COURSE NAME: ALGORITHMS
COURSE CODE: CIS 212

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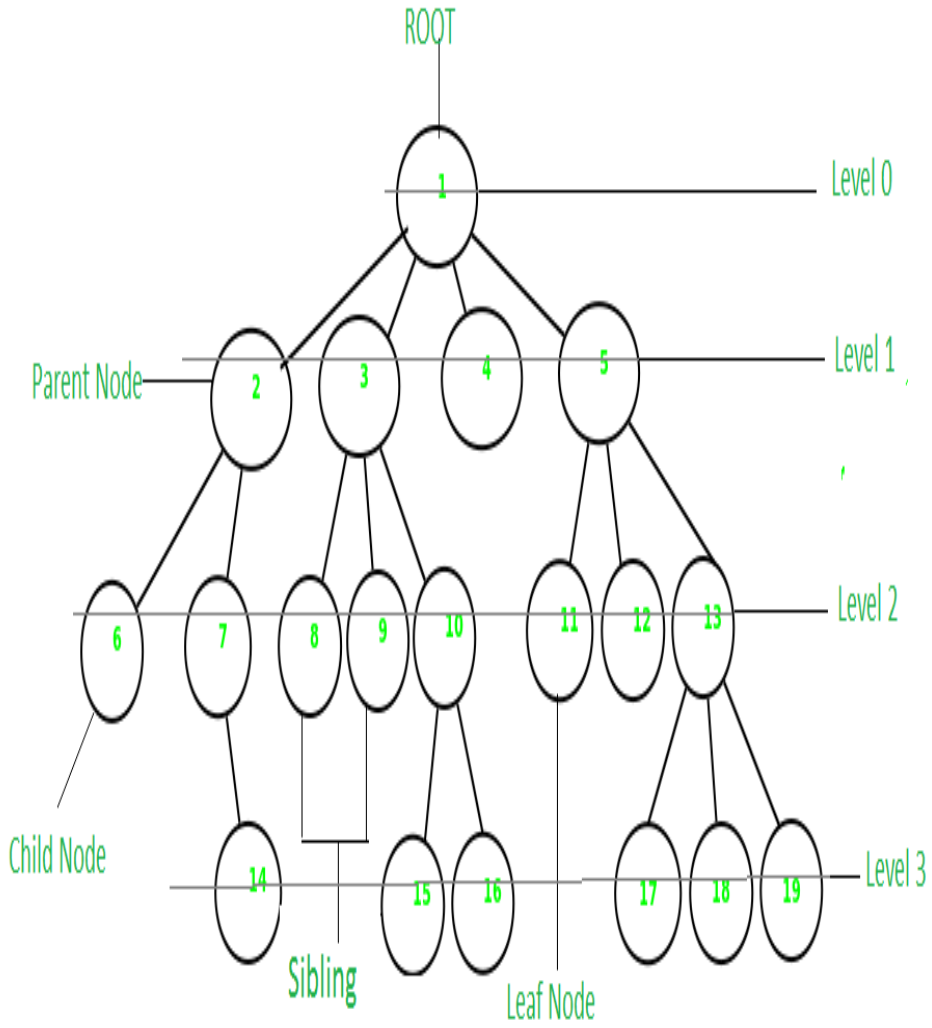
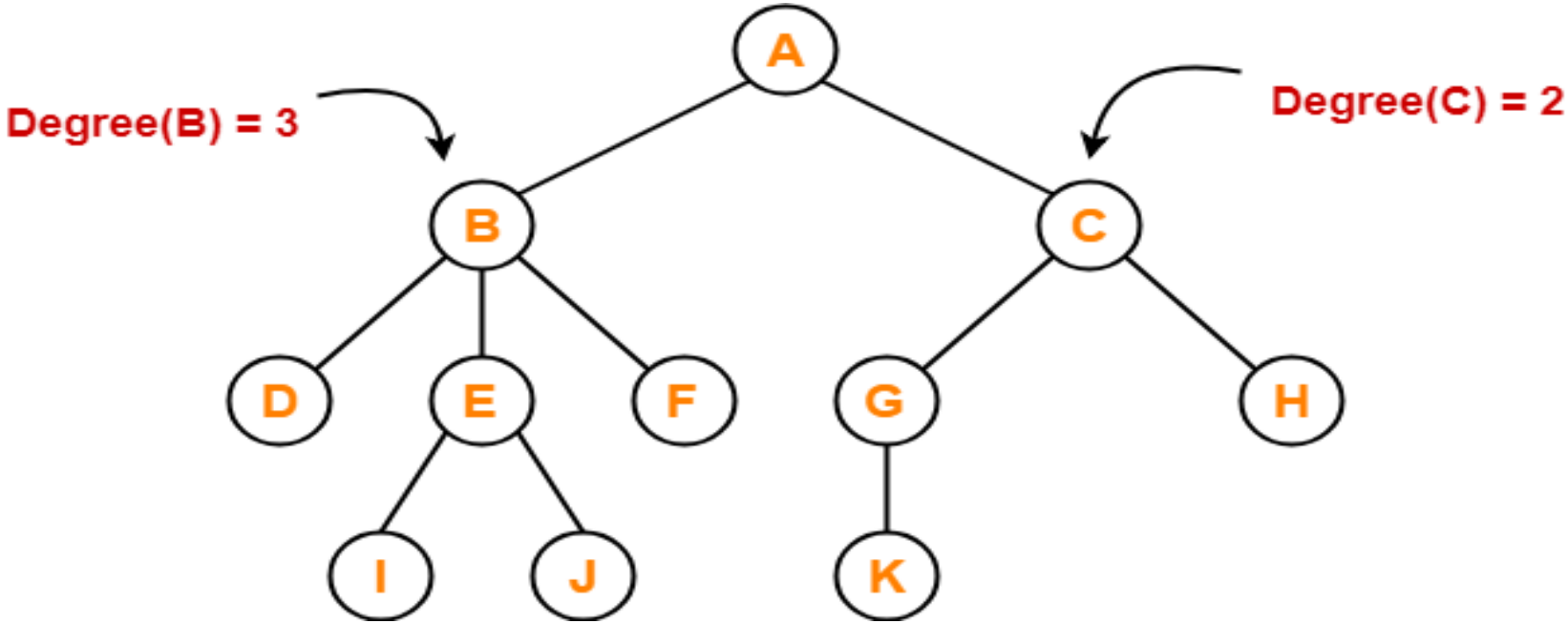
TREE

- **TREE:** Tree is a logical, non-linear, hierarchical data structure.
- **Root:** The topmost node of a tree or the node which does not have any parent node is called the root node.{1} is the root node of the tree.
- **Parent:** The node which is a predecessor of a node is called the parent node of that node. {2} is the parent node of {6,7}.
- **Child:** The node which the immediate successor of a node is called the child node of that node. {6,7} are the child nodes of {2}.



