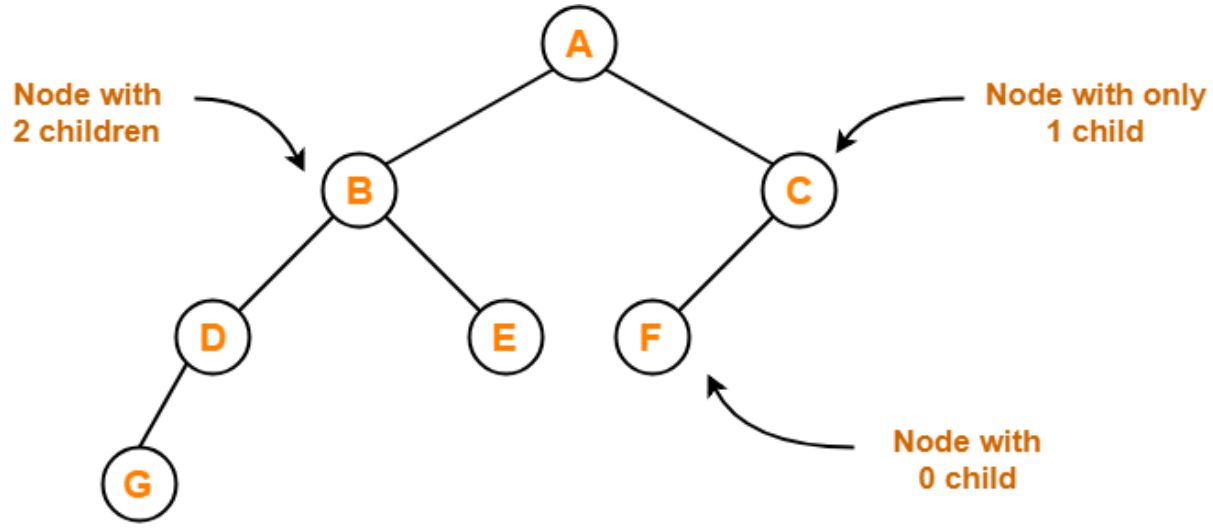
Binary Tree

Binary Tree: Binary tree is a special tree data structure in which each node can have at most 2 children.

Thus, in a binary tree, Each node has either 0 child or 1 child or 2 children.

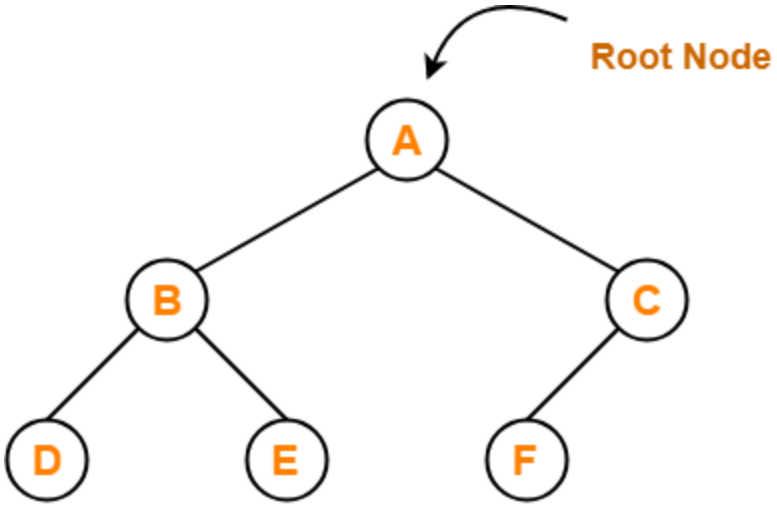


Binary Tree Example

Types of Binary Tree:

1. **Rooted Binary Tree:** A **rooted binary tree** is a binary tree that satisfies the following 2 properties-

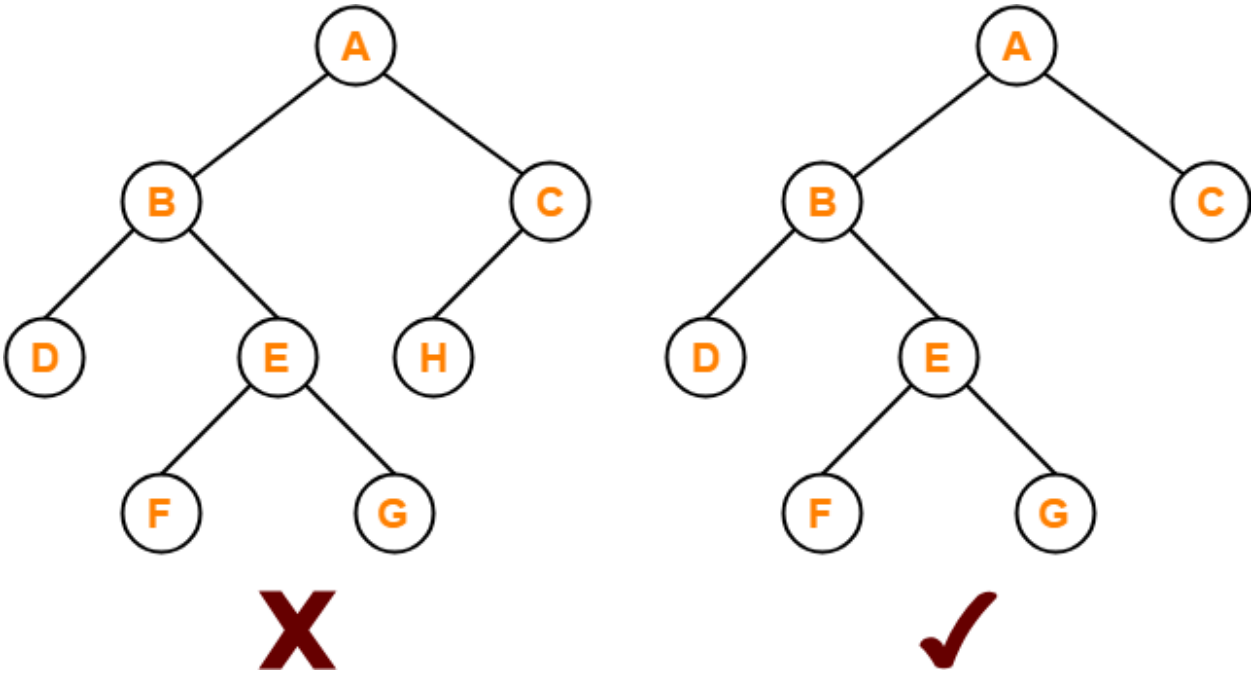
- It has a root node.
- Each node has at most 2 children.



