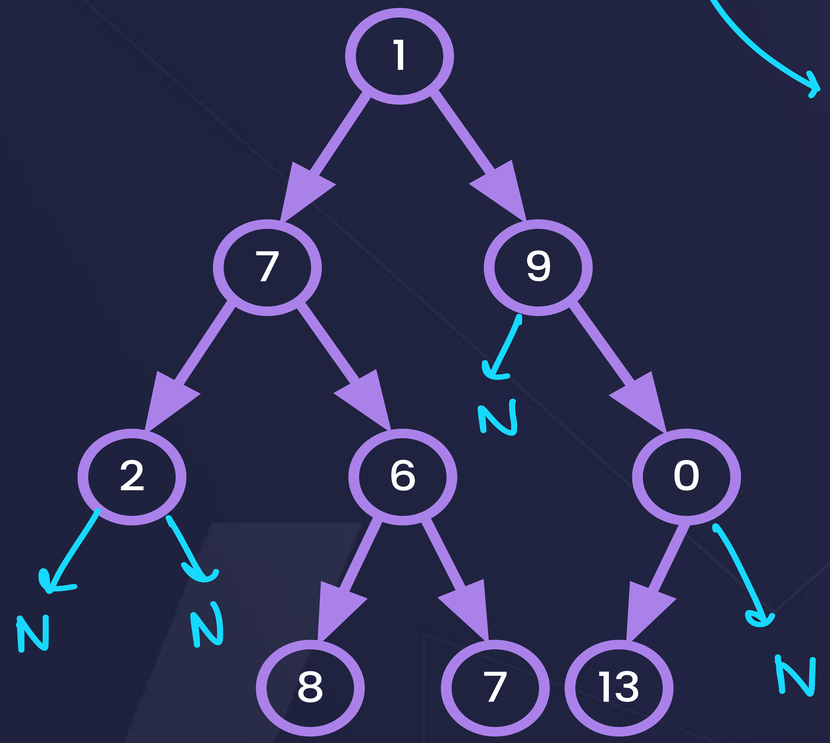
1. Generic Trees → multiple children

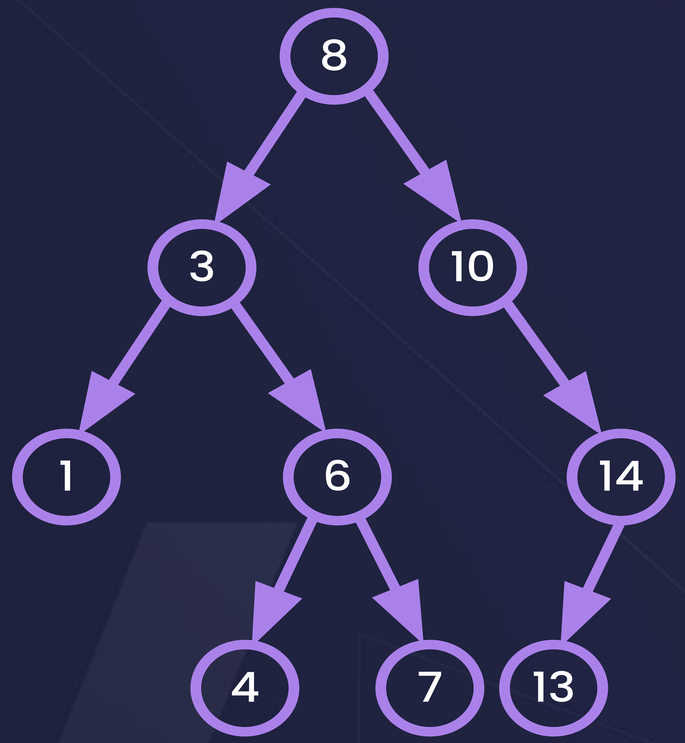


2. Binary Trees → 0, 1, 2 children [upto 2 child nodes]



Every node has a value, & its left child's address, right child's address

3. Binary Search Trees : Binary trees with some special property



Baad me

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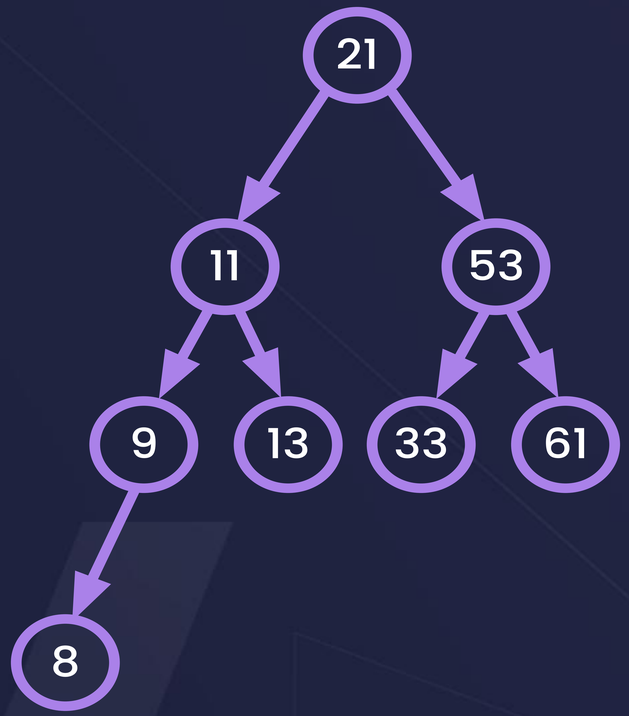
4. AVL Trees : Balanced BST's



