Binary Tree | Types of Binary Trees

gatevidyalay.com/binary-tree-types-of-trees-in-data-structure

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Tree Data Structure-

Before you go through this article, make sure that you have gone through the previous article on **Tree Data Structure**.

We have discussed-

- Tree is a non-linear data structure.
- In a tree data structure, a node can have any number of child nodes.

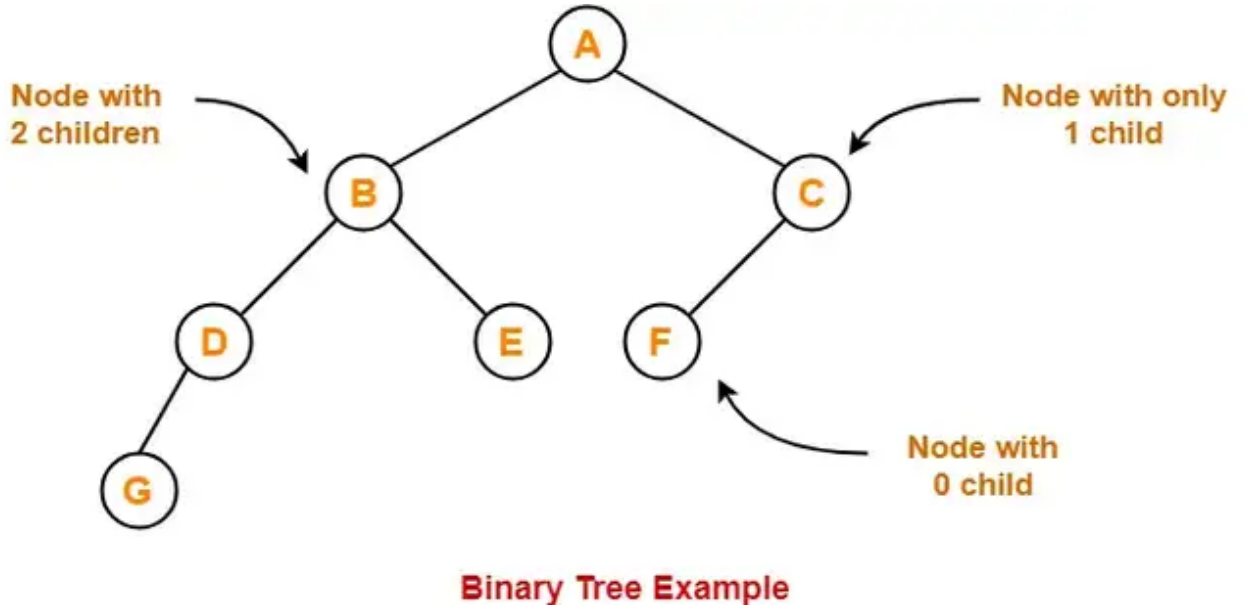
In this article, we will discuss about Binary Trees.

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.

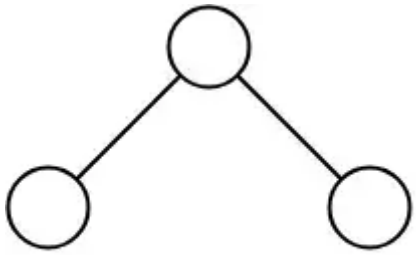
Example-



Binary Tree Example

Unlabeled Binary Tree-

A binary tree is unlabeled if its nodes are not assigned any label.



Unlabeled Binary Tree

$$\text{Number of different Binary Trees possible with 'n' unlabeled nodes} = \frac{{}^{2n}C_n}{n+1}$$

Example-

Consider we want to draw all the binary trees possible with 3 unlabeled nodes.

