Chapter 18: Data Structures

Data:

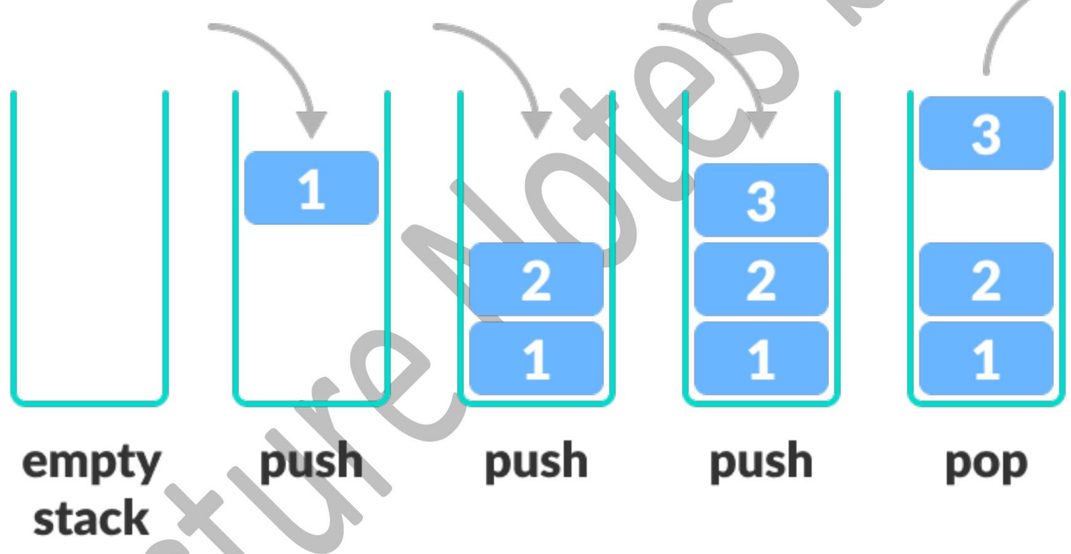
- Data can be defined as an elementary value or the collection of values.

Data Structures

- Data Structure can be defined as the group of data elements which provide an efficient way of storing and organizing data in the computer so that it can be used efficiently.

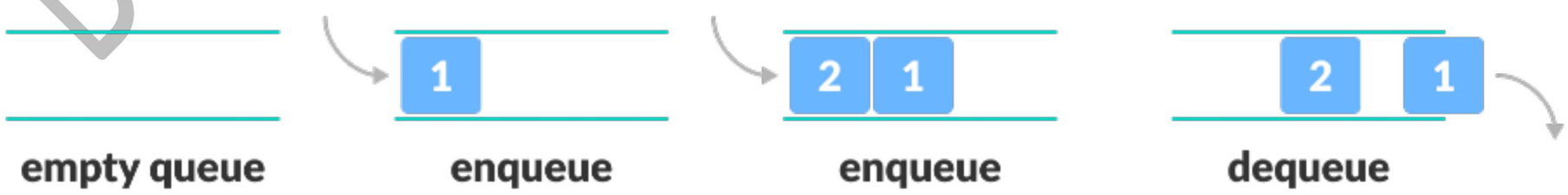
Stack

- Stack is a linear data structure that follows the **LIFO (Last-In-First-Out)** principle.



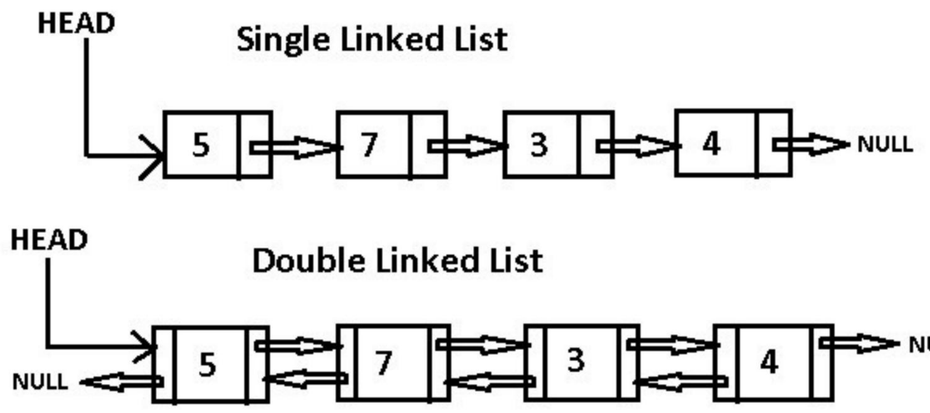
Queue

- Queue is a linear data structure that follows the **FIFO (First-In-First-Out)** principle.



Linked List

- Linked list is also a collection of elements, but the elements are not stored in a consecutive location.



Tree:

- Tree is a non-linear data structure which organizes data in hierarchical structure.
- Root:

The first node from where the tree originates is called a root node.

In any tree there must be only one root node.

- Edge:

The connecting link between any two nodes is called as an edge.

- Parent:

The node which has one or more children is called parent node.