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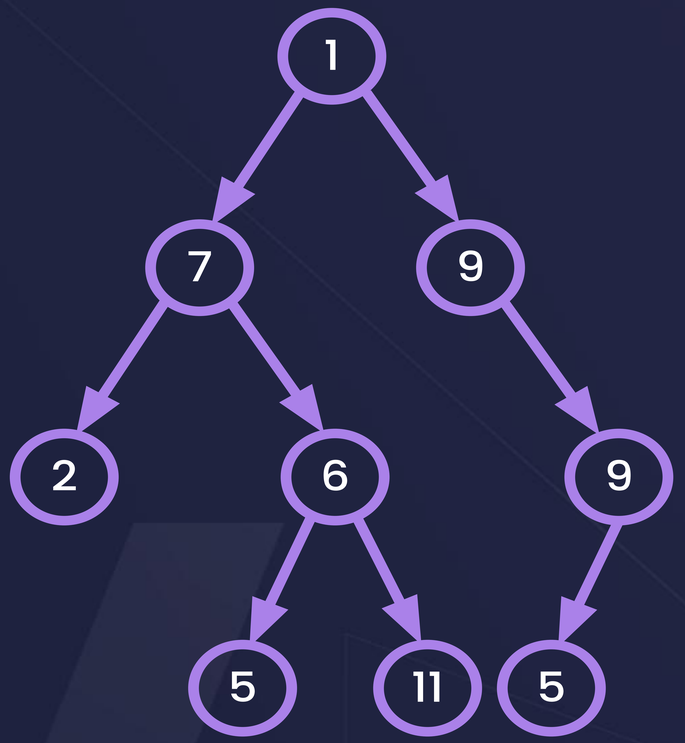
Applications of tree Data Structure

1. Hierarchical data structure
2. Searching efficiency
3. Sorting
4. Dynamic Data
5. Efficient Insertion and Deletion
6. Easy to implement

What are Binary Trees? → 0, 1, 2 child nodes



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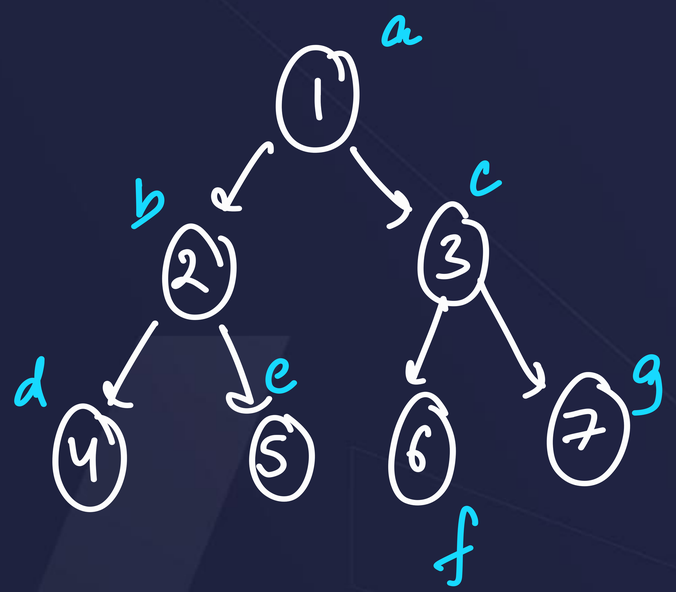
Implementation

Creating a Node class



1 2 4 5 3 6 7

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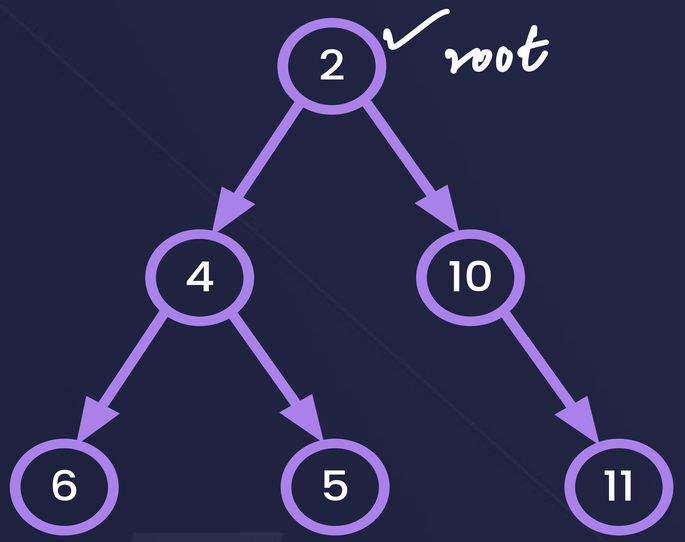
Display (root of tree) (just like in LL → head only)




```
display (head) {
        if (root == NULL) —
    cout << head -> val;
    display (head->next);
}
```