Using the above formula, we have-

Number of binary trees possible with 3 unlabeled nodes

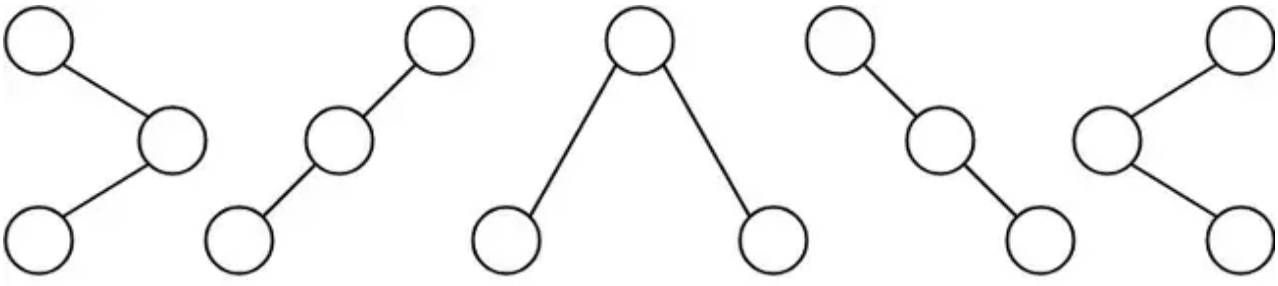
$= {}^{2 \times 3}C_3 / (3 + 1)$

$= {}^{6}C_3 / 4$

$= 5$

Thus,

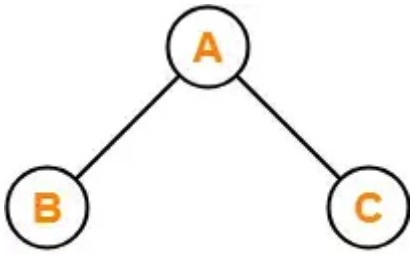
- With 3 unlabeled nodes, 5 unlabeled binary trees are possible.
- These unlabeled binary trees are as follows-



Binary Trees Possible With 3 Unlabeled Nodes

Labeled Binary Tree-

A binary tree is labeled if all its nodes are assigned a label.



Labeled Binary Tree

Number of different Binary Trees possible with 'n' labeled nodes

$$= \frac{{}^{2n}C_n}{n+1} \times n!$$

Example-

Consider we want to draw all the binary trees possible with 3 labeled nodes.