- Child:

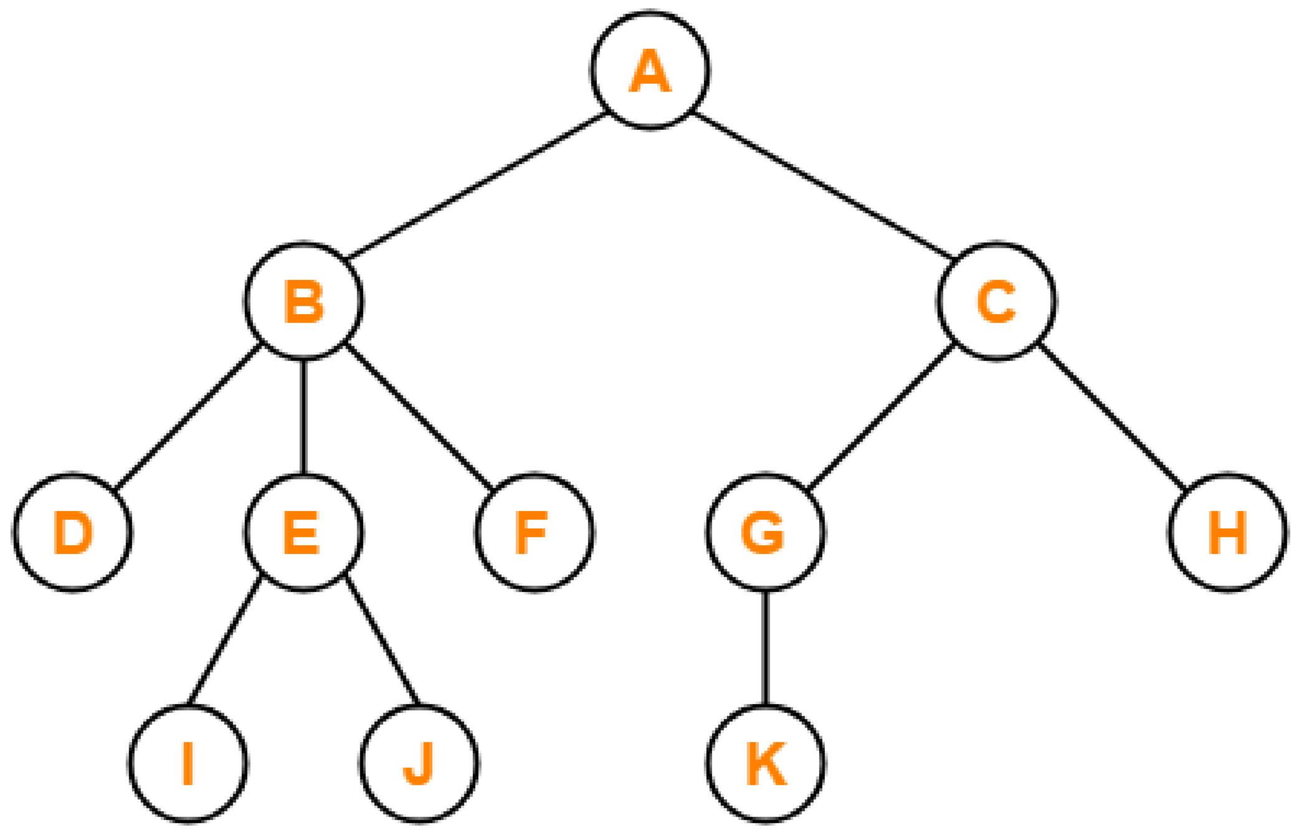
The node which is a descendant of some node is called as a child node.

- Internal Node:

The node which has atleast one child is called an internal node.

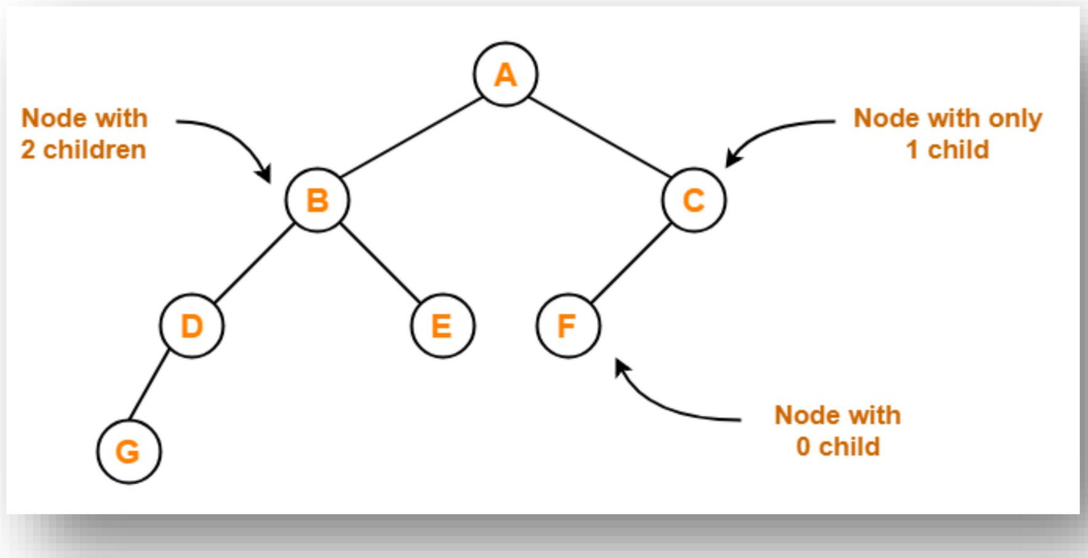
- Leaf Node:

The node which does not have any child is called as a leaf node.