3

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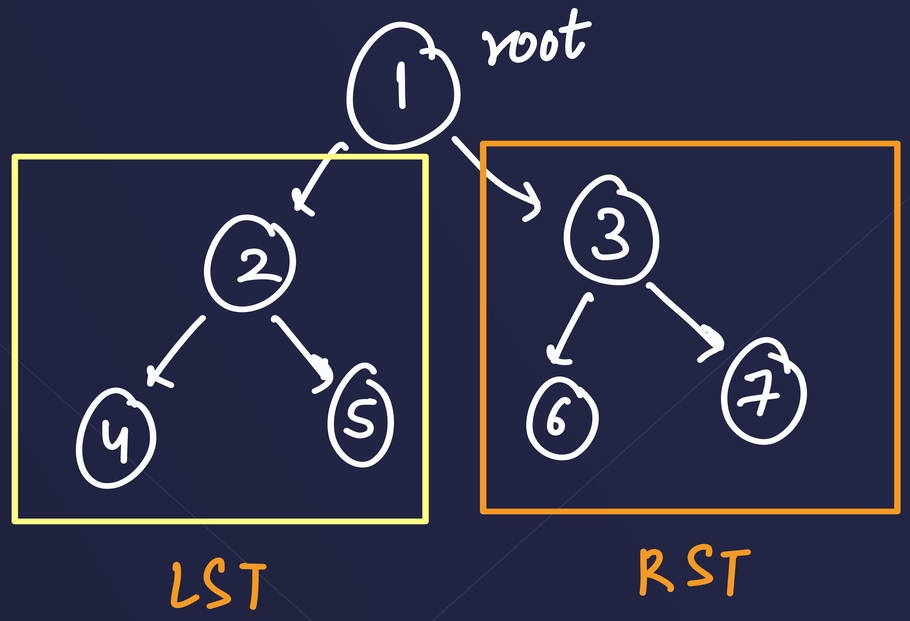
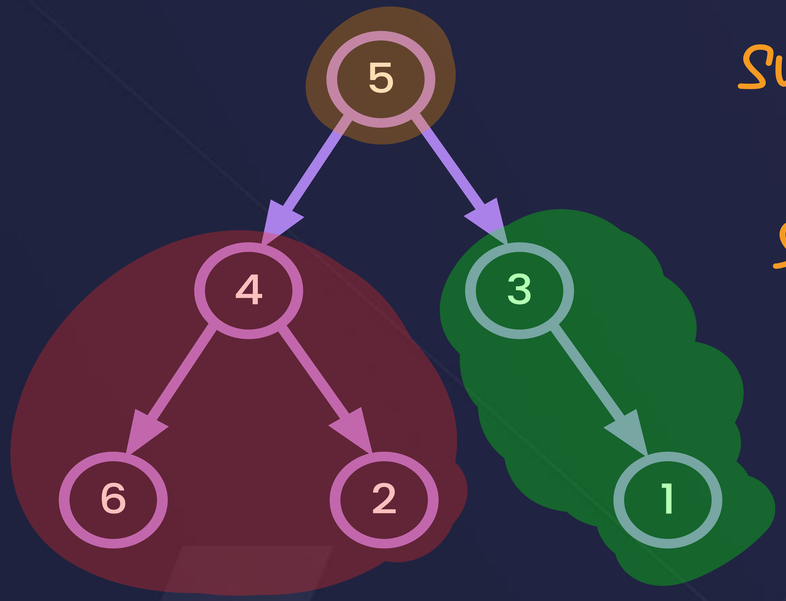
Left - Subtree & Right - Subtree



Find sum of tree nodes



Sum = root→val + LST + RST

Sum(root) = root→val + Sum(root→left)
+ Sum(root→right);

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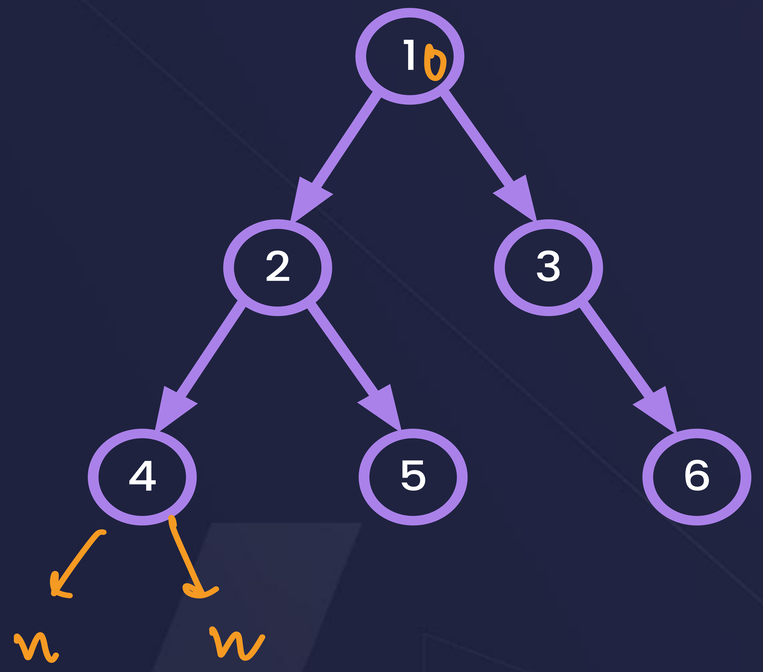
Find size of Binary Tree → Try it yourself first



Size(root) = 1 + size(root→left) + size(root→right)

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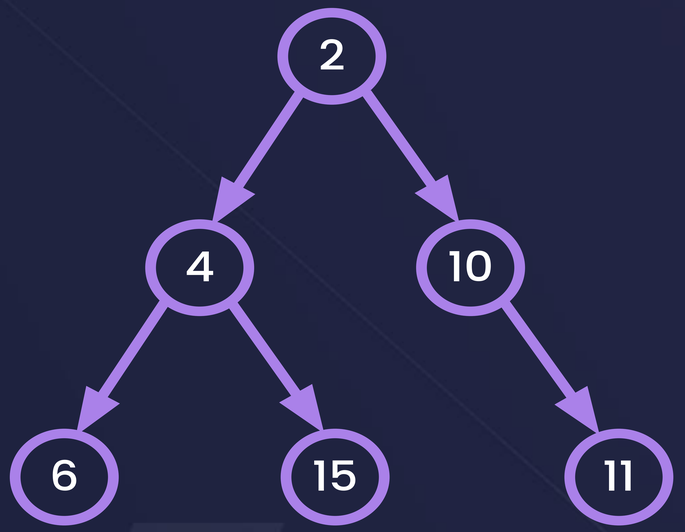
Find node with max value




```
if(root == NULL) return INT_MIN;
max(root) = max(root->val, max(left), max(right))
```