Using the above formula, we have-

Number of binary trees possible with 3 labeled nodes

$= \{ {}^{2 \times 3}C_3 / (3 + 1) \} \times 3!$

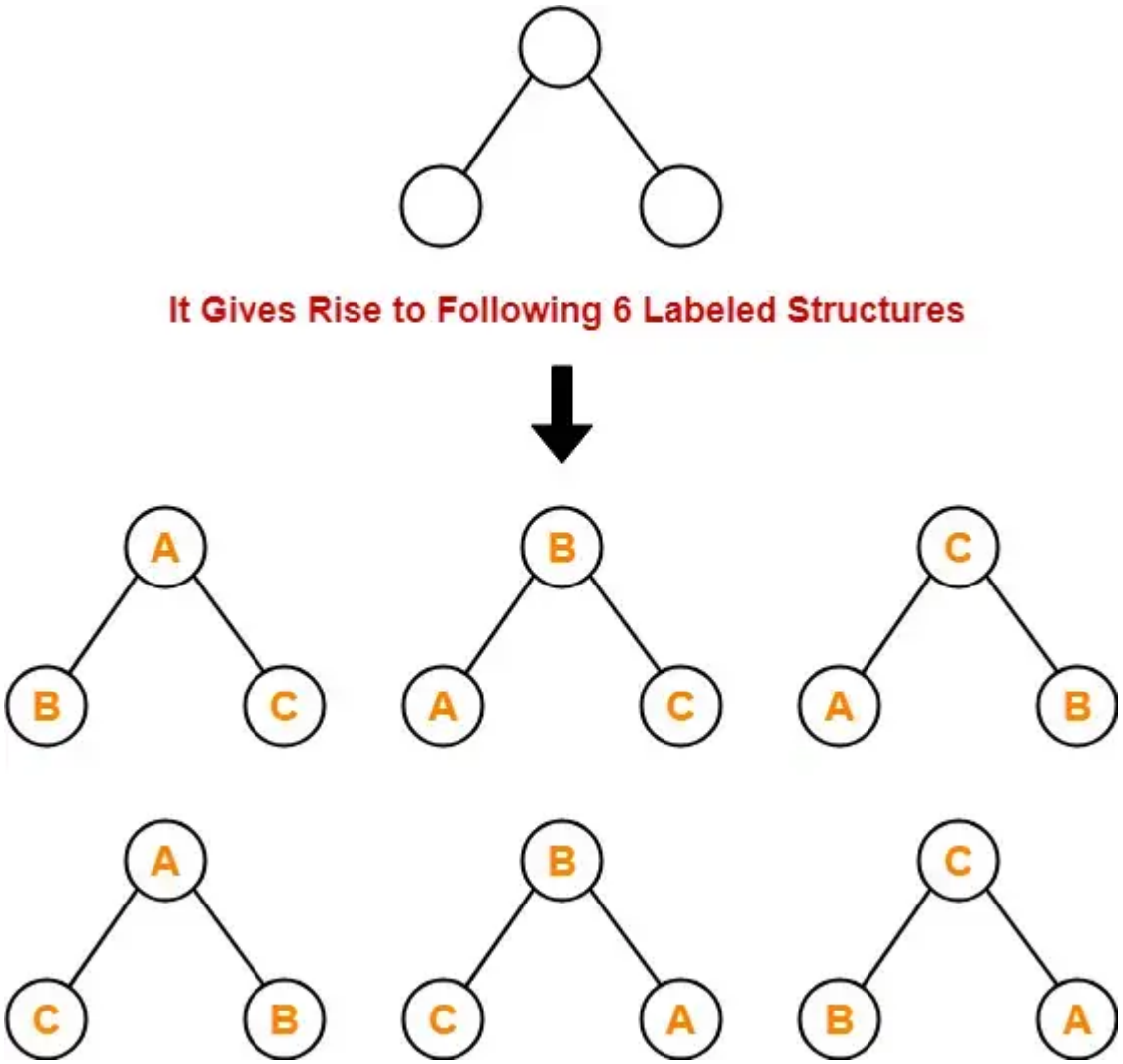
$= \{ {}^{6}C_3 / 4 \} \times 6$

$= 5 \times 6$

$= 30$

Thus,

- With 3 labeled nodes, 30 labeled binary trees are possible.
- Each unlabeled structure gives rise to 3! = 6 different labeled structures.

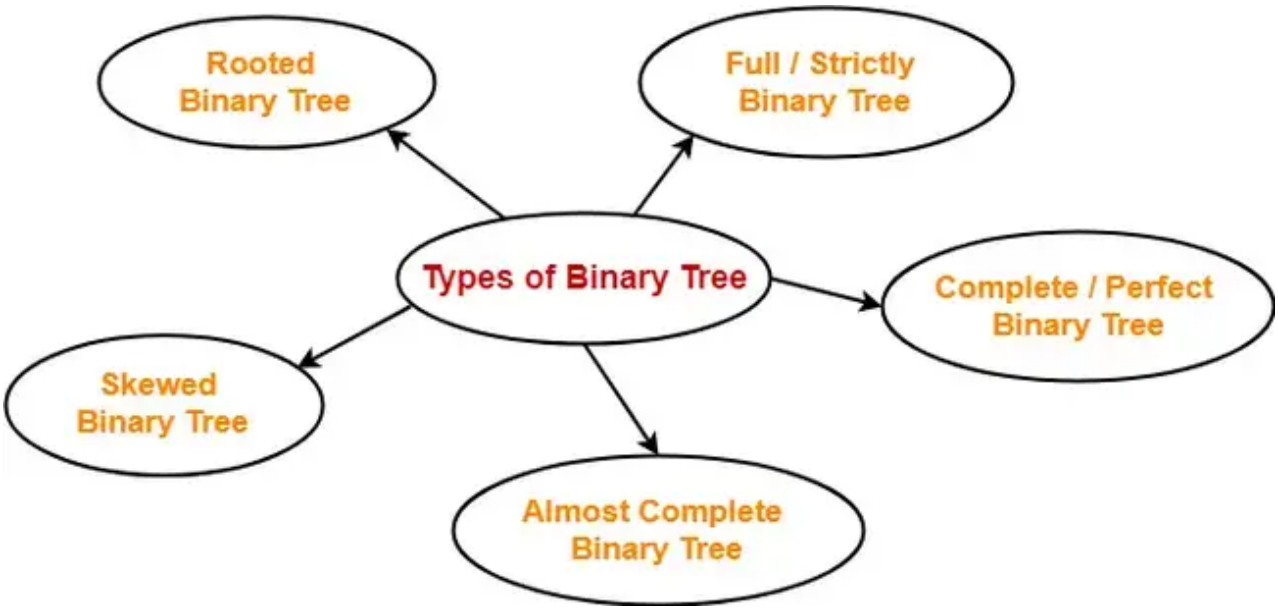


Similarly,

- Every other unlabeled structure gives rise to 6 different labeled structures.
- Thus, in total 30 different labeled binary trees are possible.