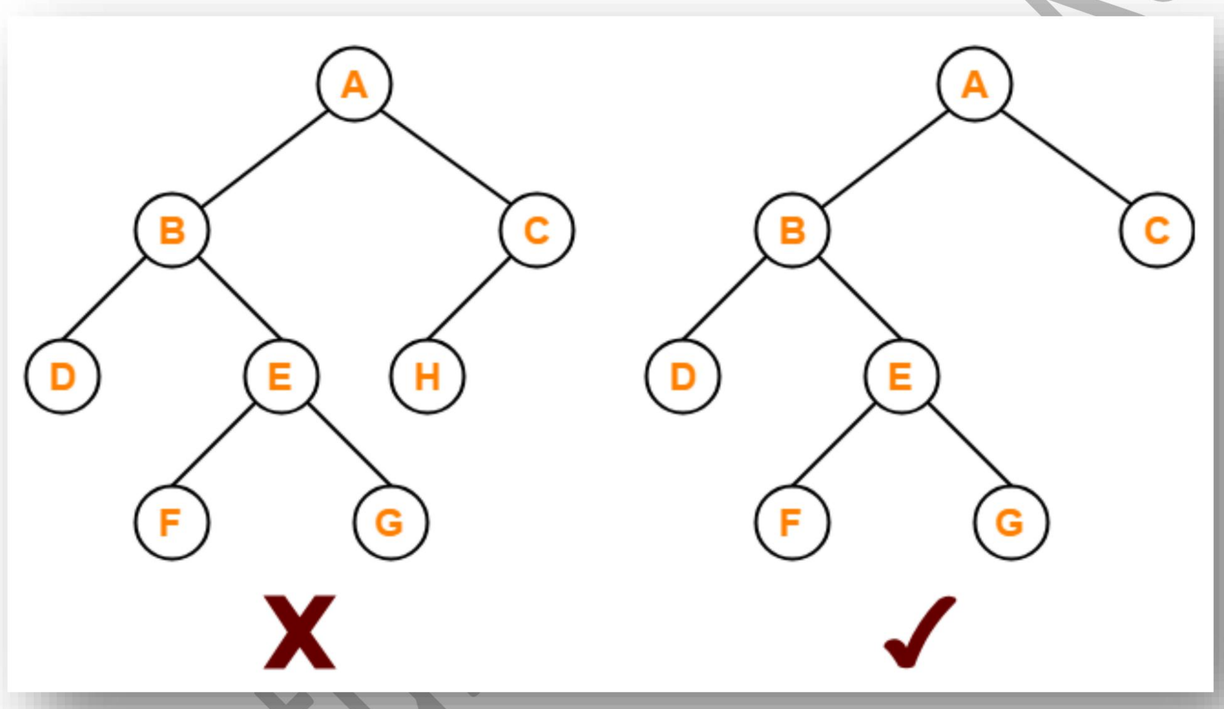
Binary Tree:

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



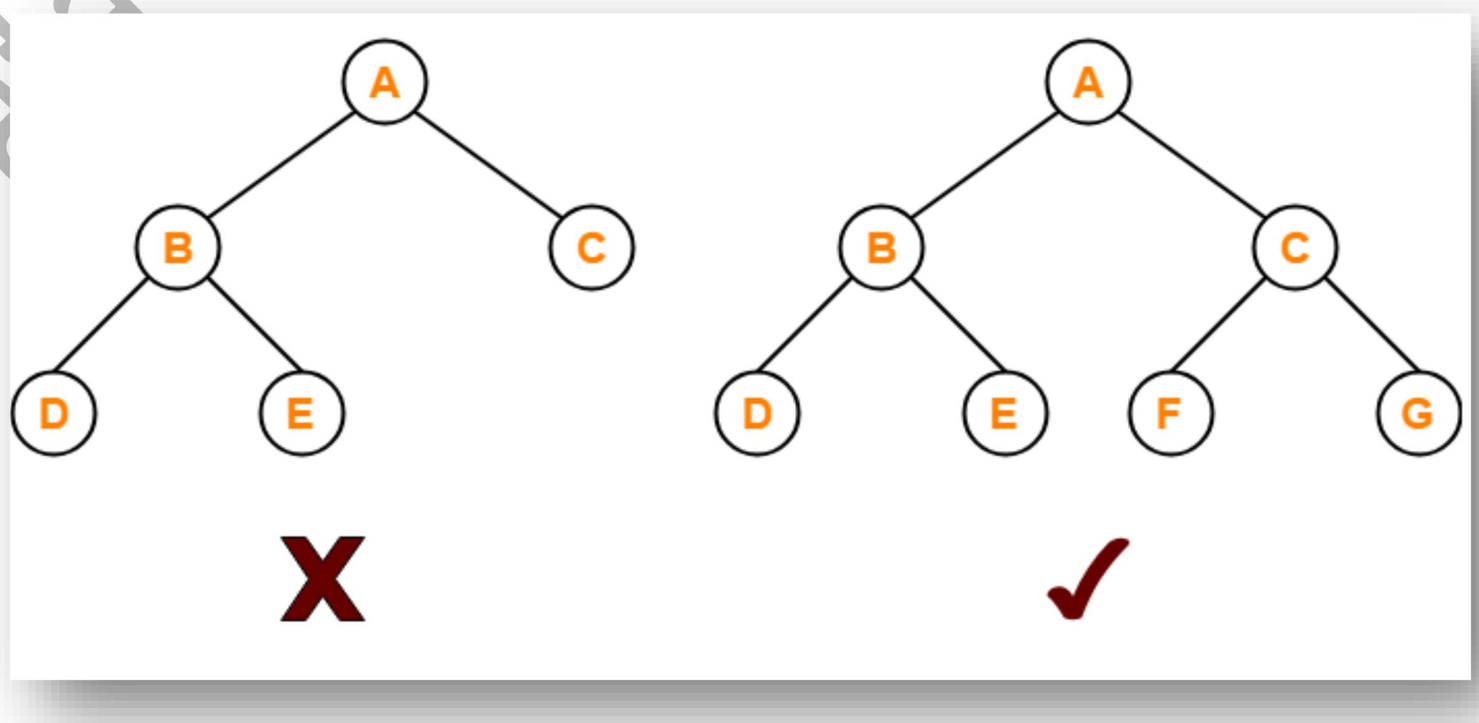
Full / Strictly Binary Tree:

