Graph vs Tree

The basis of Comparison	Graph	Tree
Definition	Graph is a non-linear data structure.	Tree is a non-linear data structure.
Structure	It is a collection of vertices/nodes and edges.	It is a collection of nodes and edges.
Edges	Each node can have any number of edges.	If there is n nodes then there would be n-1 number of edges
Types of Edges	They can be directed or undirected	They are always directed
Root node	There is no unique node called root in graph.	There is a unique node called root(parent) node in trees.
Loop Formation	A cycle can be formed.	There will not be any cycle.
Traversal	For graph traversal, we use Breadth-First Search (BFS), and Depth-First Search (DFS).	We traverse a tree using in-order, pre-order, or post-order traversal methods.
Applications	For finding shortest path in networking graph is used.	For game trees, decision trees, the tree is used

A **binary tree** is a tree-type non-linear data structure with a maximum of two children for each parent. Every node in a **binary tree** has a left and right reference along with the data element. The node at the top of the hierarchy of a tree is called the root node. The nodes that hold other sub-nodes are the parent nodes.
A parent node has two child nodes: the left child and right child. Hashing, routing data for network traffic, data compression, preparing binary heaps, and binary search trees are some of the applications that use a binary tree.

Terminologies associated with Binary Trees and Types of Binary Trees

- **Node:** It represents a termination point in a tree.
- **Root:** A tree's topmost node.
- **Parent:** Each node (apart from the root) in a tree that has at least one sub-node of its own is called a parent node.

- **Child:** A node that straightway came from a parent node when moving away from the root is the child node.
- **Leaf Node:** These are external nodes. They are the nodes that have no child.
- **Internal Node:** As the name suggests, these are inner nodes with at least one child.
- **Depth of a Tree:** The number of edges from the tree's node to the root is.
- **Height of a Tree:** It is the number of edges from the node to the deepest leaf. The tree height is also considered the root height.

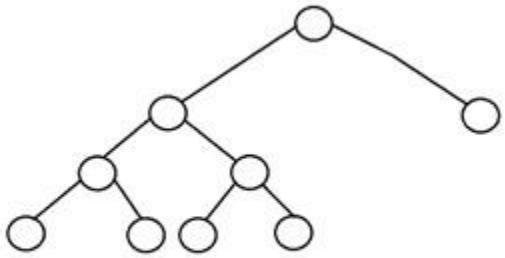
Types of Binary Trees

There are various **types of binary trees**, and each of these **binary tree types** has unique characteristics. Here are each of the **binary tree types** in detail:

1. Full Binary Tree

It is a special kind of a binary tree that has either zero children or two children. It means that all the nodes in that binary tree should either have two child nodes of its parent node or the parent node is itself the leaf node or the external node.

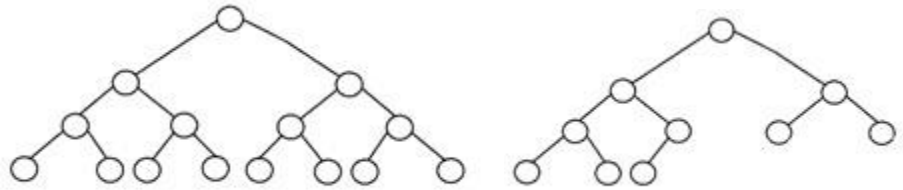
Here is the structure of a full binary tree:



2. Complete Binary Tree

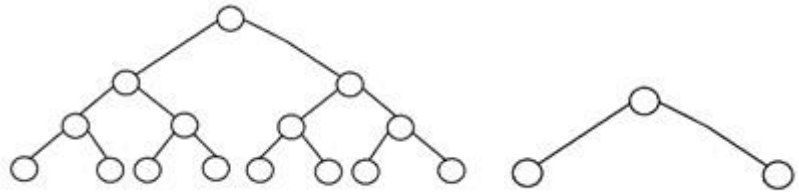
A complete binary tree is another specific type of binary tree where all the tree levels are filled entirely with nodes, except the lowest level of the tree. Also, in the last or the lowest level of this binary tree, every

node should possibly reside on the left side. Here is the structure of a complete binary tree:



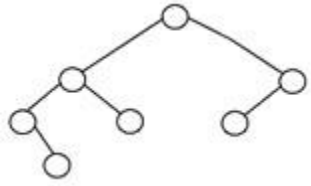
3. Perfect Binary Tree

A binary tree is said to be 'perfect' if all the internal nodes have strictly two children, and every external or leaf node is at the same level or same depth within a tree. A perfect binary tree having height 'h' has 2h – 1 node. Here is the structure of a perfect binary tree:



4. Balanced Binary Tree

A binary tree is said to be 'balanced' if the tree height is O(logN), where 'N' is the number of nodes. In a balanced binary tree, the height of the left and the right subtrees of each node should vary by at most one. An AVL Tree and a Red-Black Tree are some common examples of data structure that can generate a balanced binary search tree. Here is an example of a balanced binary tree:



5. Degenerate Binary Tree

A binary tree is said to be a degenerate binary tree or pathological binary tree if every internal node has only a single child. Such trees are similar

to a linked list performance-wise. Here is an example of a degenerate binary tree: