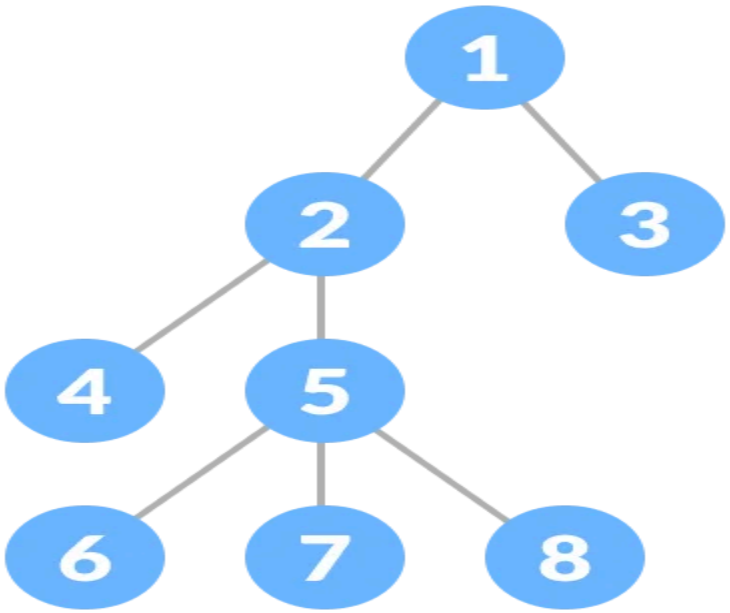
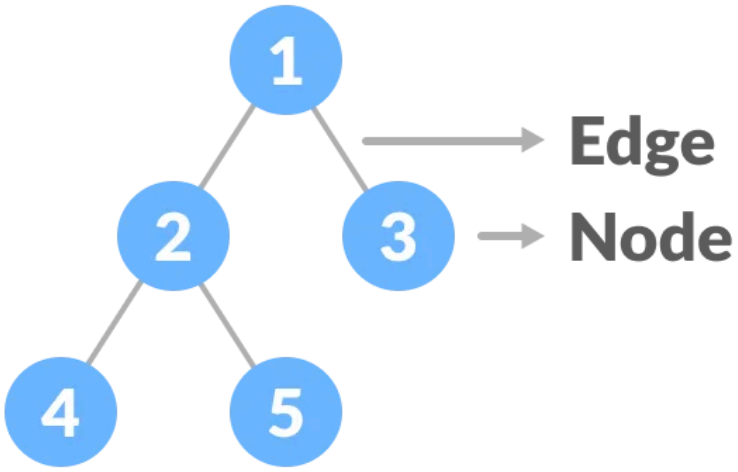
A tree data structure is a hierarchical data structure that consists of nodes connected by edges. It is called a "tree" because it resembles a tree in nature.

Collection of nodes and edges (nodes contain data and edges link nodes to each other)



Node: Each node contains some data and the link or reference of other nodes.

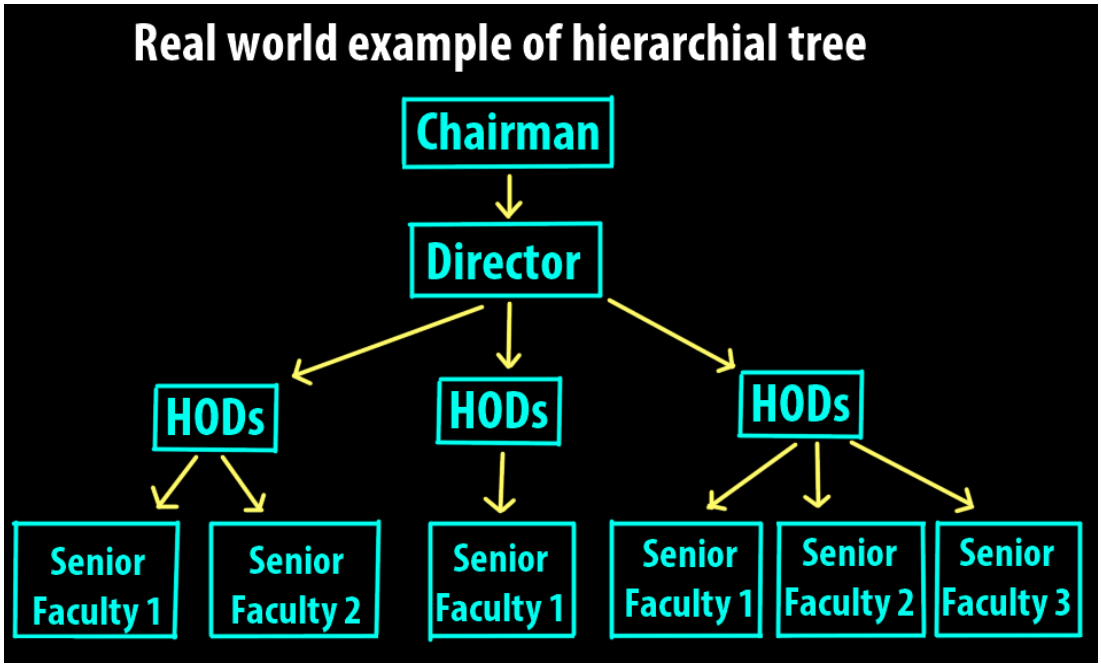
Edge: It is the link between any two nodes.