- It is a binary tree in which every node has either 0 or 2 children



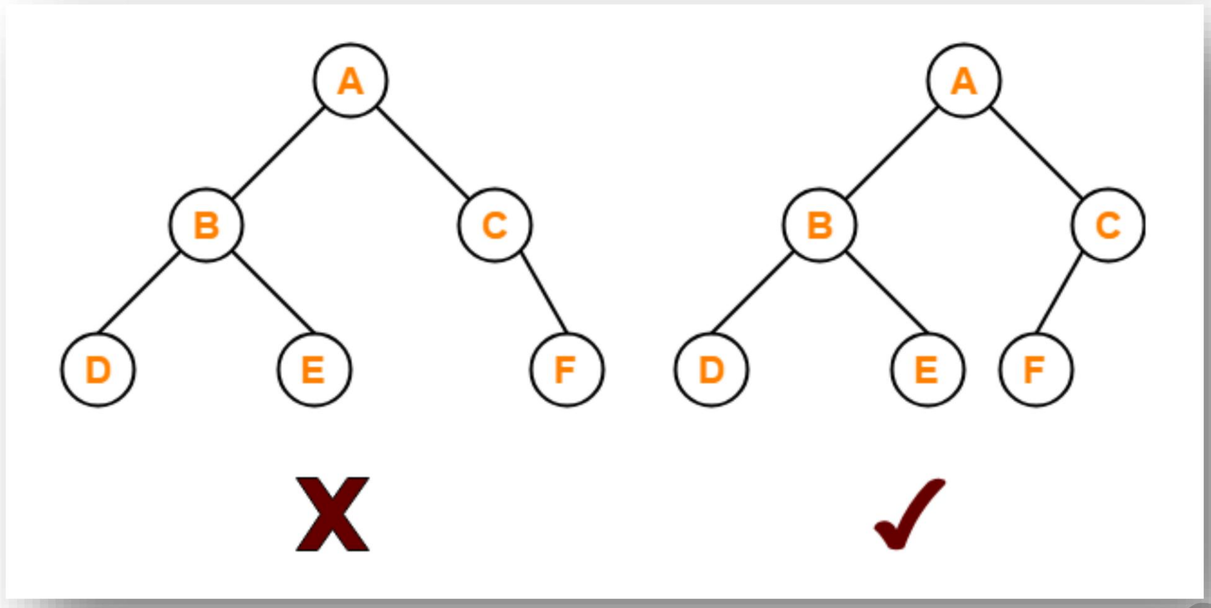
Complete/Perfect Binary Tree:

- It is a binary tree in which every internal node has exactly two children and all leaf nodes are at the same level.



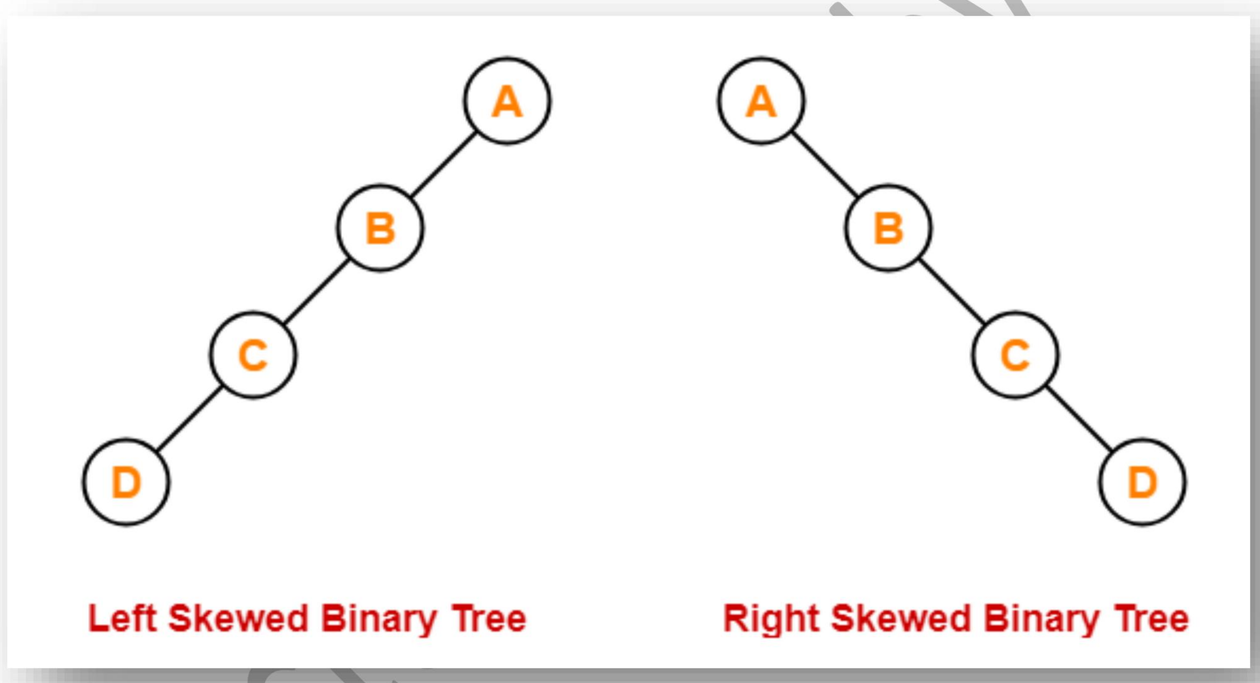
Almost Complete Binary Tree:

- It is a binary tree in which all the levels are completely filled except possibly the last level which must be strictly filled from left to right.