Types of Binary Trees-

Binary trees can be of the following types-



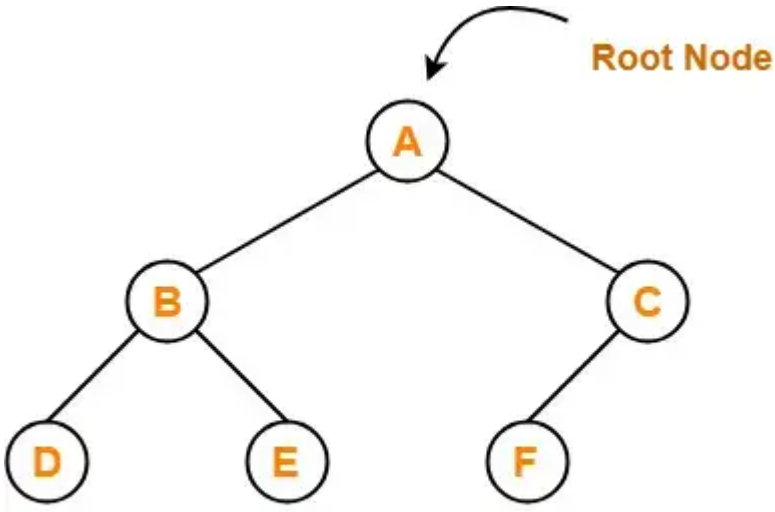
1. Rooted Binary Tree
2. Full / Strictly Binary Tree
3. Complete / Perfect Binary Tree
4. Almost Complete Binary Tree
5. Skewed Binary Tree

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.