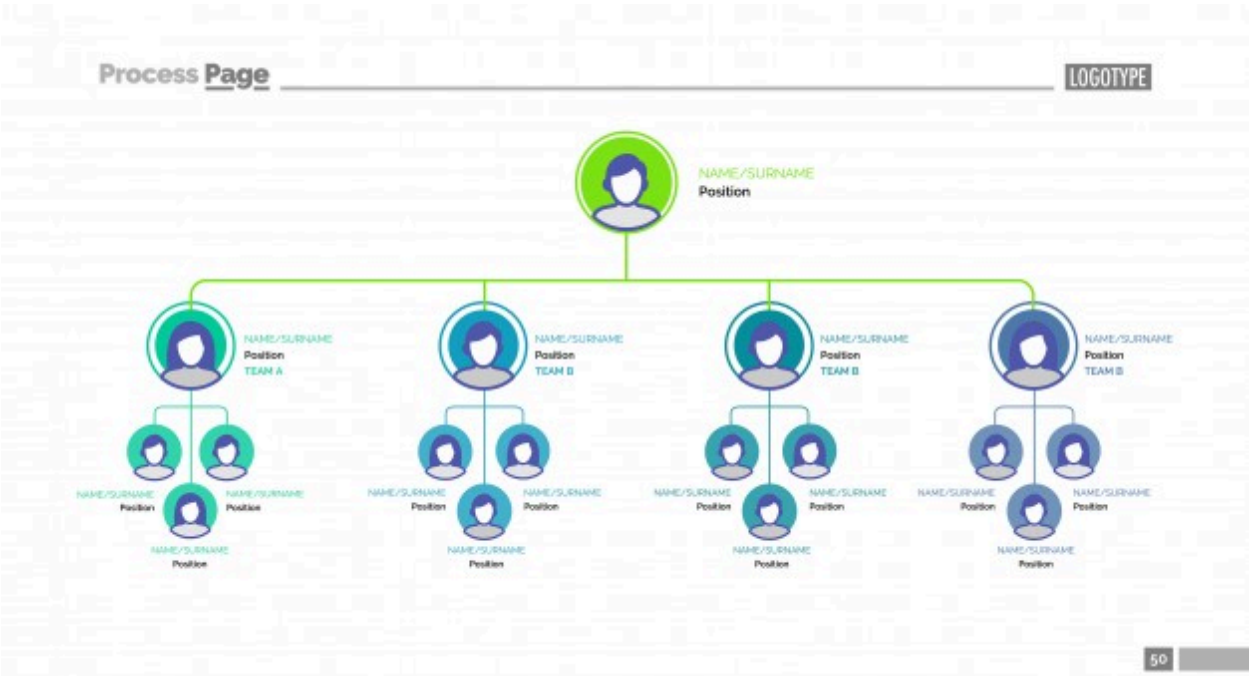


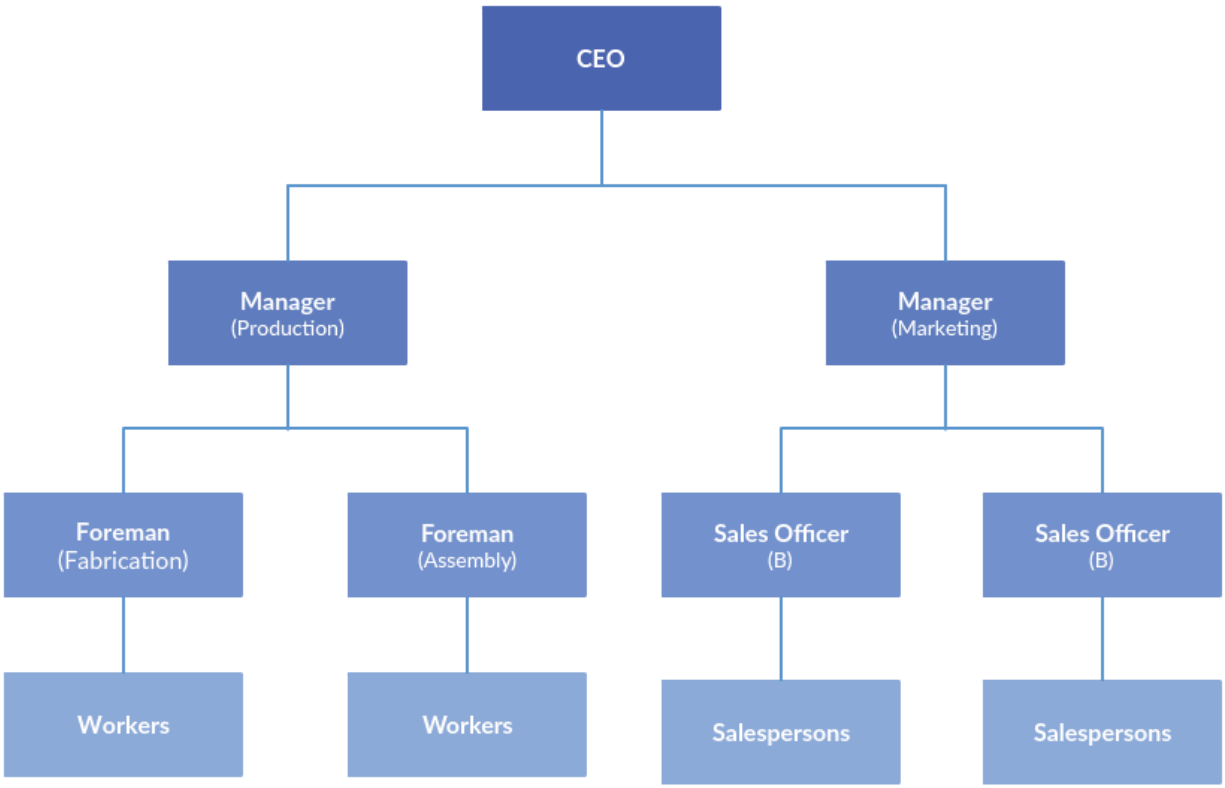
Nodes: Each node in a tree can have zero or more child nodes. Nodes other than the root node have exactly one parent node.