a, b, c

```
max( a, max(b,c));
```

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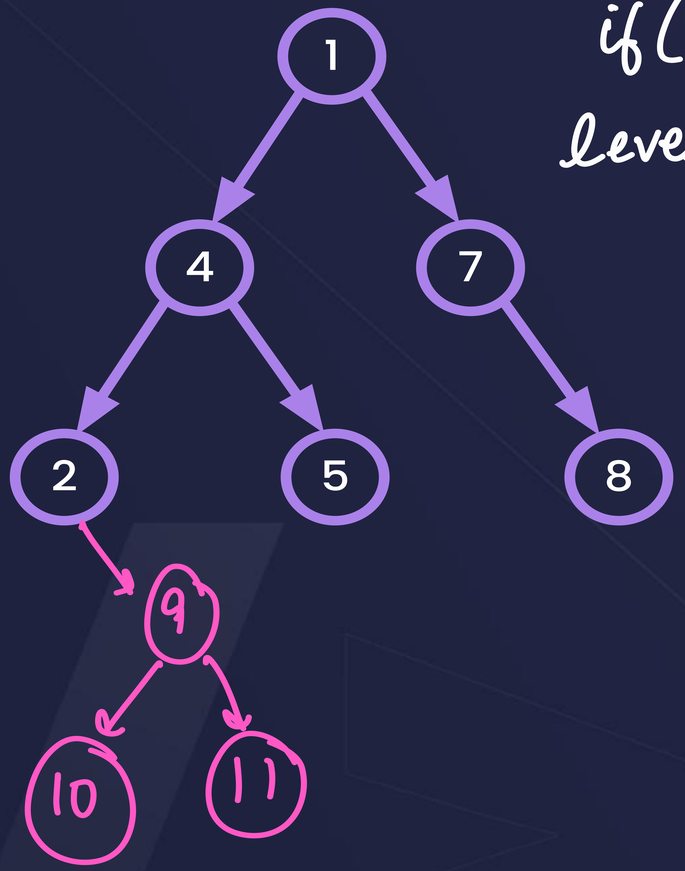
no. of levels

Find ~~height~~ of Binary Tree




```
if(root==NULL) return 0;
levels(root) = 1 + max(levels(root->left), levels(root->right))
```

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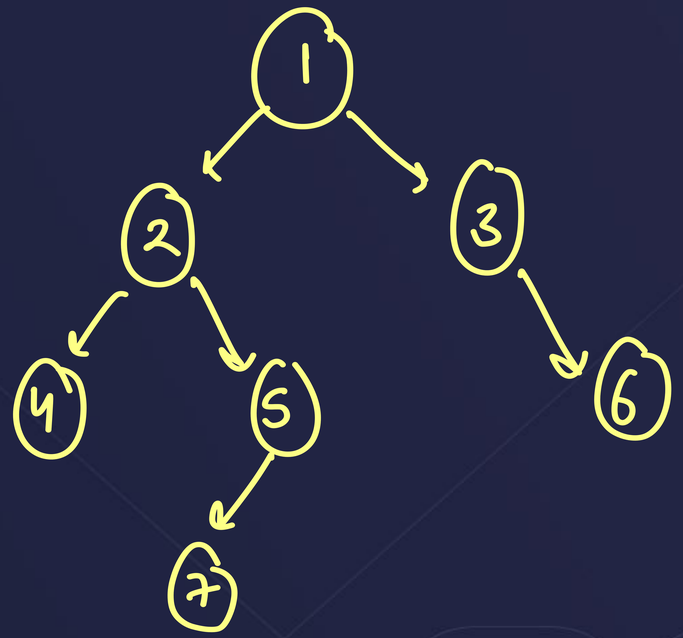
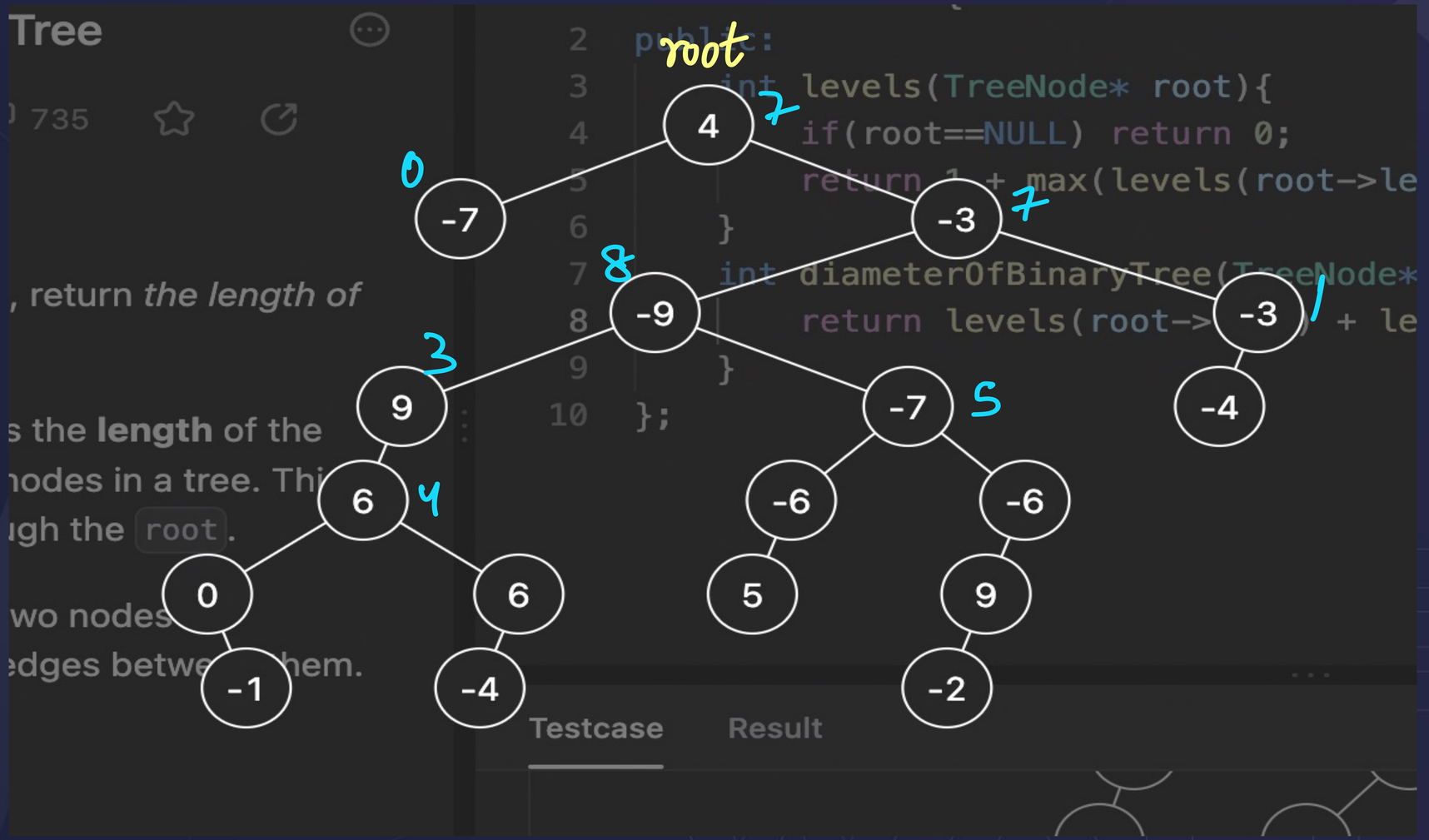
Ques: Diameter of Binary Tree [LeetCode 543]