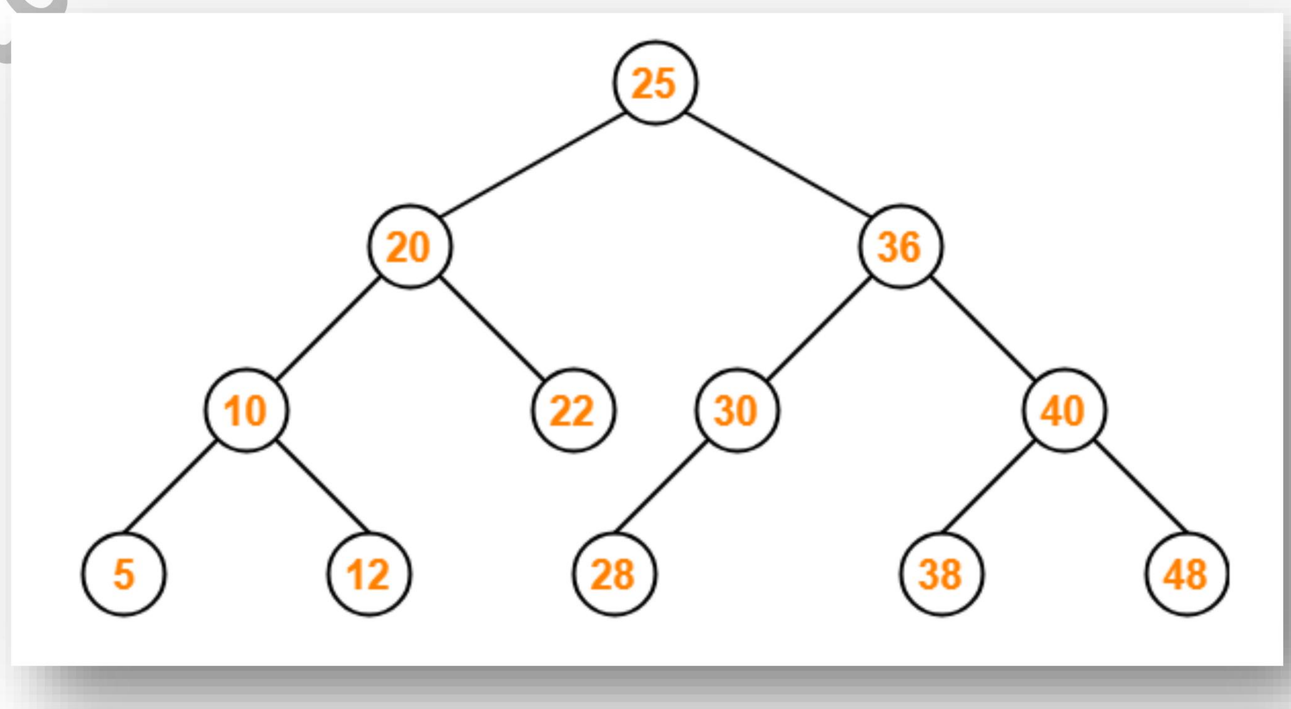
Skewed Binary Tree:

- It is a binary tree in which all the nodes except last node has one and only one child.



Binary Search Tree:

- Binary Search Tree is special kind of binary tree in which each node contains only smaller values in its left sub tree and only larger values in its right sub tree.



Tree Traversal:

- Tree Traversal refers to the process of visiting each node in a tree data structure exactly once.
- There are three traversal technique:

