

Tree

Conceptual Session - [Week 5-1]

1) What is Tree?

Ans:

A tree is a hierarchical data structure.

Each node can have zero or more child nodes

There is a unique path from the root to every other node in the tree.

2) Key characteristics of a tree include.

Ans:

Root: The topmost node in the tree from which all other nodes are derived. It serves as the starting point for traversing the tree.

Edge: An edge represents the link or connection between two nodes.

Nodes: Each element in the tree is called a node. Nodes can be connected to other nodes through edges.

Parent and Child Nodes: A node that is connected to another node is referred to as the parent node, and the connected node is called its child node.

Leaf Nodes/External Node: A node which doesn't have any child

Branch/Internal Nodes: Internal nodes are nodes that have at least one child node. They are not leaf nodes.

Path: A path in a tree refers to a sequence of nodes connected by edges, starting from a specific node and leading to a destination node.

Depth: The depth of a binary tree is the number of edges on the longest path from the root node to a leaf node.

Height: The height of a tree is the maximum depth of any node in the tree.

Depth: Root to x (destination node) Node

Height: From x (destination) to root node

Subtree: A subtree is a smaller tree within a larger tree.

Sibling Nodes: Sibling nodes are nodes that have the same parent

Cousin Nodes: Cousin nodes in a tree refer to nodes that are at the same level or depth but do not share the same parent.

Ancestor : In a tree data structure, an ancestor of a node is any node that lies on the path from the root to that specific node.

Descendant : In a tree data structure, a descendant of a node is any node that is reachable by following a path from that specific node.

Diameter: The diameter of a tree is the longest path between any two nodes in the tree.
(Number of node including two nodes)

Degree: The degree of a node in a tree refers to the number of edges connected to that node. It represents the count of immediate connections a node has with other nodes in the tree.

3) What is Binary Tree?

Ans:

A binary tree is a hierarchical data structure in which each node has at most two children, referred to as the left child and the right child.

4) Variant of Binary Tree.

Ans:

1) Perfect Binary Tree - All level are filled.

2) Complete Binary Tree - A complete binary tree is a binary tree in which every level is completely filled, except for the last level, which may be filled from left to right.

3) Full Binary Tree - Every Node has exactly 0 or 2 child

5) Hack Binary Tree:

1) Number of Nodes:

For a Perfect binary tree: Number of nodes = $2^{(\text{height} + 1)} - 1$

For a complete binary tree: Number of nodes = $2^{(\text{height} - 1)} + (\text{number of leaf nodes})$

2) Number of Edge:

For a Perfect binary tree: Number of edges = $2^{(\text{height} + 1)} - 2$

For a complete binary tree: Number of edges = $2^{(\text{height} - 1)} + (\text{number of leaf nodes}) - 1$

3) Height of a Binary Tree:

For a binary tree: Height = maximum depth of any node in the tree

If the tree is empty: Height = -1

If the tree has only one node (root): Height = 0

4) Maximum possible Height of a Binary Tree with n Nodes:

For a binary tree with n nodes: Maximum height = $n - 1$

5) Number of Internal Nodes in a Binary Tree:

For a binary tree: Number of internal nodes = Total number of nodes - Number of leaf nodes

6) Maximum Width of a Binary Tree (Number of Nodes in the Widest Level):

For a binary tree: Maximum width = Maximum number of nodes in any level of the tree