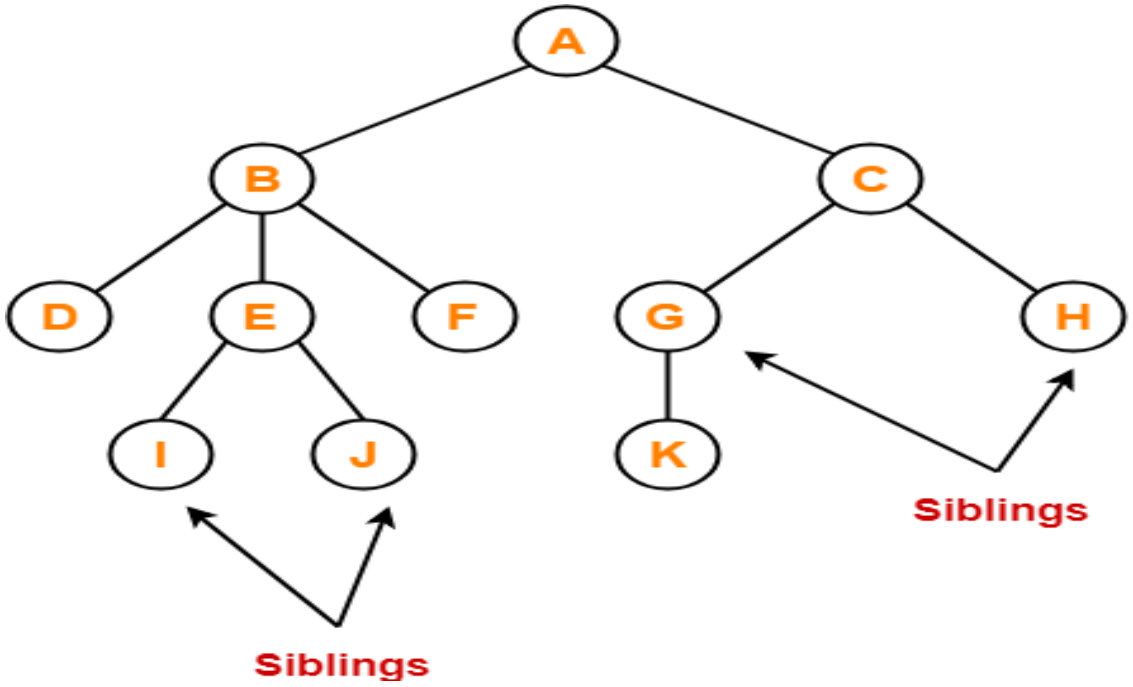
TREE

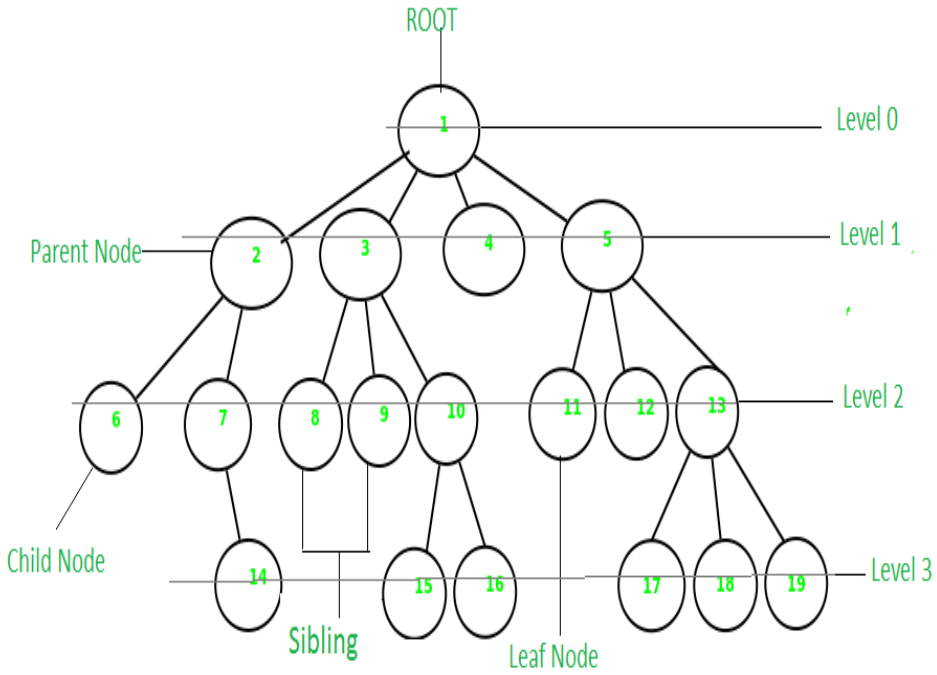
- **Degree of a Node:** Degree of a node is the total number of children of that node.
- Degree of a tree is the highest degree of a node among all the nodes in the tree



TREE

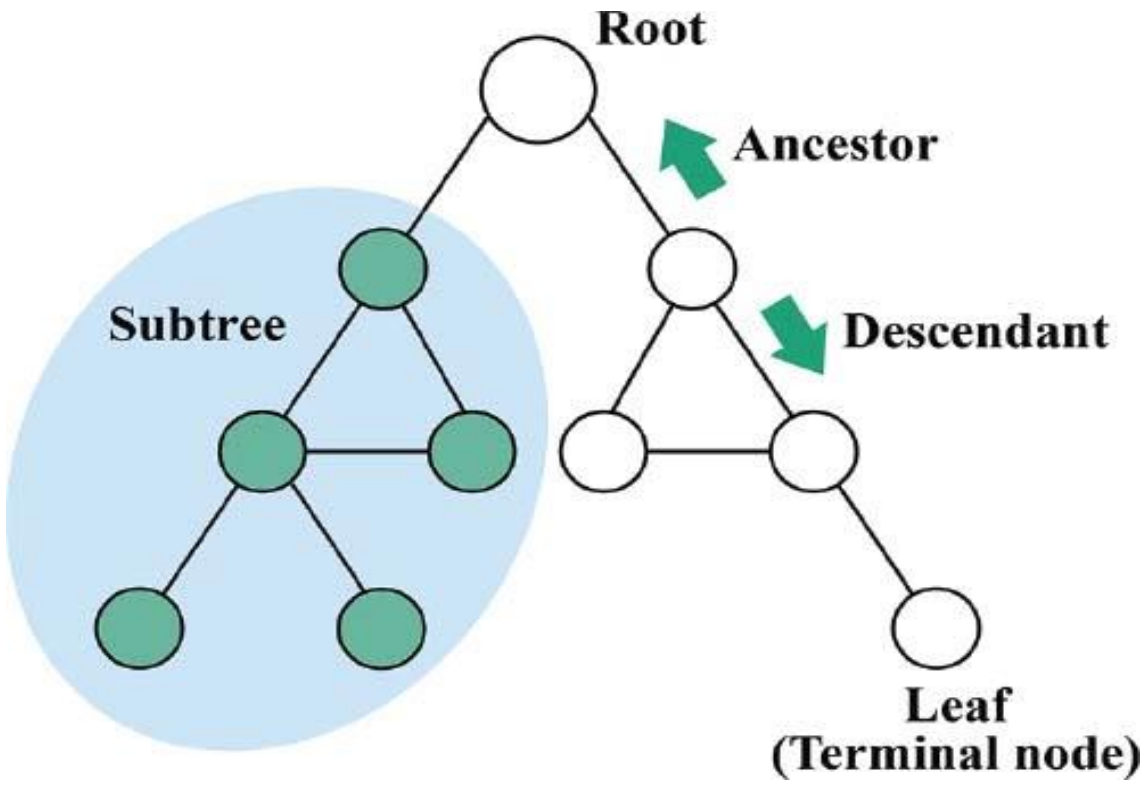
- **Siblings:** Children of the same parent node are called siblings. {8,9,10} are called siblings.