Inorder traversal

Preorder traversal

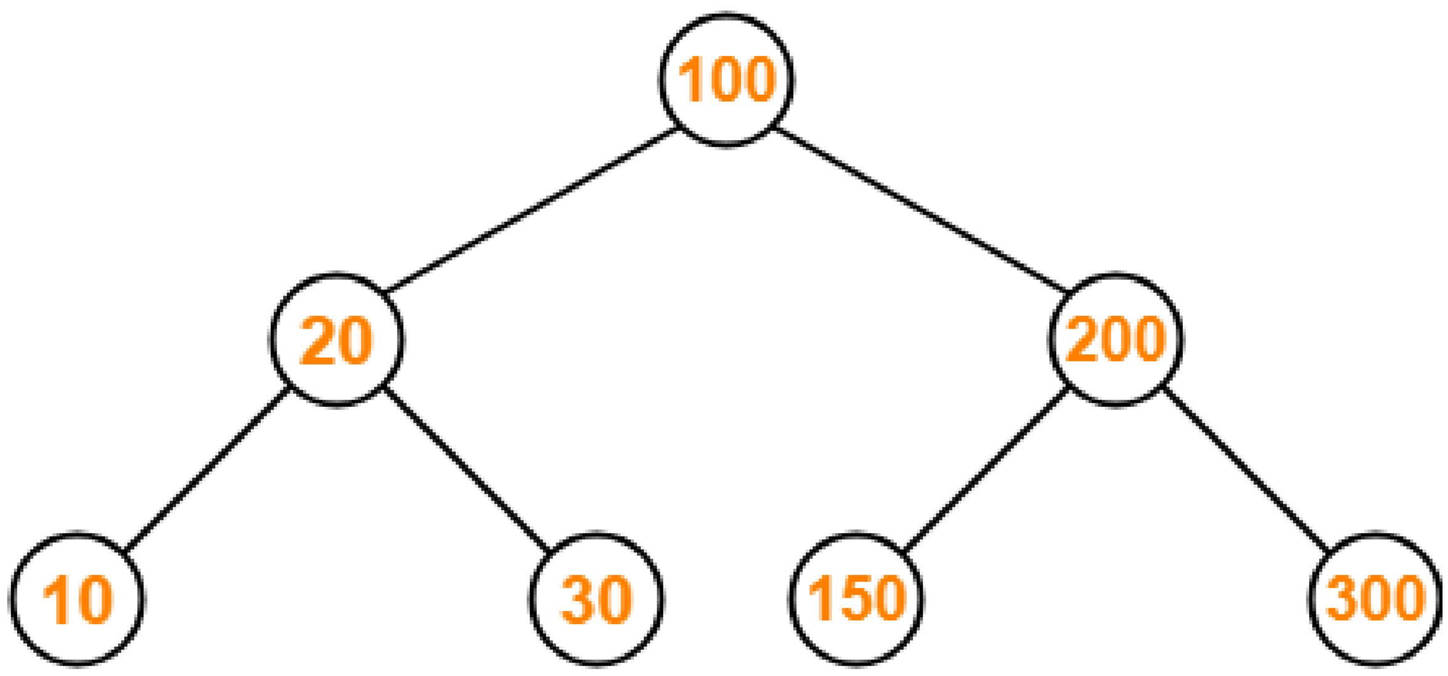
Postorder traversal

- Inorder traversal algorithm:
  - Traverse the left subtree
  - Visit the root
  - Traverse the right subtree

- Preorder traversal algorithm:
  - Visit the root
  - Traverse the left subtree
  - Traverse the right subtree

- Postorder traversal algorithm:
  - Traverse the left subtree
  - Traverse the right subtree
  - Visit the root

Eg1:

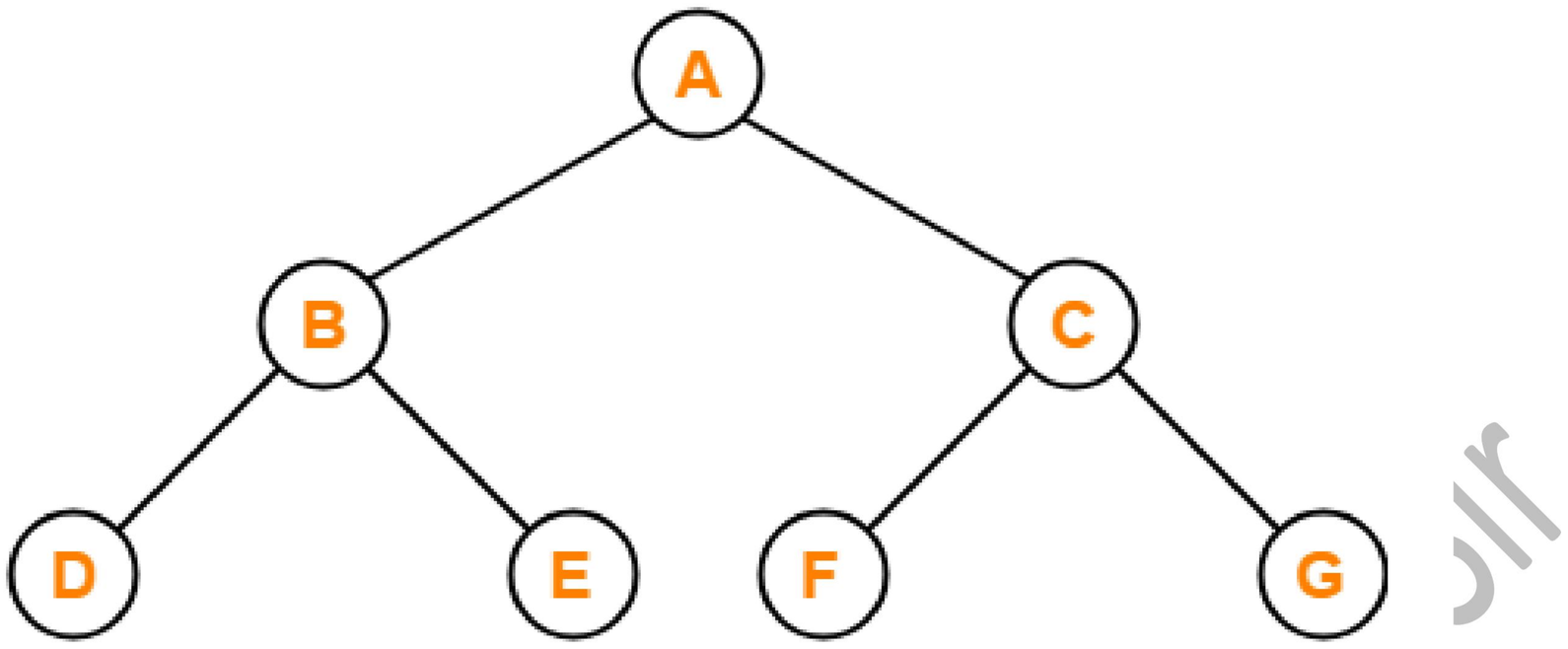


Inorder:

PreOrder:

PostOrder:

Eg2:

