SNS COLLEGE OF ENGINEERING

Kurumbapalayam(Po), Coimbatore – 641 107
Accredited by NAAC-UGC with 'A' Grade
Approved by AICTE, Recognized by UGC & Affiliated to Anna University, Chennai

Department of Artificial Intelligence and Data Science

Course Name: 23ITB201 Data structures and Algorithms

II Year / III semester

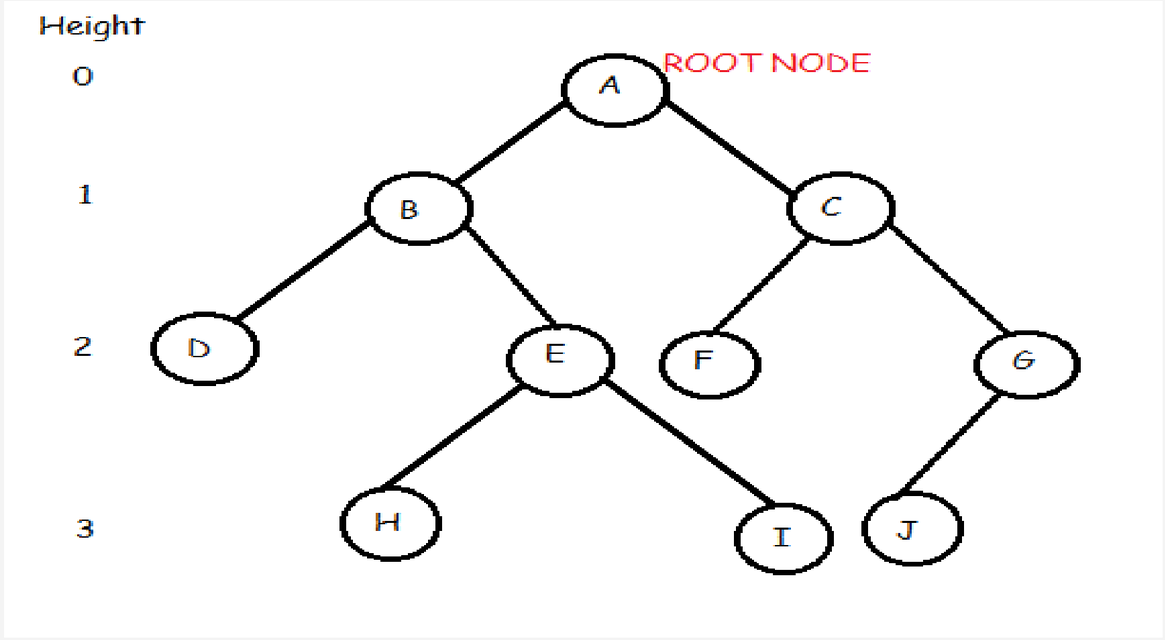
Unit IV –Tree ADT

Topic: Binary tree

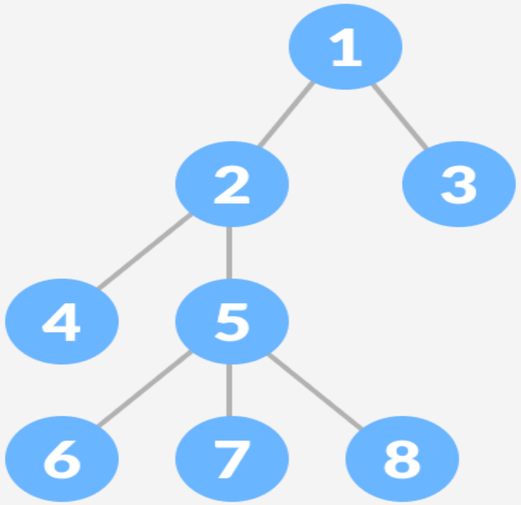
Binary Tree Data structure

- In a normal tree, every node can have any number of children. A binary tree is a special type of tree data structure in which every node can have a **maximum of 2 children**. One is known as a left child and the other is known as right child.
- A tree in which every node can have a maximum of two children is called Binary Tree.
- In a binary tree, every node can have either 0 children or 1 child or 2 children but not more than 2 children.