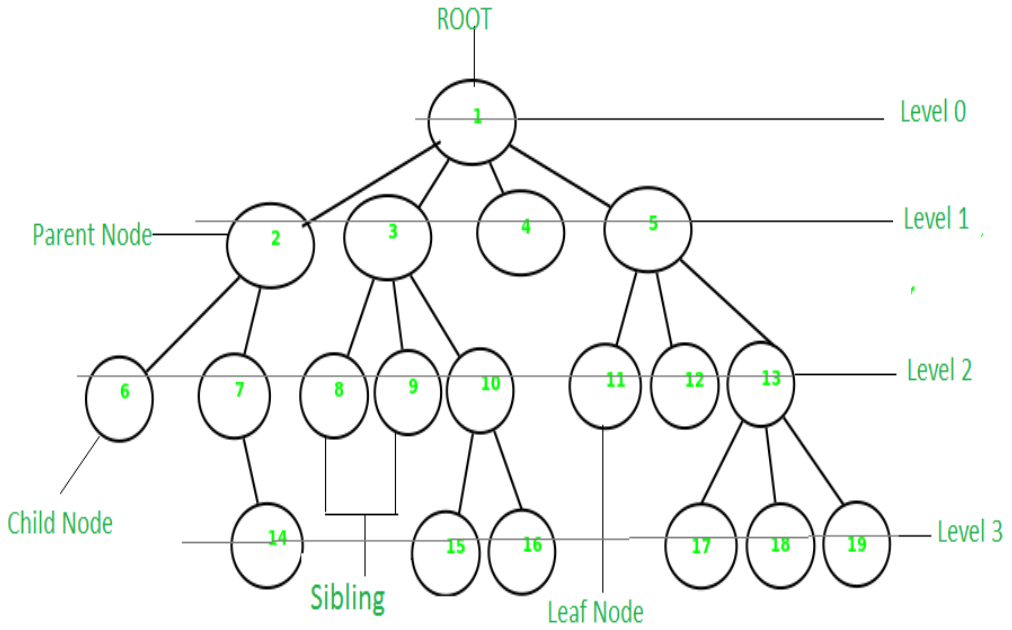




TREE

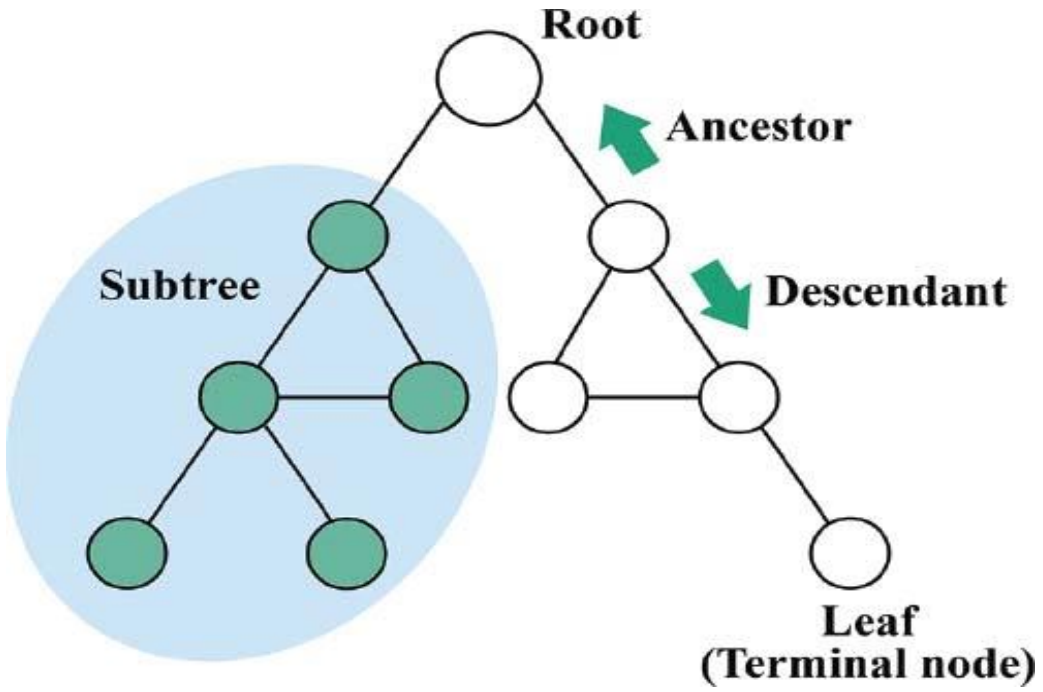
- **Descendant:** Any successor node on the path from the leaf node to that node. {7,14} are the descendants of the node {2}.