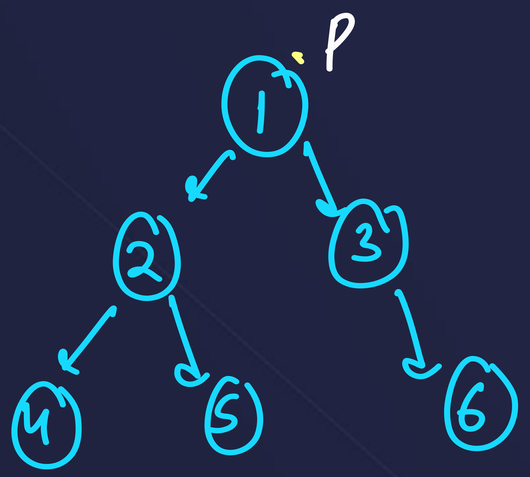
Approach 1 : Diameter (longest path b/w any 2 nodes)

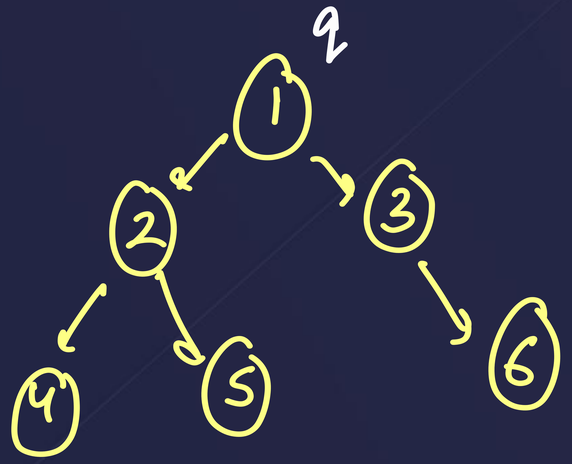
= no. of levels in LST + levels (RST)

Ques: Diameter of Binary Tree [LeetCode 543]



Ques: Same Tree [LeetCode 100]

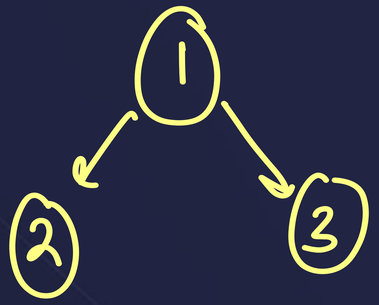


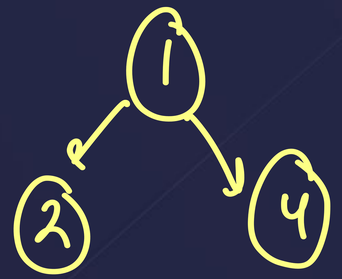


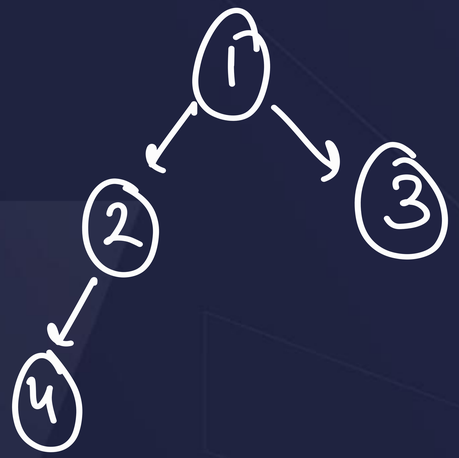
1) if (p != q) return false;
2) bool LSTans = isSameTree(p→left, q→left),→
3) bool RSTans = isSameTree(p→right, q→right)→false
4) return true

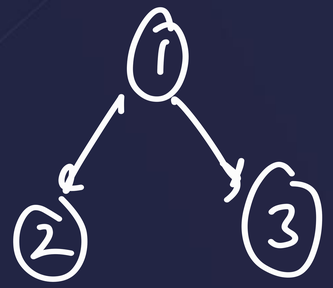
Ques: Same Tree

[LeetCode 100]