Rooted Binary Tree

2. Full / Strictly Binary Tree-

- A binary tree in which every node has either 0 or 2 children is called as a Full binary tree.
- Full binary tree is also called as Strictly binary tree.



Here,

- First binary tree is not a full binary tree.

- This is because node C has only 1 child.

3. Complete / Perfect Binary Tree-

- If all levels of tree are completely filled except the last level and the last level has all keys as left as possible, is said to be a Complete Binary Tree.
- Complete binary tree is also called as Perfect Binary Tree.

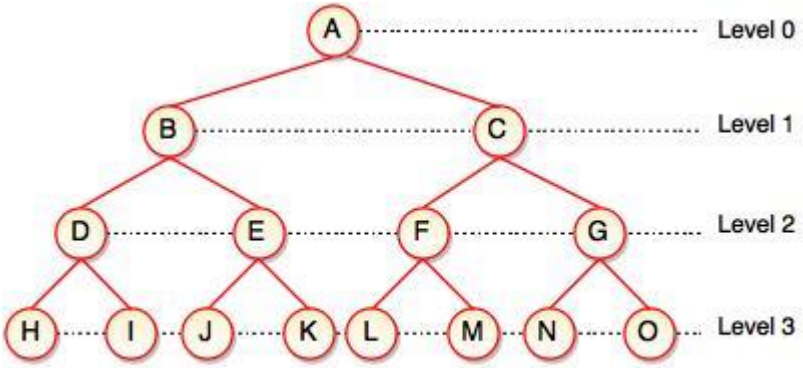


Fig. Complete Binary Tree

- In a complete binary tree, every internal node has exactly two children and all leaf nodes are at same level.
- For example, at Level 2, there must be $2^2 = 4$ nodes and at Level 3 there must be $2^3 = 8$ nodes.

4. Skewed Binary Tree

- If a tree which is dominated by left child node or right child node, is said to be a Skewed Binary Tree.
- In a skewed binary tree, all nodes except one have only one child node. The remaining node has no child.

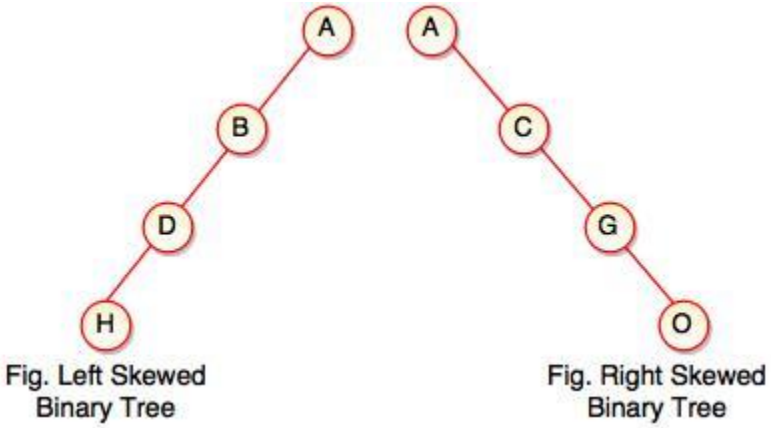


Fig. Left Skewed Binary Tree

Fig. Right Skewed Binary Tree

- In a left skewed tree, most of the nodes have the left child without corresponding right child.
- In a right skewed tree, most of the nodes have the right child without corresponding left child.

5. **Extended Binary Tree**

- Extended binary tree consists of replacing every null subtree of the original tree with special nodes.
- Empty circle represents internal node and filled circle represents external node.
- The nodes from the original tree are internal nodes and the special nodes are external nodes.
- Every internal node in the extended binary tree has exactly two children and every external node is a leaf. It displays the result which is a **complete binary tree**.

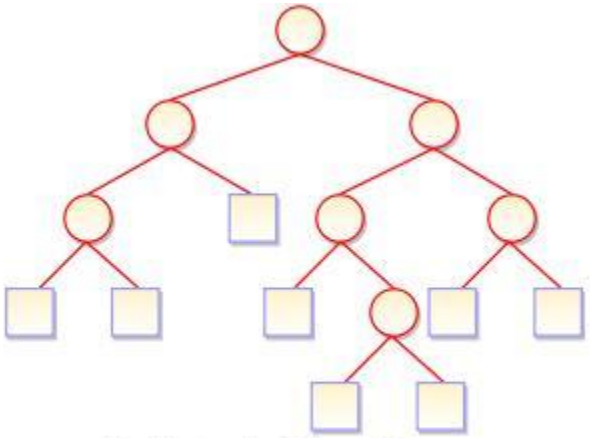


Fig. Extended Binary Tree