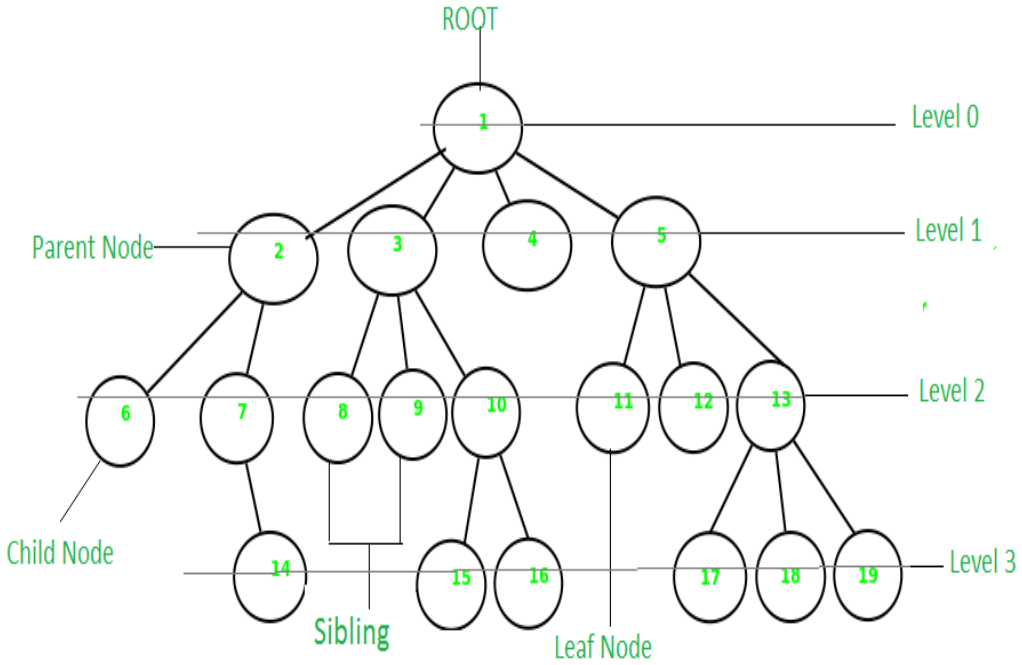




TREE

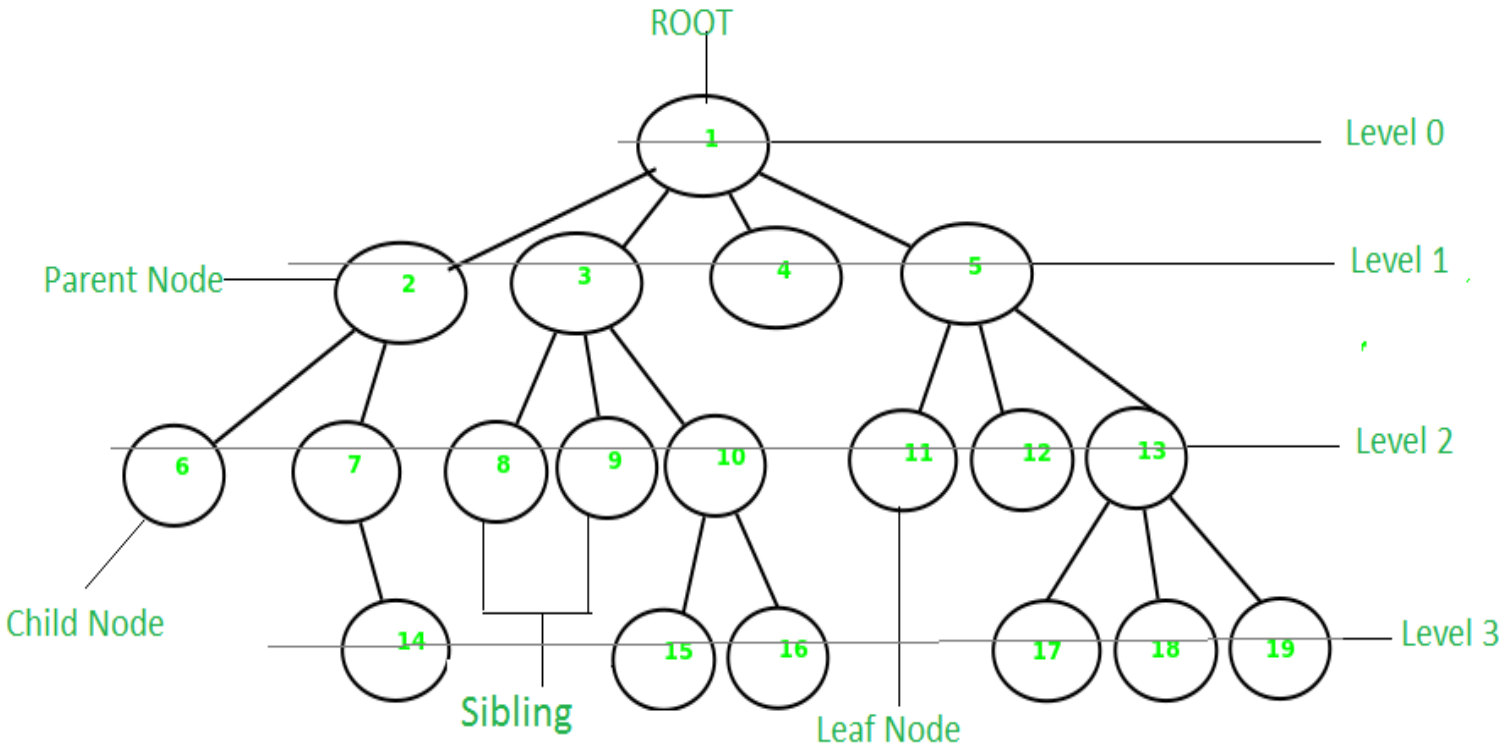
- **Ancestors:** Any predecessor nodes on the path of the root to that node are called Ancestors of that node. {1,2} are the parent nodes of the node {7}.





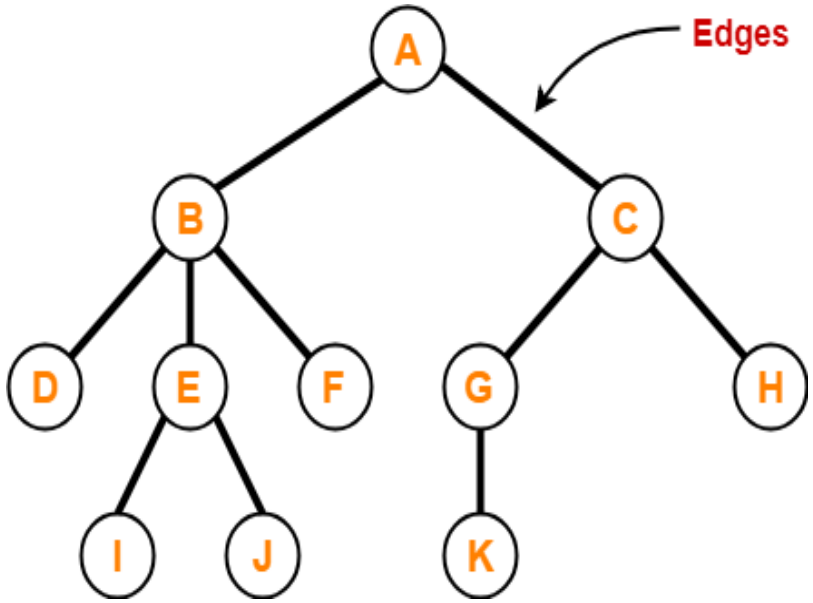
TREE

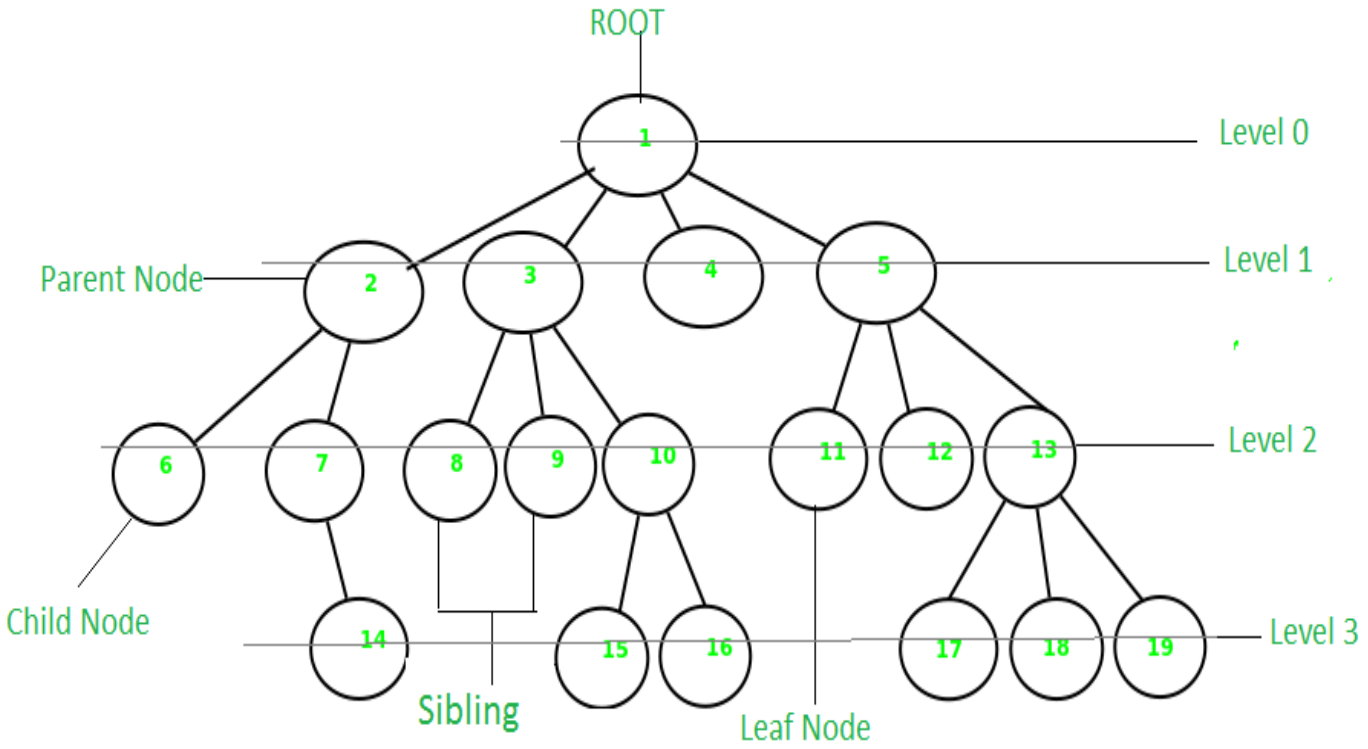
- **Internal/Non-Leaf nodes:** A node with at least one child is called internal node.
- **External/Leaf nodes:** The nodes which do not have any child nodes are called leaf nodes. {6,14,8,9,15,16,4,11,12,17,18,19} are the leaf nodes of the tree.