Example-

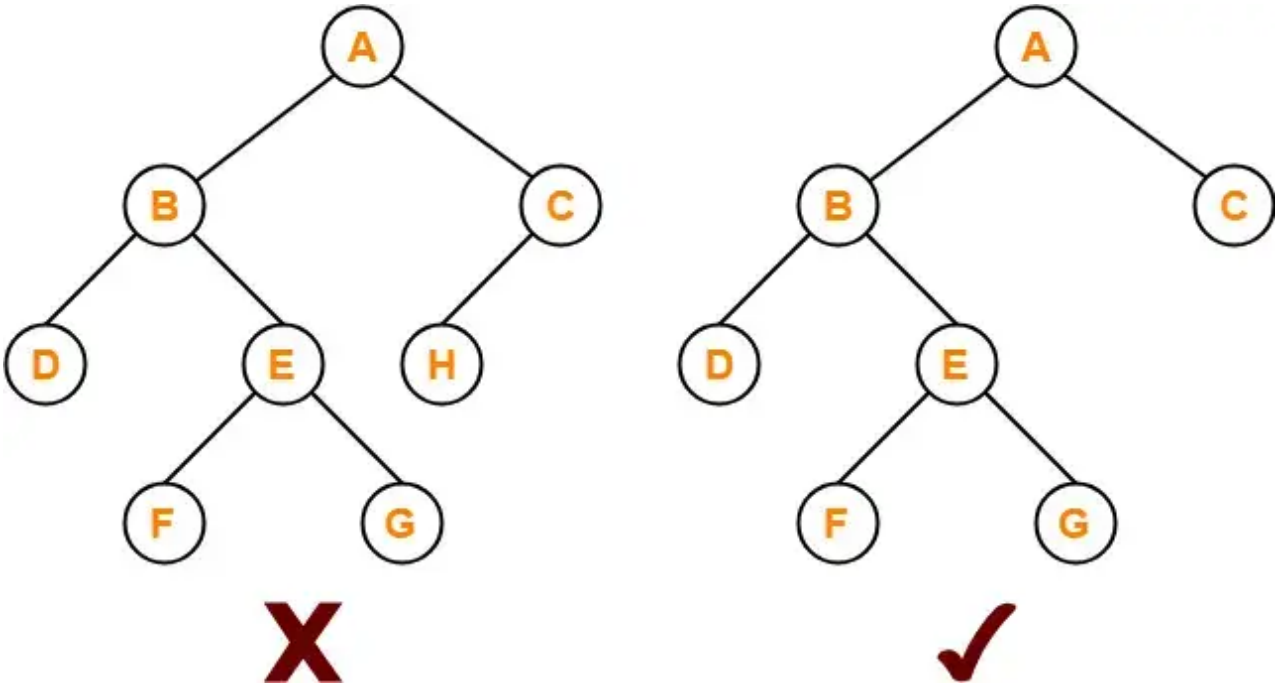


Rooted Binary Tree

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**.

Example-



Here,

- First binary tree is not a full binary tree.
- This is because node C has only 1 child.

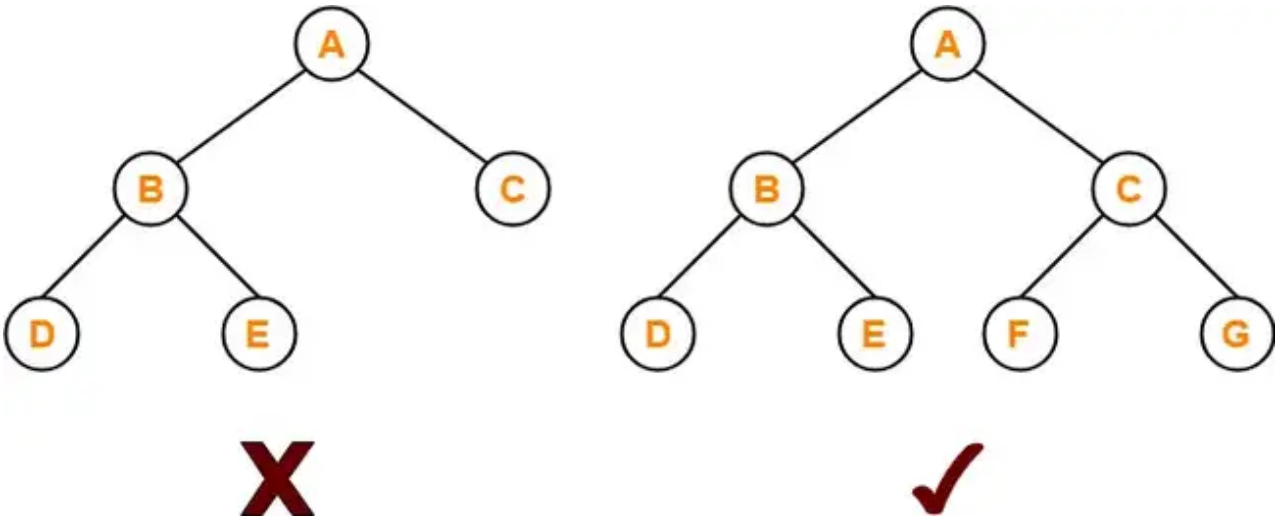
3. Complete / Perfect Binary Tree-

A **complete binary tree** is a binary tree that satisfies the following 2 properties-

- Every internal node has exactly 2 children.
- All the leaf nodes are at the same level.

Complete binary tree is also called as **Perfect binary tree**.