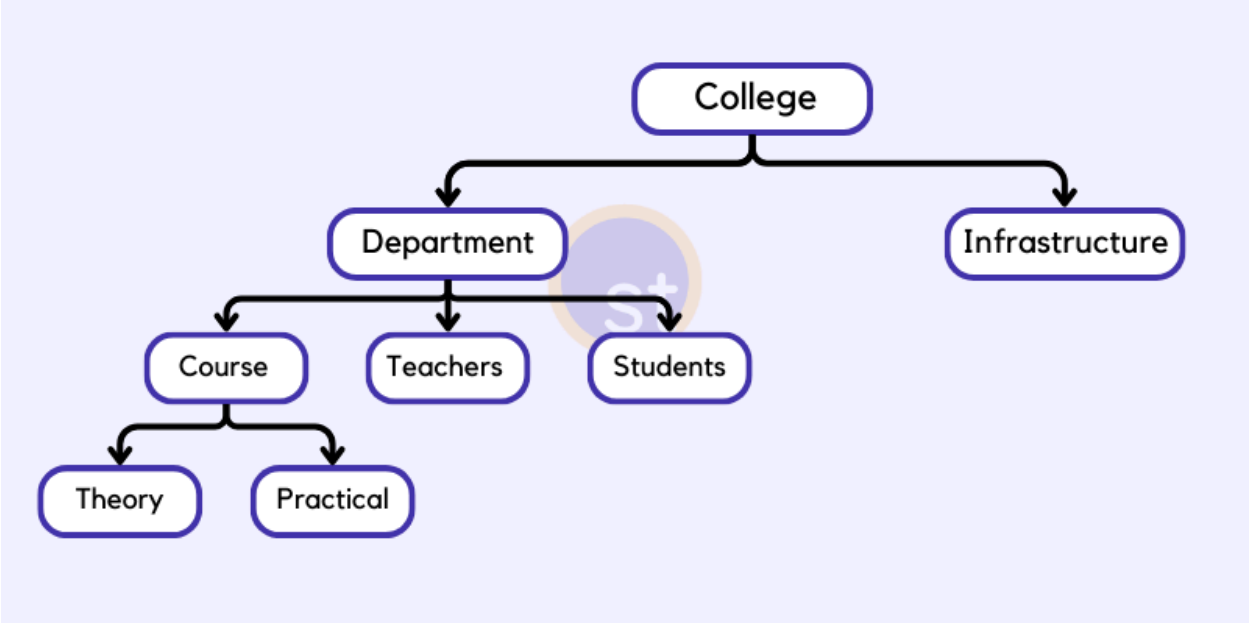
Edges: The edges represent the connections between nodes. They are typically represented as lines connecting nodes.