TREE

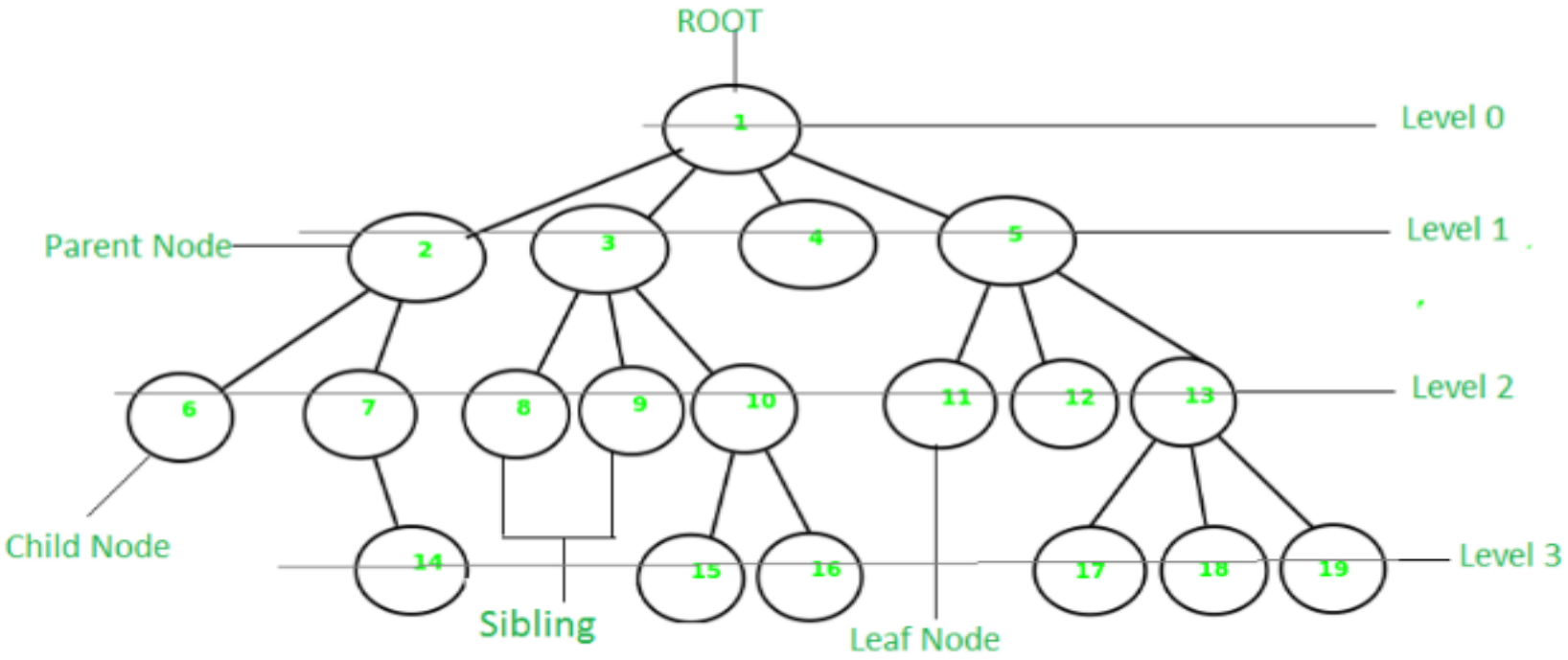
- **Level or Depth:** The count of edges on the path from the root node to that node is called the level of a node. The root node has level 0.
- In a tree, each step from top to bottom is called as level of a tree. The level count starts with 0 and increments by 1 at each level or step.





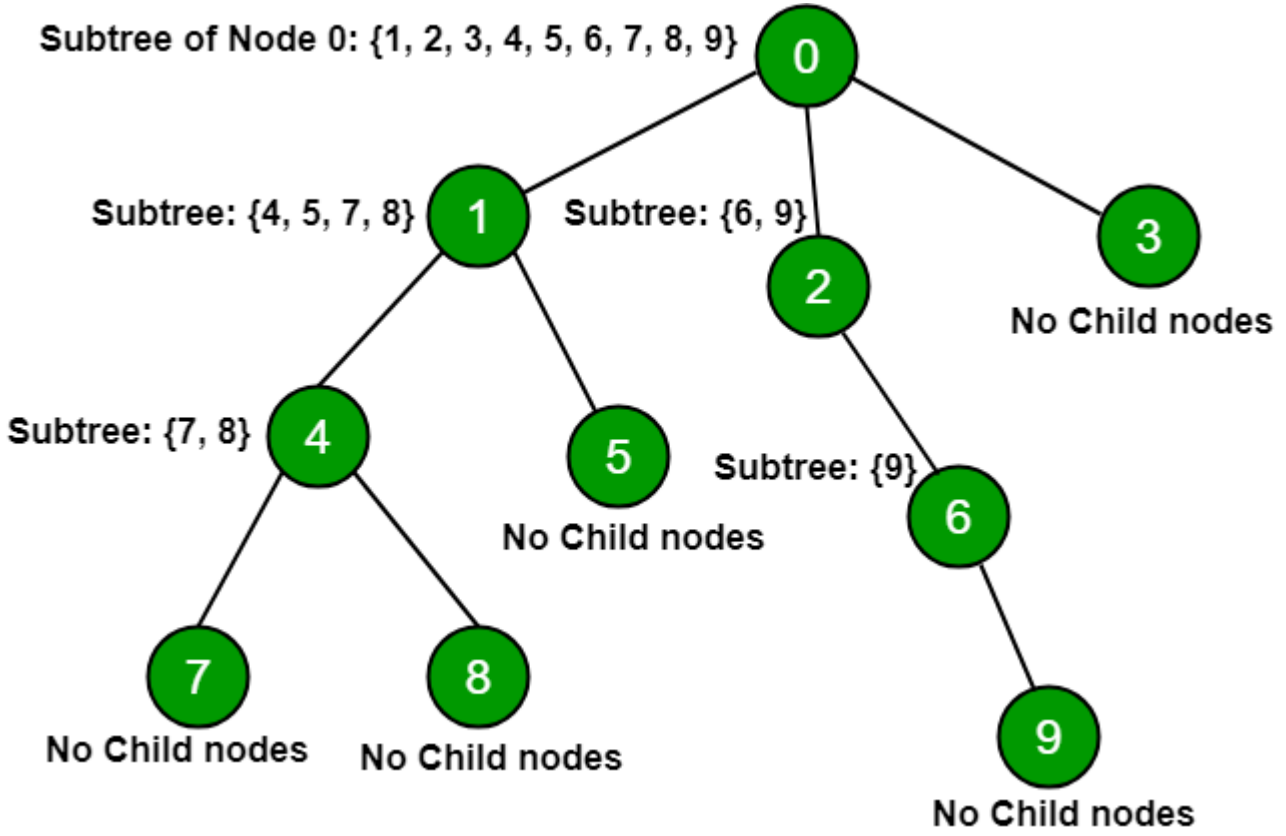
TREE

- **Height of a tree:** The height of a tree is the height of the root node. The count of edges from deepest leaf node to the root node. The height of the above tree is 3.
- **Height of a node:** The number of edges on the longest path from leaf node to that node. Height of node {3} is 2.