Example-



Here,

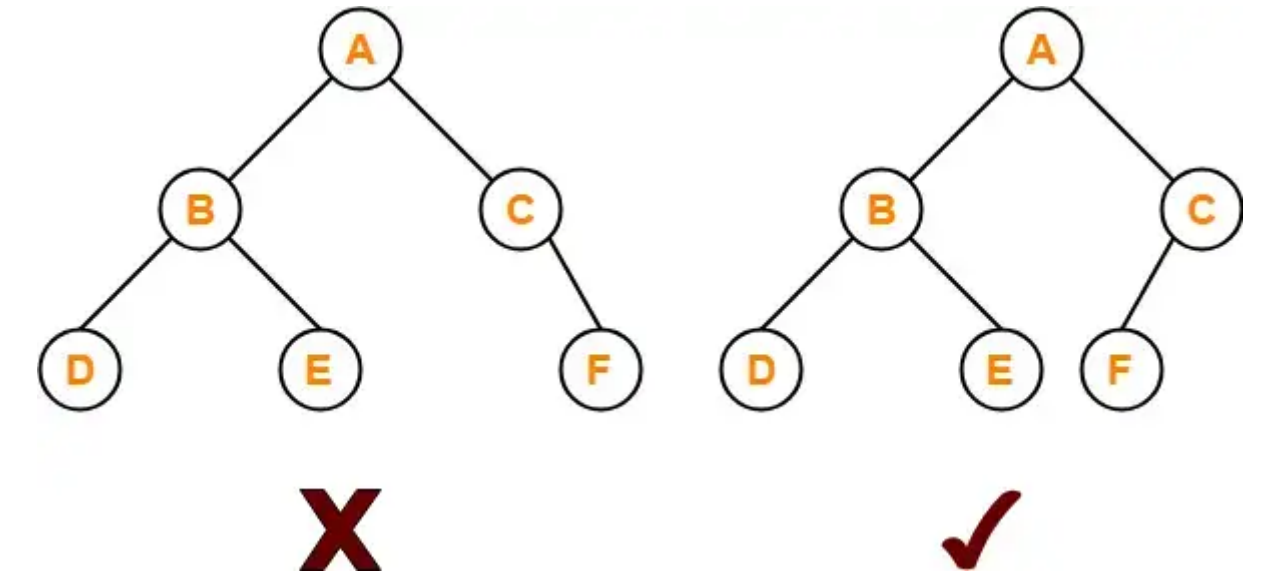
- First binary tree is not a complete binary tree.
- This is because all the leaf nodes are not at the same level.

4. Almost Complete Binary Tree-

An **almost complete binary tree** is a binary tree that satisfies the following 2 properties-

- All the levels are completely filled except possibly the last level.
- The last level must be strictly filled from left to right.

Example-



Here,

- First binary tree is not an almost complete binary tree.
- This is because the last level is not filled from left to right.

5. Skewed Binary Tree-

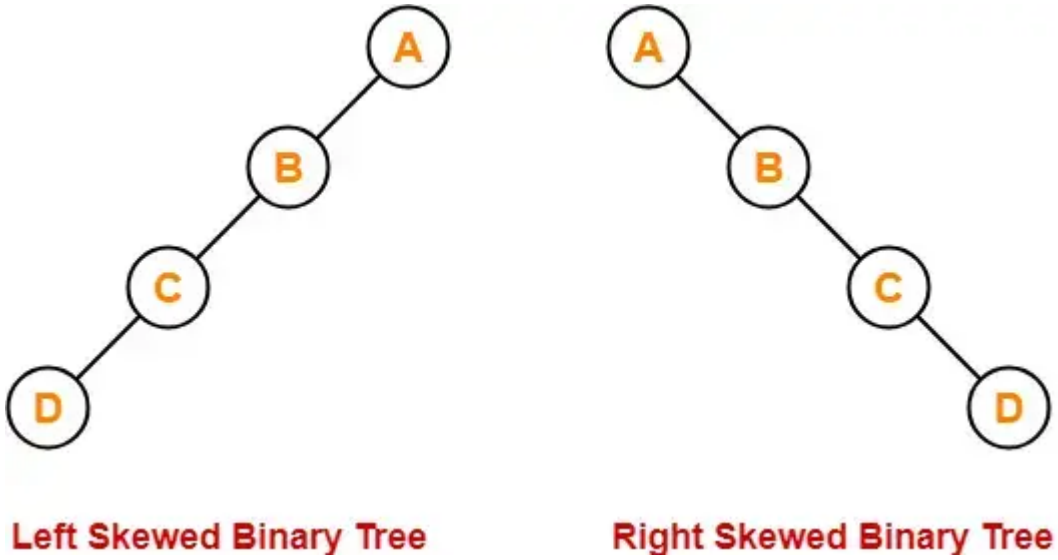
A **skewed binary tree** is a binary tree that satisfies the following 2 properties-

- All the nodes except one node has one and only one child.
- The remaining node has no child.

OR

A **skewed binary tree** is a binary tree of n nodes such that its depth is (n-1).

Example-



Left Skewed Binary Tree Right Skewed Binary Tree

To gain better understanding about Binary Tree and its types-

Watch this Video Lecture

LearnVidFun.