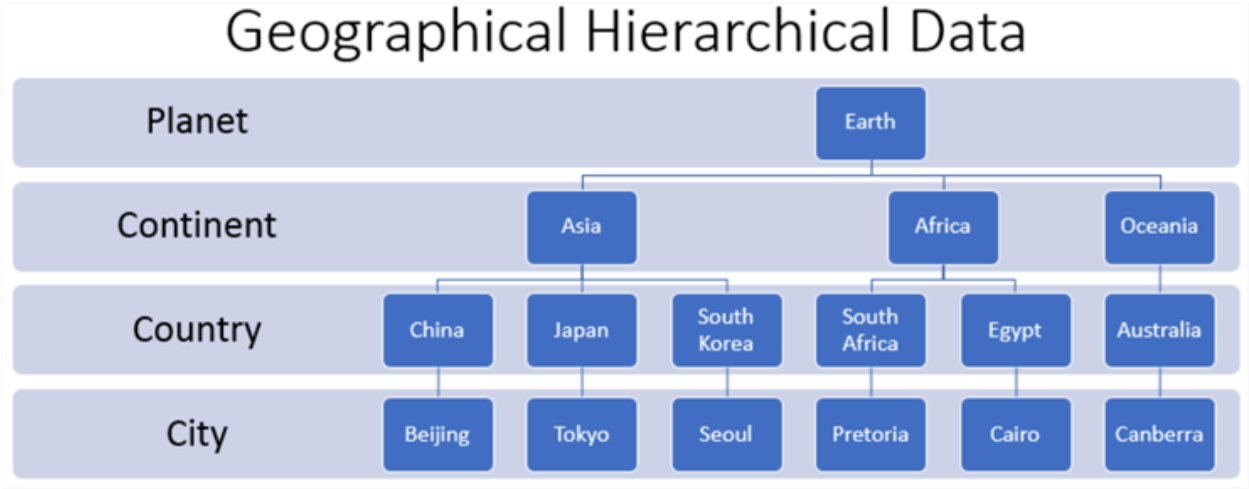
Trees are useful to store hierarchical data.




Process Page
LOGOTYPE
NAME/SURNAME
Position
TEAM A
TEAM B
50


CEO
Manager
(Production)
Manager
(Marketing)
Foreman
(Fabrication)
Foreman
(Assembly)
Sales Officer
(B)
Sales Officer
(B)
Workers
Workers
Salespersons
Salespersons





Important Tree Terms:

In a tree:

Root: It is the topmost node in the tree. There is a single root node that has no parent.

Parent Node: A node with a branch from itself to any other successive node is called the parent node

Child Node: A descendant of any node is known as a child node.

Leaf Nodes: Nodes that have no children are called leaf nodes. They are the nodes at the bottom of the tree.

Siblings: Nodes that belong to the same parent are called siblings.

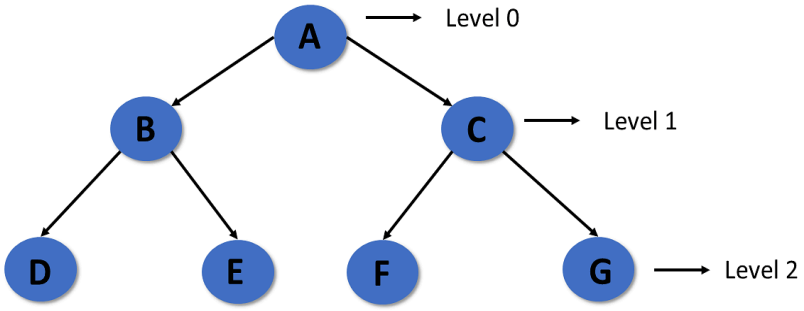
Ancestors:

Descendants:

Degree: The degree of a node is defined as the number of its children

Path: A path is a sequence of nodes ($a_0, a_1, \ldots, a_n$)

Level : In tree data structures, the root node is said to be at level 0, and the root node's children are at level 1, and the children of that node at level 1 will be level 2, and so on.