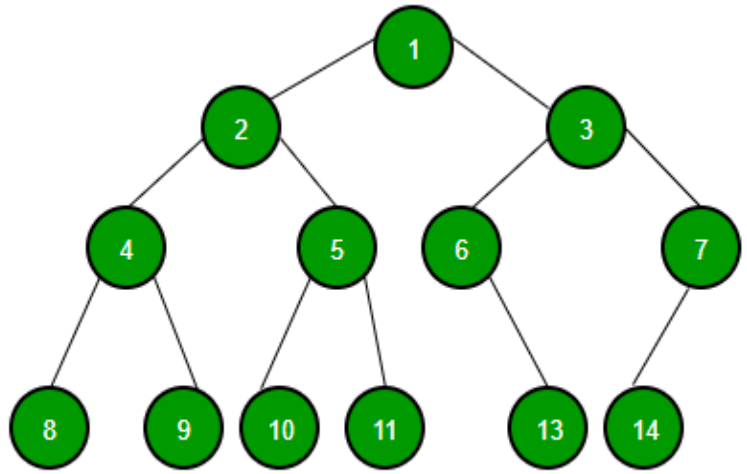
TREE

- **Subtree:** Any node of the tree along with its descendant.

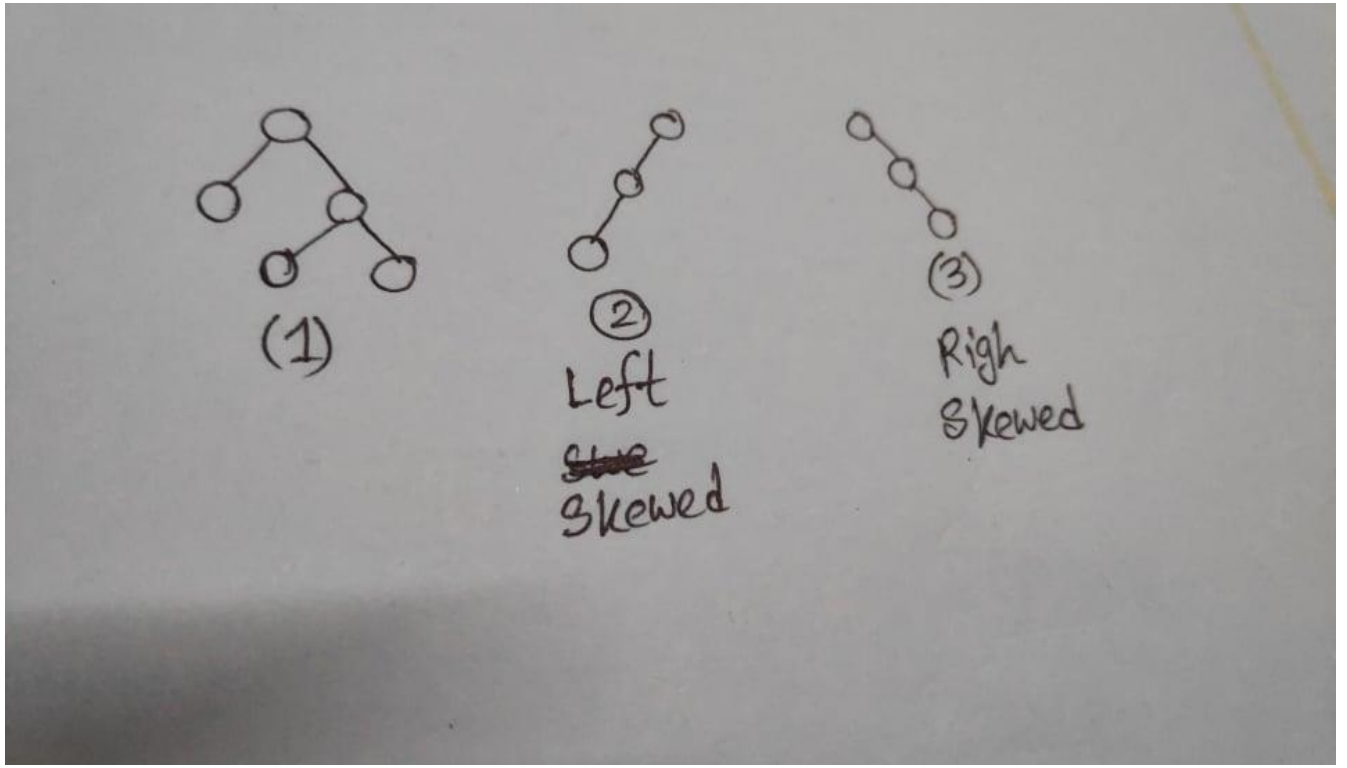


BINARY TREE

- Binary Tree: A tree whose elements have at most 2 children is called a binary tree. Since, each element in a binary tree can have only 2 children, we typically name them the left and right child.
- Child can be {0,1,2} possible.