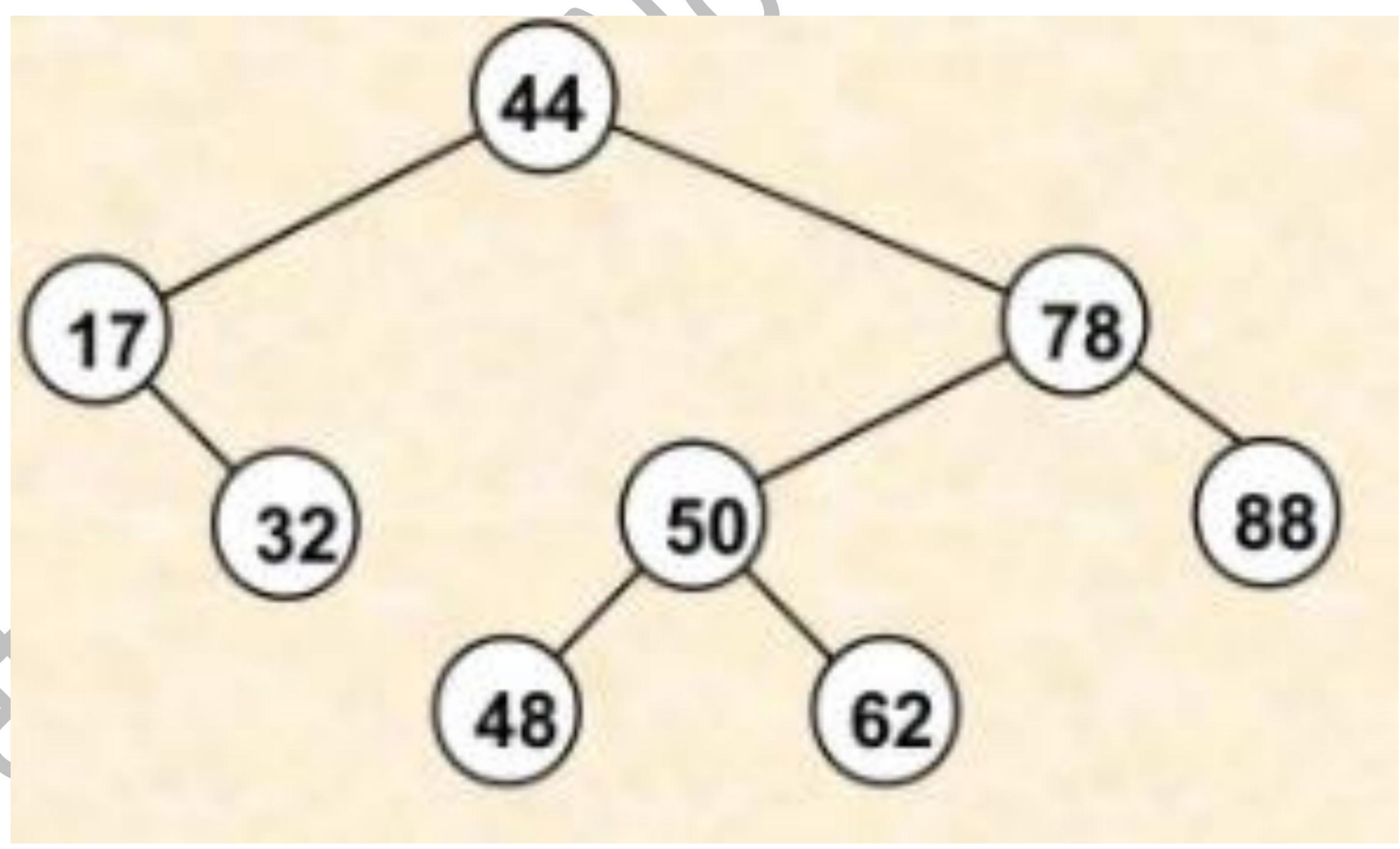


Inorder:

PreOrder:

PostOrder:

Eg 3:



Inorder:

PreOrder:

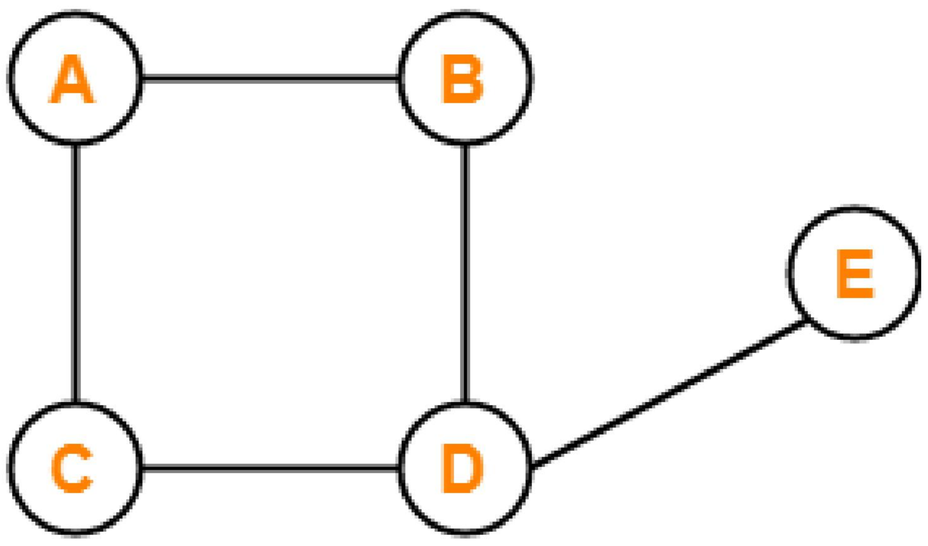
PostOrder:

Graphs:

- Graph is a non-linear data structure consisting of nodes and edges.
- The nodes are sometimes also referred to as vertices and the edges are lines or arcs that connect any two nodes in the graph.
- More formally a Graph can be defined as :

Graph consists of a finite set of vertices(or nodes) and set of Edges which connect a pair of nodes.

G = (V,E)

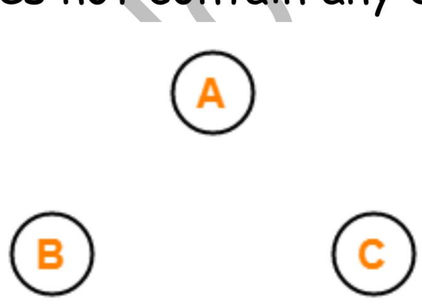


V = { A , B , C , D , E }

E = { AB , AC , BD , CD , DE }

Null Graph:

- A graph whose edge set is empty is called as a null graph.
- In other words, a null graph does not contain any edges in it.