Height of a Node

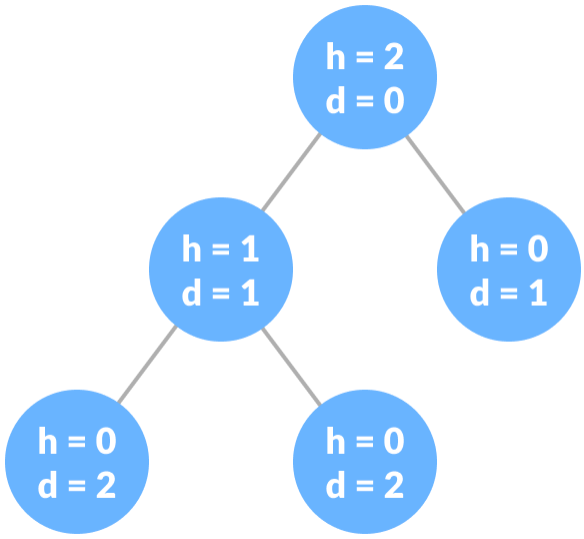
The height of a node is the number of edges from the node to the deepest leaf (ie. the longest path from the node to a leaf node).

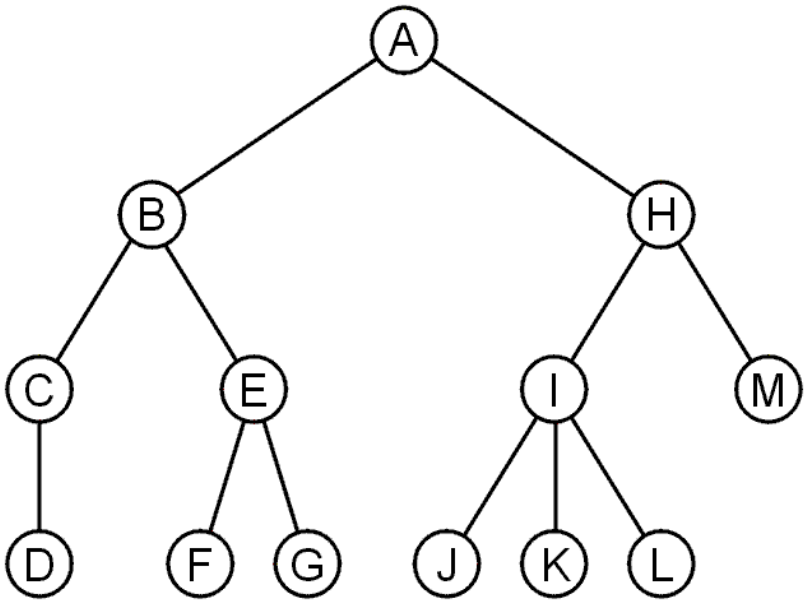
Height of a Tree

The height of a Tree is the height of the root node.

Depth of a Node

The depth of a node is the number of edges from the root to that node.





Subtrees:

Subtree – Subtree represents the descendants of a node.