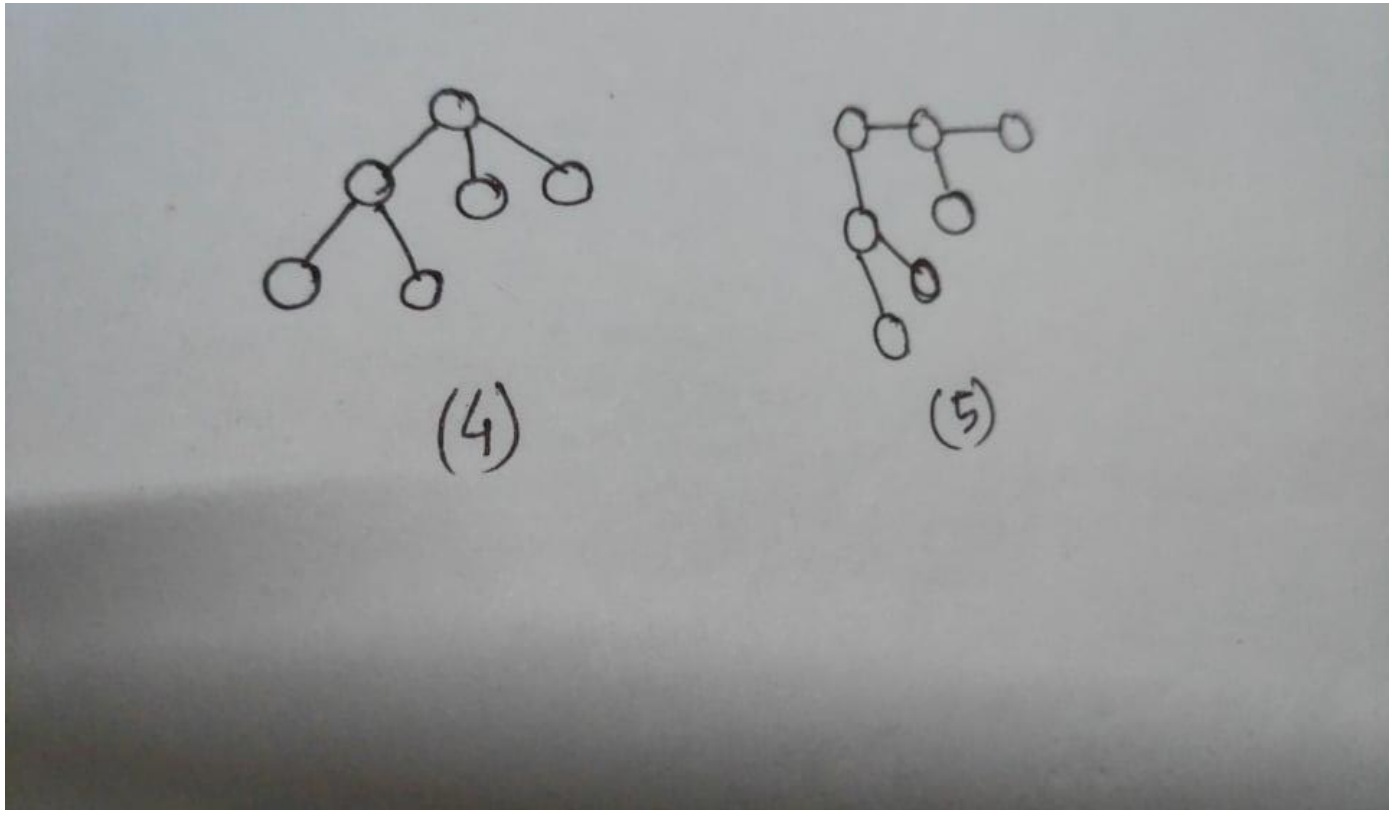


BINARY TREE



- 1,2,3 all are binary tree

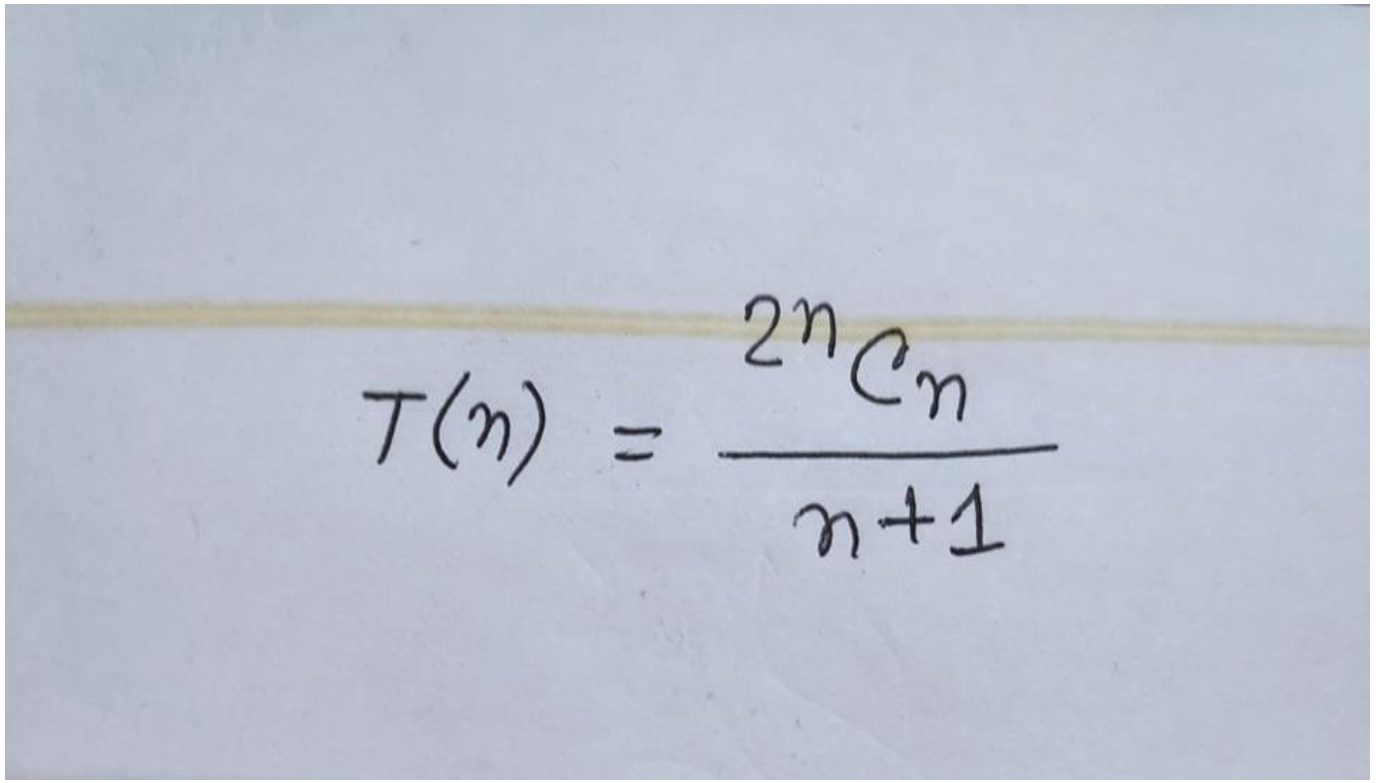
BINARY TREE



- 4 not a binary tree
- 5 is a binary tree

BINARY TREE

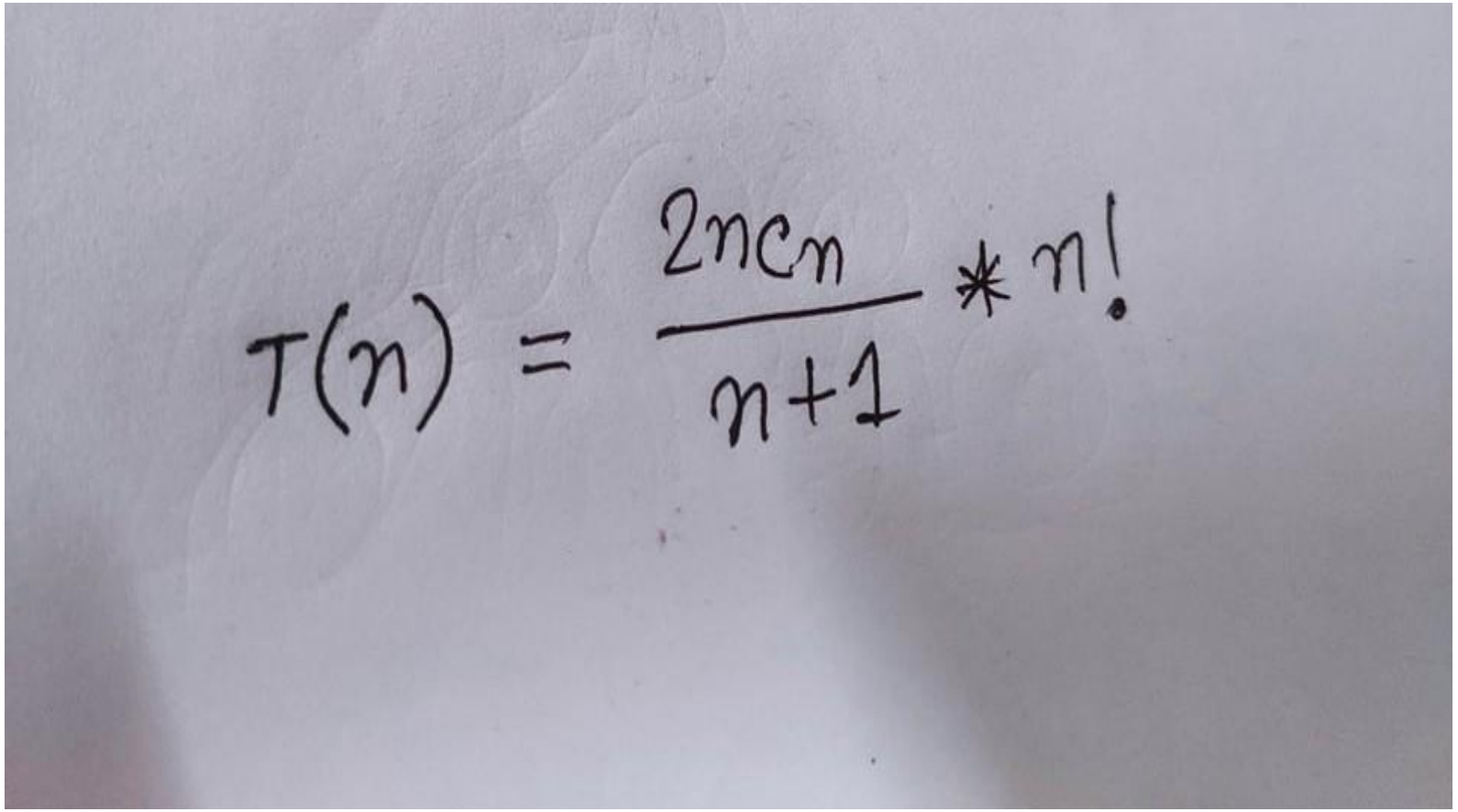
- If number of **unlabeled** nodes are given, how many binary trees can be generated?