Tree Data Structures



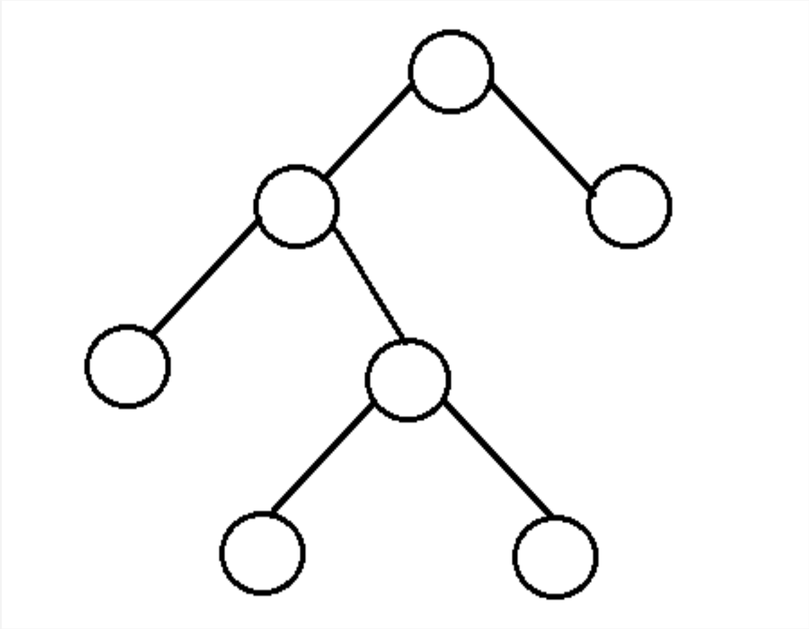
It is not a Binary Tree



Types of Binary Trees (Based on Structure)

Full binary tree:

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



- The number of nodes, n, in a full binary tree is atleast n = 2h – 1, and atmost $n = 2^{h+1} - 1$, where h is the height of the tree.

- The number of leaf nodes l, in a full binary tree is number, L of internal nodes + 1, i.e, $l = L+1$.

Types of Binary Trees (Based on Structure)

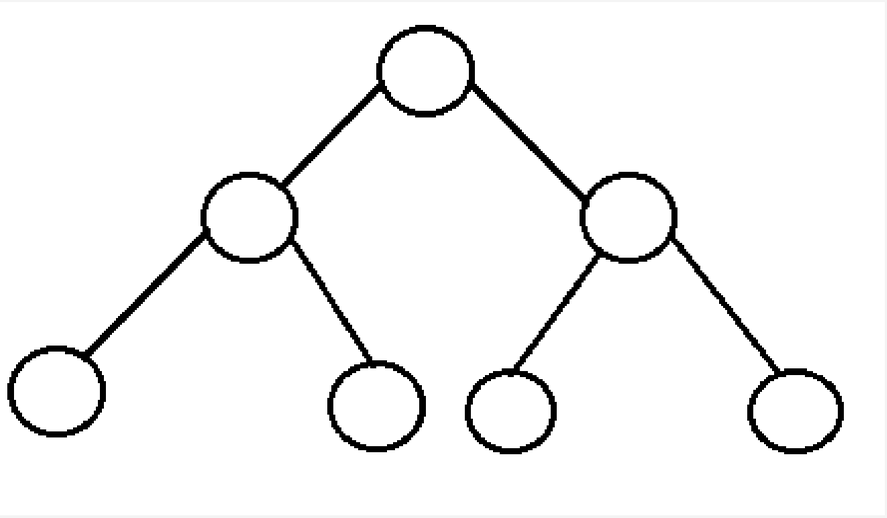
Complete binary tree:

A binary tree in which every internal node has exactly two children and all leaf nodes are at same level is called Complete Binary Tree.

The Total number of nodes in complete binary tree are $n = 2^{h+1} - 1$ *'h' is the height.*

$h = 2$; *then* $n = 2^{2+1} - 1 = 7$

The number of leaf nodes in a complete binary tree : $n = 2^h = 2^2 = 4$



Types of Binary Trees (Based on Structure)

A binary tree data structure is represented using two methods. Those methods are as follows

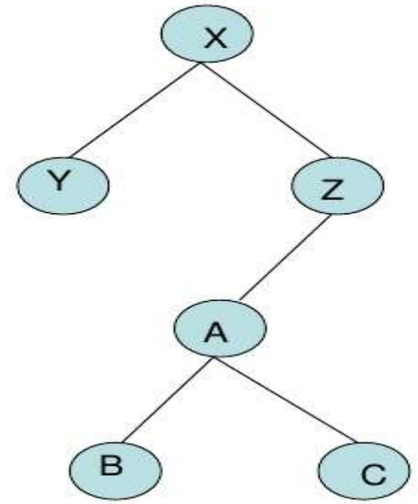
1.Array Representation

2.Linked List Representation

Binary Tree Representation Using Array

Representation of Binary Tree

- Array representation
  - The root of the tree is stored in position 0.
  - The node in position p, is the implicit father of nodes 2p+1 and 2p+2.
  - Left child is at 2p+1 and right at 2p+2.



0	1	2	3	4	5	6	7	8	9	10	11	12
X	Y	Z			A						B	C

Linked List Representation of Binary Tree

- We use a double linked list to represent a binary tree. In a double linked list, every node consists of three fields.
- First field for storing left child address, second for storing actual data and third for storing right child address.
- In this linked list representation, a node has the following structure

Binary tree linked list representation node

Example of Linked list Representation of Binary Trees