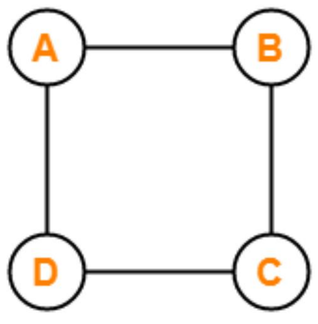


Trivial Graph:

- A graph having only one vertex in it is called as a trivial graph.
- It is the smallest possible graph.

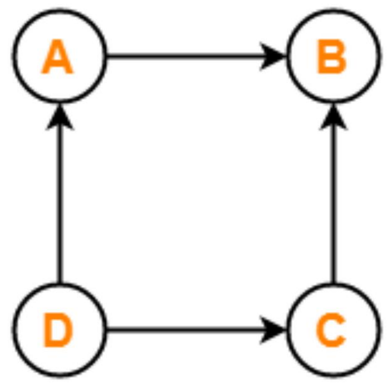
Non-Directed Graph:

- A graph in which all the edges are undirected is called as a non-directed graph.
- In other words, edges of an undirected graph do not contain any direction.



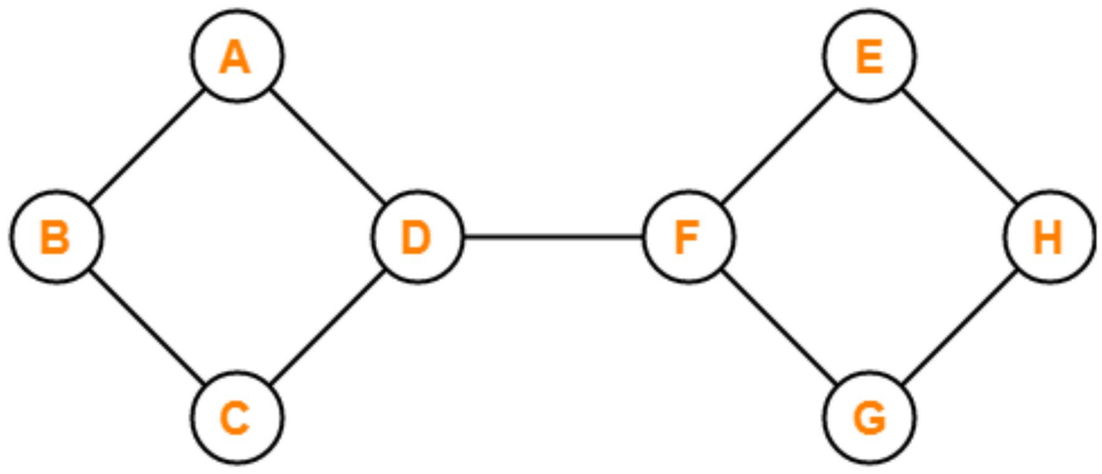
Directed Graph:

- A graph in which all the edges are directed is called as a directed graph.
- In other words, all the edges of a directed graph contain some direction.
- Directed graphs are also called as digraphs.



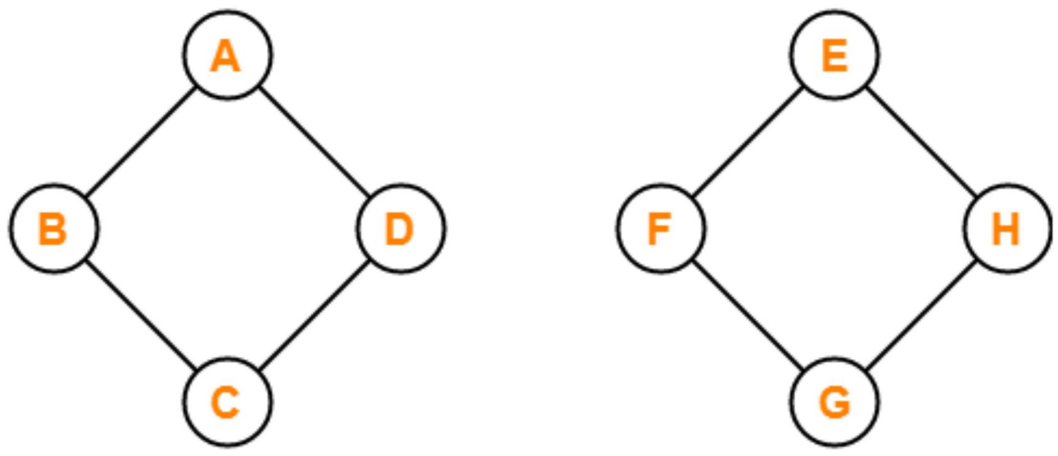
Connected Graph:

- A graph in which we can visit from any one vertex to any other vertex is called as a connected graph.
- In connected graph, at least one path exists between every pair of vertices.



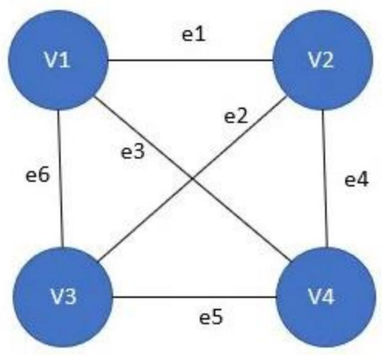
Disconnected Graph:

- A graph in which there does not exist any path between at least one pair of vertices is called as a disconnected graph.



Weighted Graph:

- Graph is said to be a labelled or weighted graph because each of the edges in the graph holds some value or weight that denotes traversal cost through that edge.



Infinite Graph:

- Graph is finite if the number of edges and vertices are finite in number else it is infinite Graph.