CATALAN NUMBER

BINARY TREE

- If number of **labeled** nodes are given, how many binary trees can be generated?



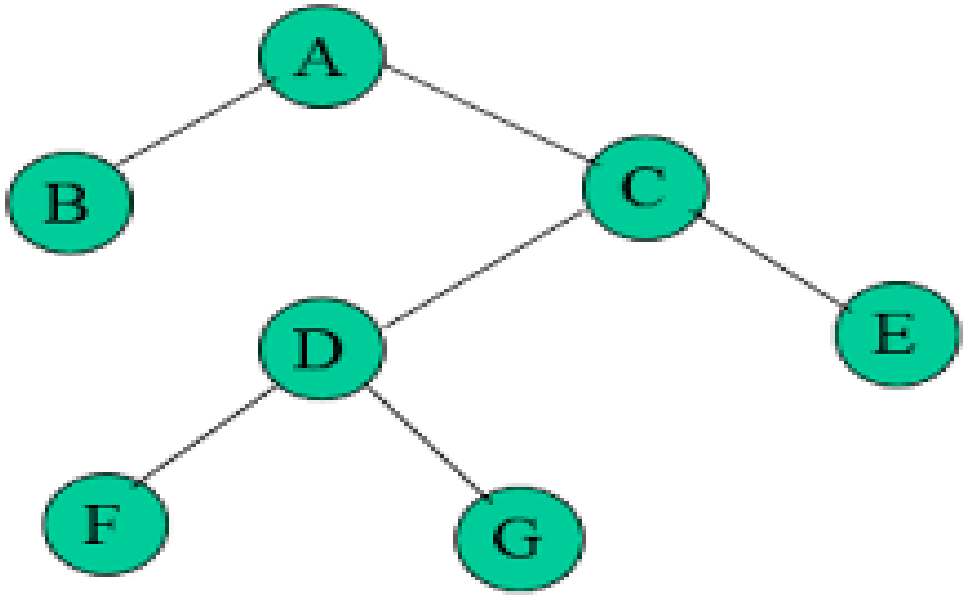
BINARY TREE

- If, Height of a Binary Tree is given then,
- Min. Nodes, n = (h+1)
- Max. Nodes n = 2^(h+1) – 1

- If Nodes of a Binary Tree is given then,
- Min. Height, h = log2 (n+1) -1
- Max. Height, h = (n-1)

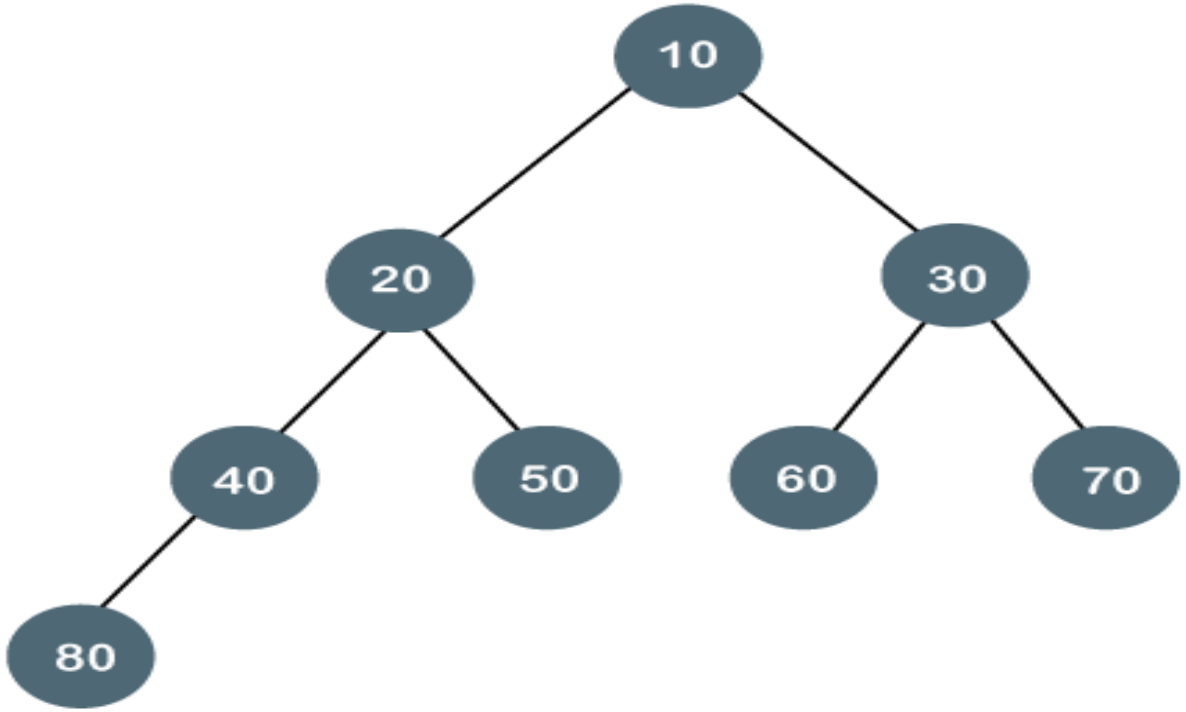
FULL / PROPER / STRICT BINARY TREE

- Full/Proper/Strict BT: The full binary tree is also known as a strict binary tree. The tree can only be considered as the full binary tree if each node must contain either 0 or 2 children.



COMPLETE BINARY TREE

- Complete BT: The complete binary tree is a tree in which all the nodes are completely filled except the last level. In the last level, all the nodes must be as left as possible. In a complete binary tree, the nodes should be added from the left.



BINARY SEARCH TREE

- Binary Search Tree: A binary search tree follows some order to arrange the elements. In a binary search tree, the value of left node must be smaller than the parent node, and the value of right node must be greater than the parent node. This rule is applied recursively to the left and right subtrees of the root.