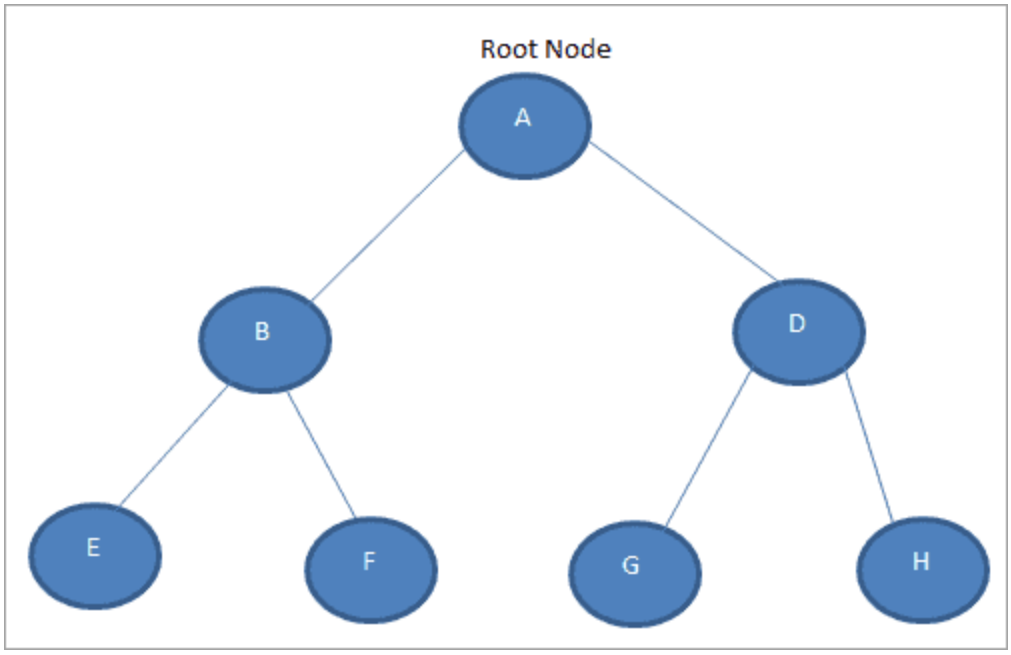
A subtree is a tree structure consisting of a node and all of its descendants (its children, grandchildren, and so on).

Types of Tree

1. Binary Tree
2. Binary Search Tree
3. AVL Tree

Binary Tree

A tree data structure in which each node has at most two child nodes is called a binary tree.



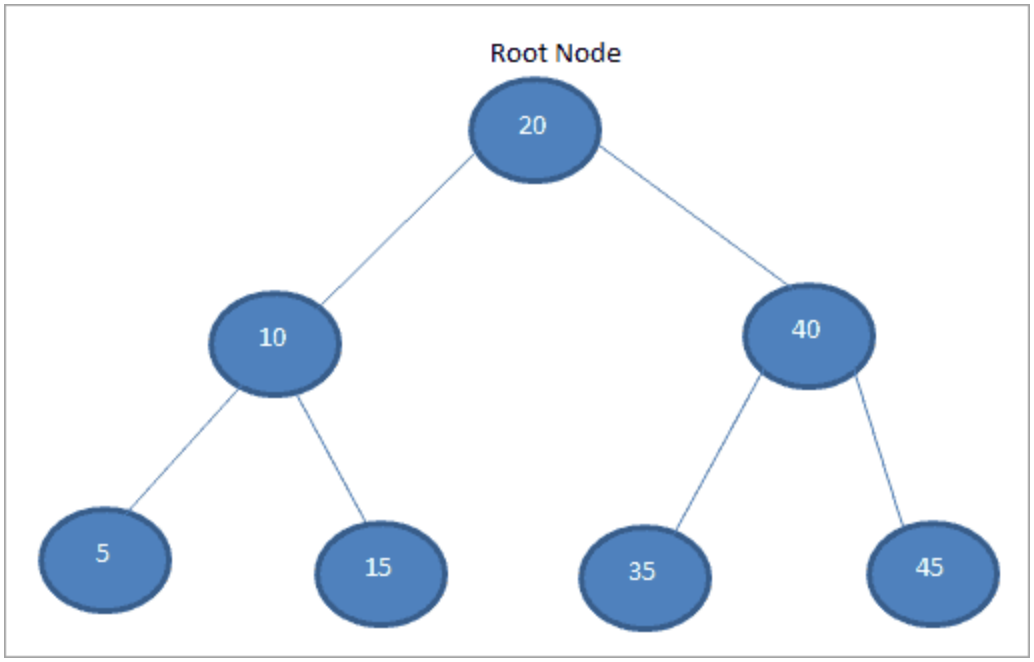
A binary tree in which each node has exactly zero or two children is called a full binary tree. In this tree, there are no nodes that have one child.

A complete binary tree has a binary tree that is completely filled with the exception of the lowest level that is filled from left to right.

Binary Search Tree

The binary tree that is ordered is called the binary search tree. In a binary search tree, the nodes to the left are less than the root node while the nodes to the right are greater than or equal to the root node.

An example of a binary search tree is shown below.



Tree Traversal

Traversal of the tree in data structures is a process of visiting each node and prints their value. There are three ways to traverse tree data structure. Trees are commonly used in computer science for various purposes, such as organizing hierarchical data (like file systems), representing relationships between data (like in hierarchical databases), implementing various data structures (like binary search trees, AVL trees, etc.), and facilitating efficient searching, sorting, and retrieval operations.