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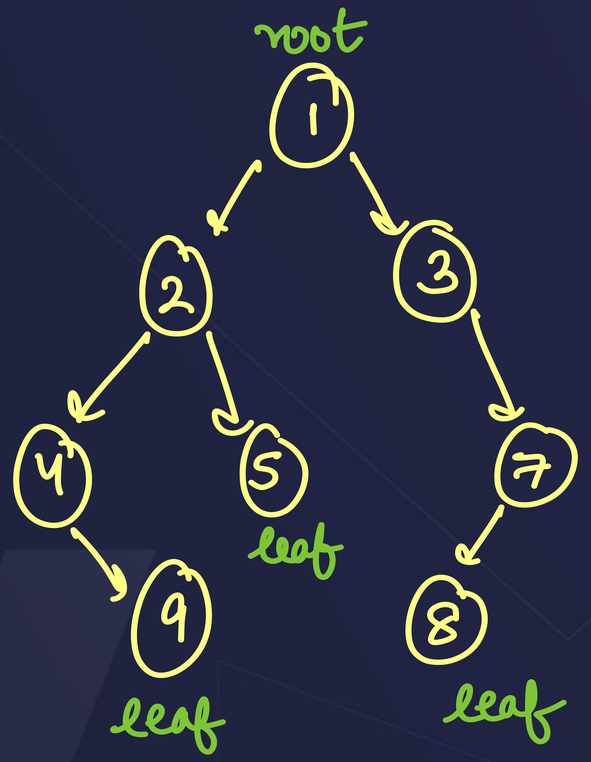
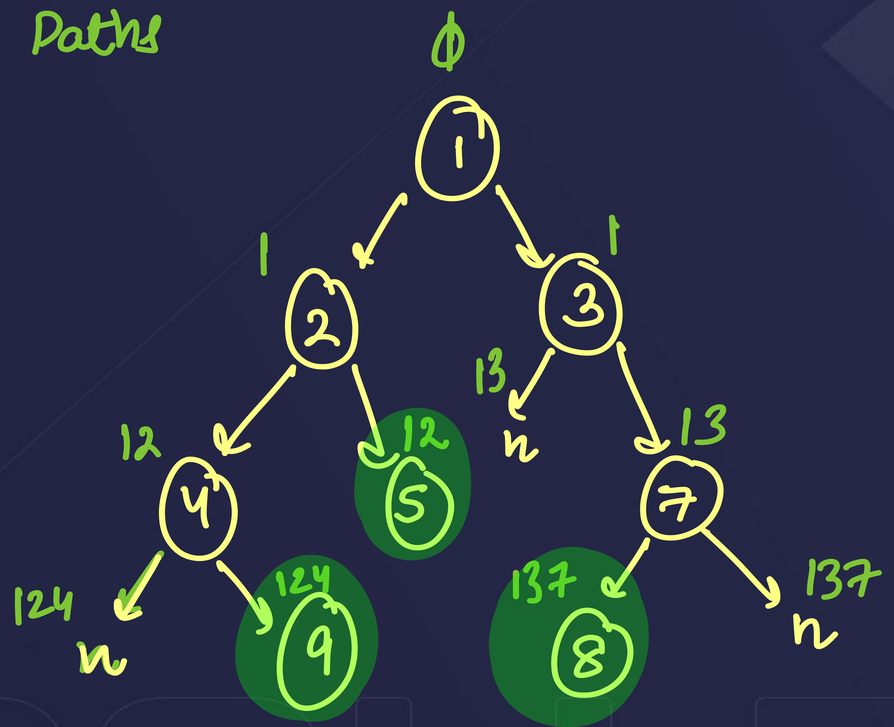
Ques: Invert Binary Tree [LeetCode 226]

Ques: Binary Tree Paths [LeetCode 257]

ϕ = ""

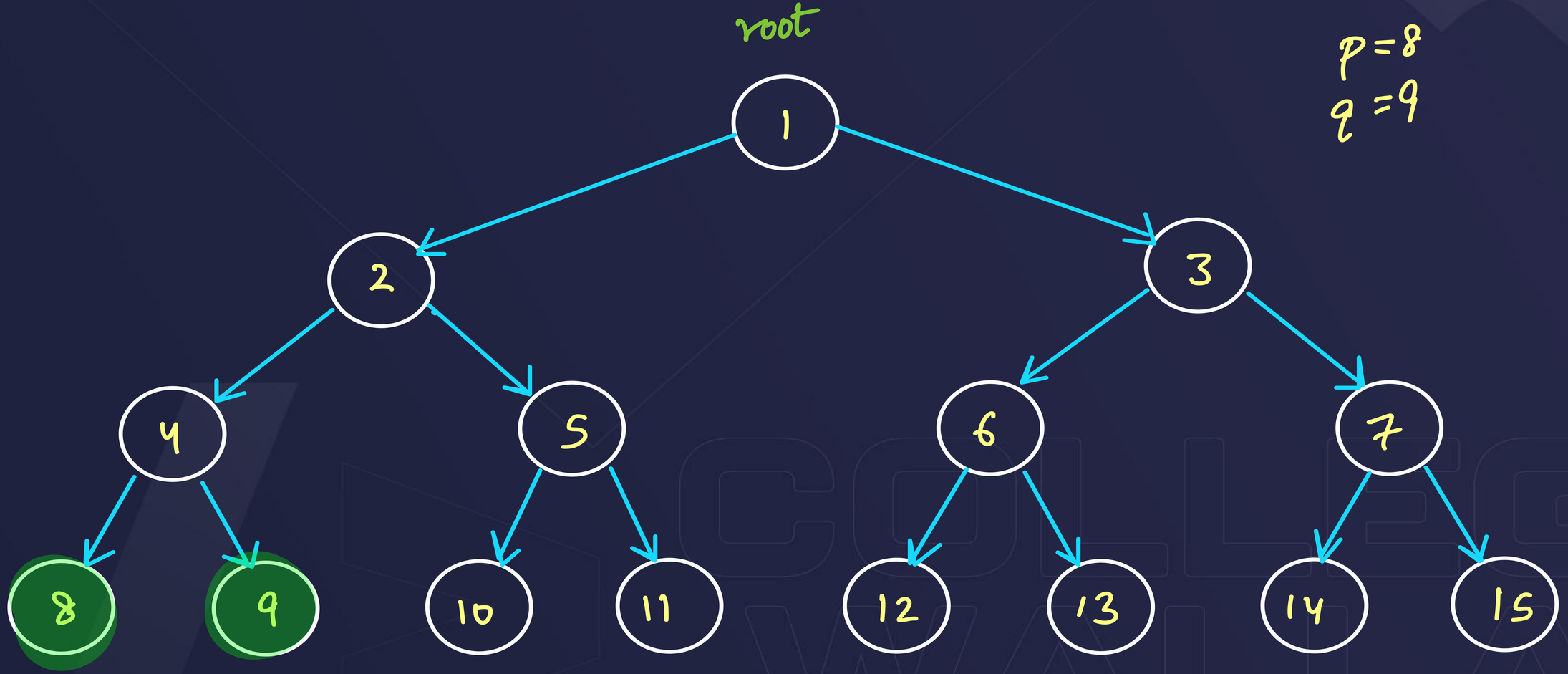
Root to Leaf Paths





→ v { "1249" , "125" , "1378" }

Ques: Lowest Common Ancestor of a Binary Tree (LCA) [LeetCode 236]



Types of Binary Trees

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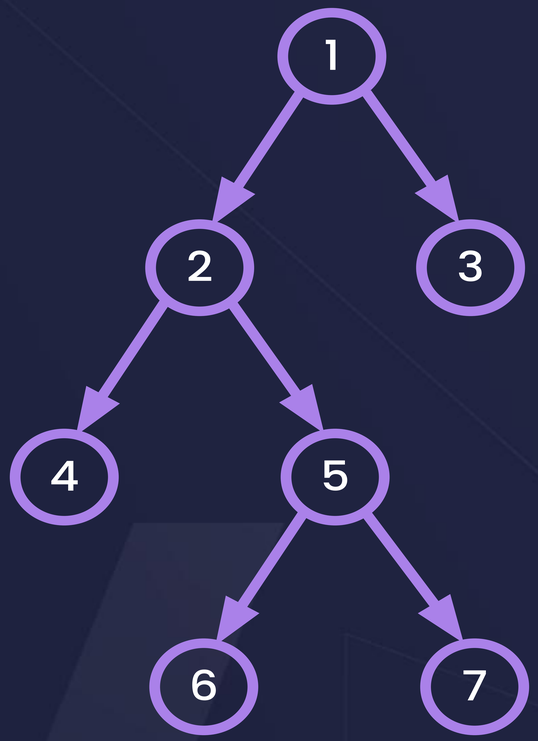
1. Full Binary Tree (0 or 2)



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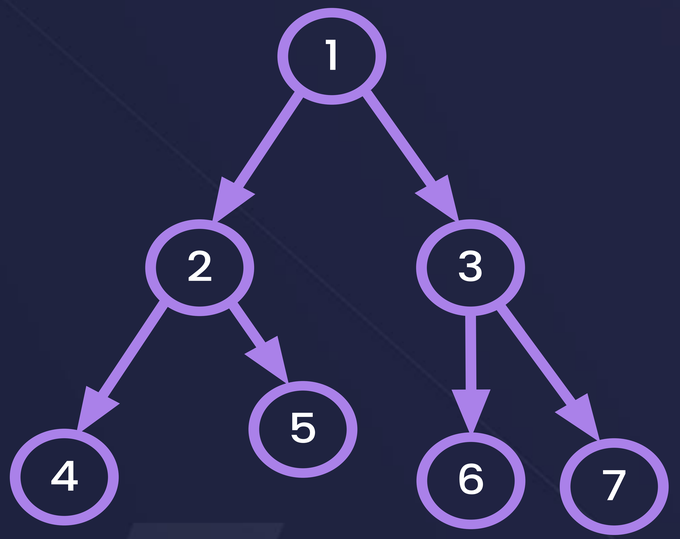
2. Perfect Binary Tree



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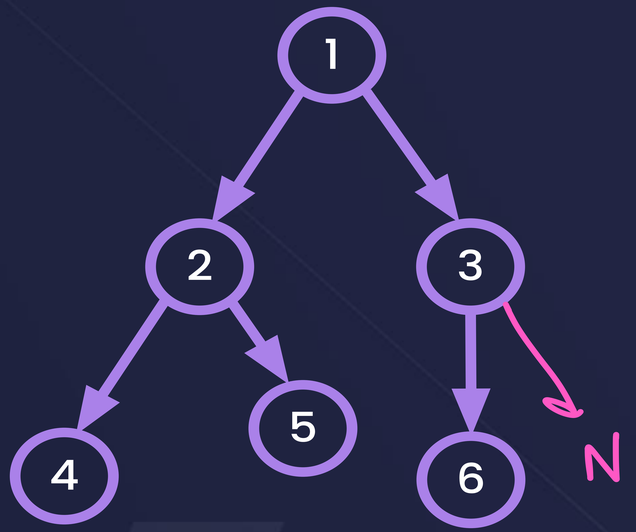
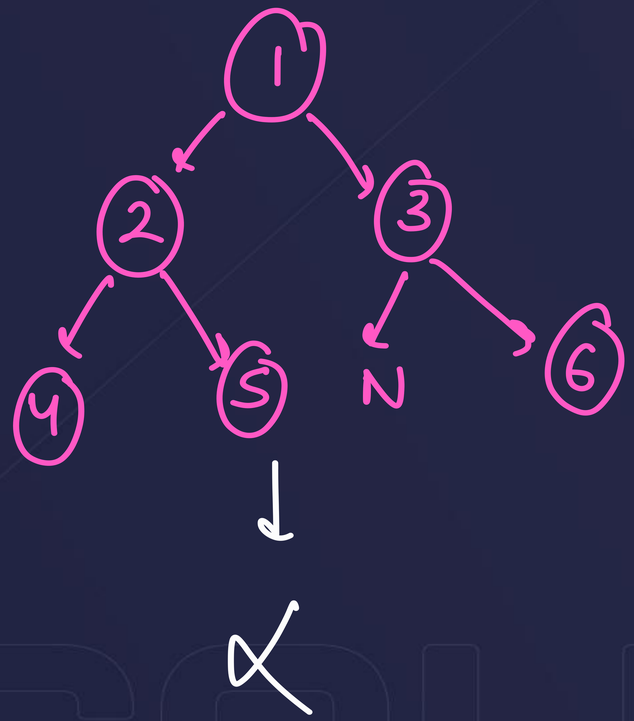
Every Node (except the last level leaf nodes)

has 2 child nodes

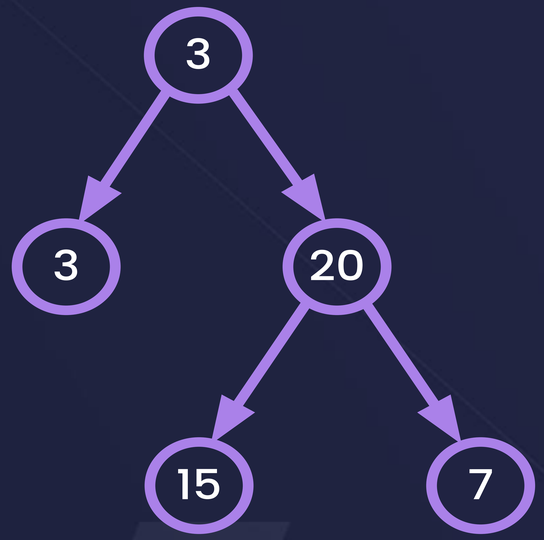
the last level has 0 child

3. Complete Binary Tree





4. Balanced Binary Tree : "Important"



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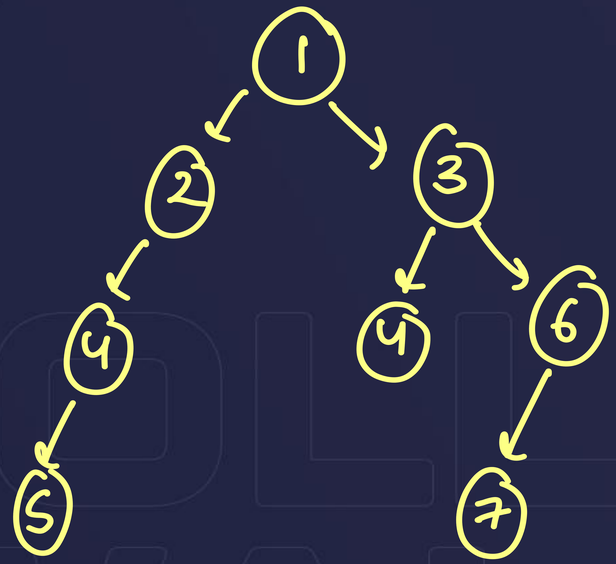
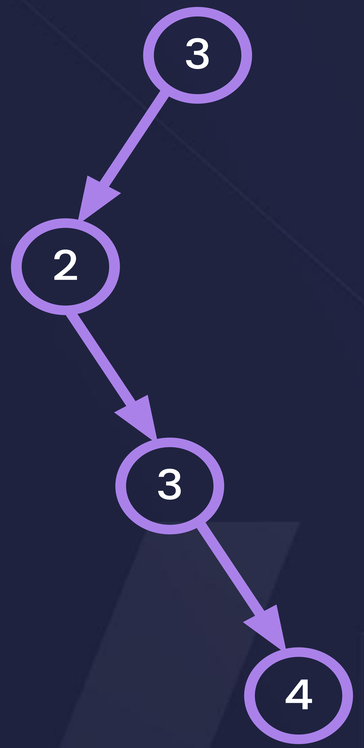
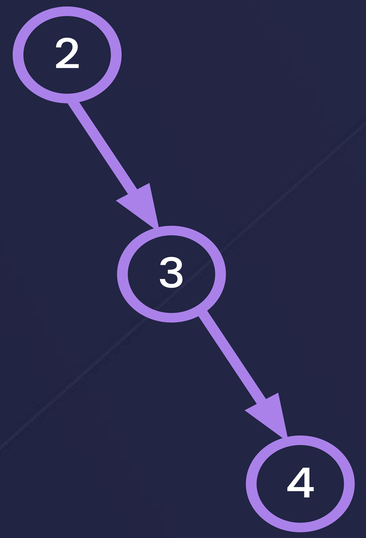
For every node, the difference b/w the levels of LST & RST should be atmost 1.



5. Degenerate and Skewed Binary Trees





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0 or 1 child

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Summary

- In this lecture , we studied about the Tree data structure.
- We studied its representation.
- We studied about its terminology.
- We studied about various types of Trees.
- We studied about Binary trees
- We studied about its implementation.
- We studied the various traversals on binary trees.
- We solved some problems on binary trees.
- We studied about the various types of Binary trees.

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Next Lecture

- ~~Interview problems on binary trees~~

  Traversals in Trees

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THANK YOU

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