DATA STRUCTURES AND ITS APPLICATIONS
UE19CS202

Shylaja S S & Kusuma K V
Department of Computer Science & Engineering

DATA STRUCTURES AND ITS APPLICATIONS

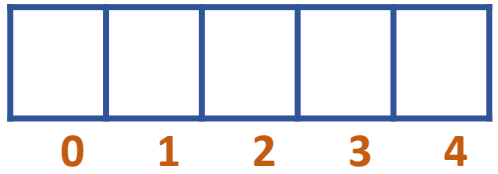
Basic Concept and Definitions: Trees

Shylaja S S

Department of Computer Science & Engineering

Introduction to Trees

Linear Data Structures



List as an Array

Disadvantage:

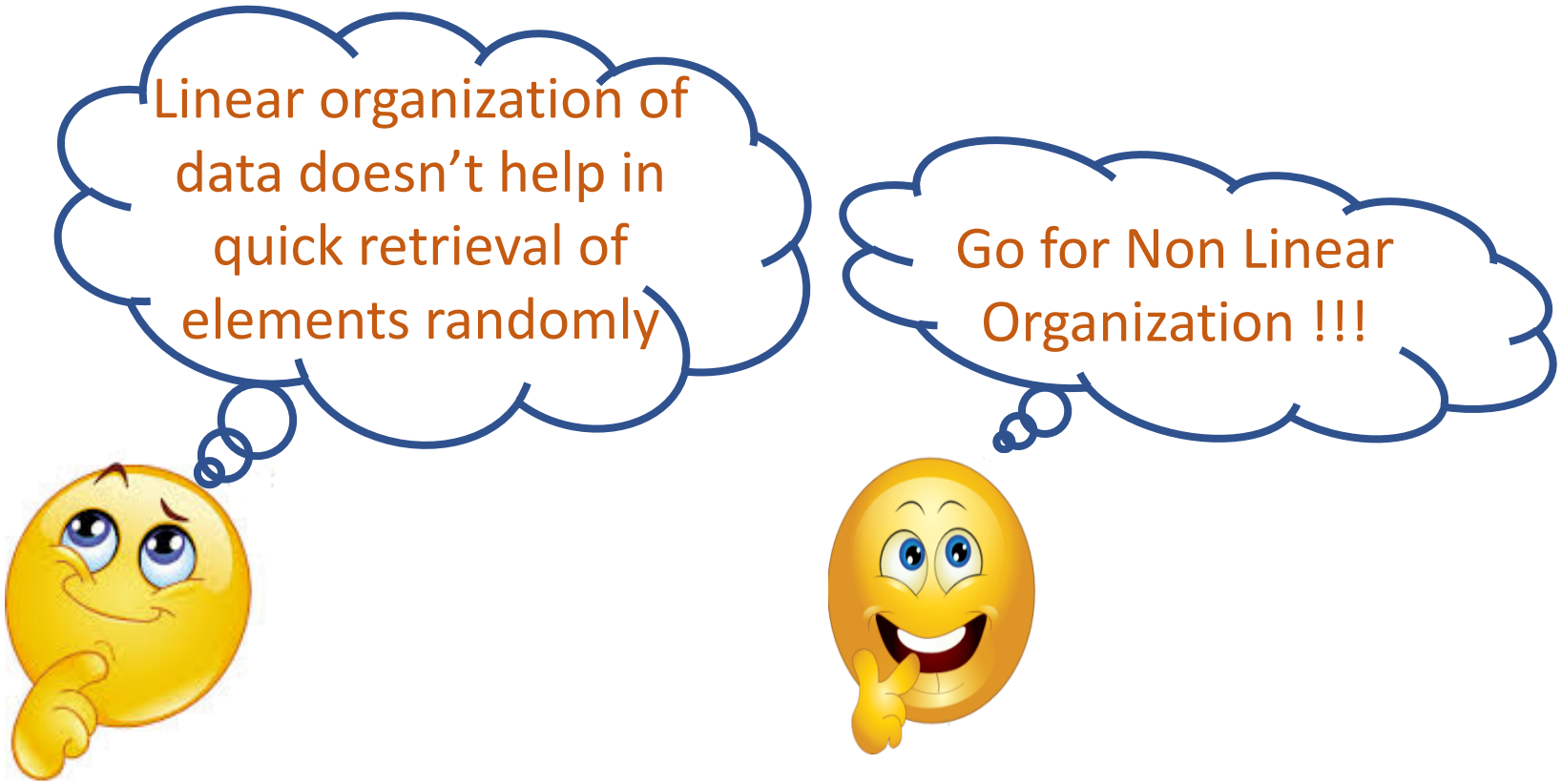
- Fixed Size
  - Expansion ✗
  - Shrink ✗
- Random Insertion & Deletion is Time Consuming

List as a Linked List

Disadvantage:

- Random Access is Time consuming

Introduction to Trees



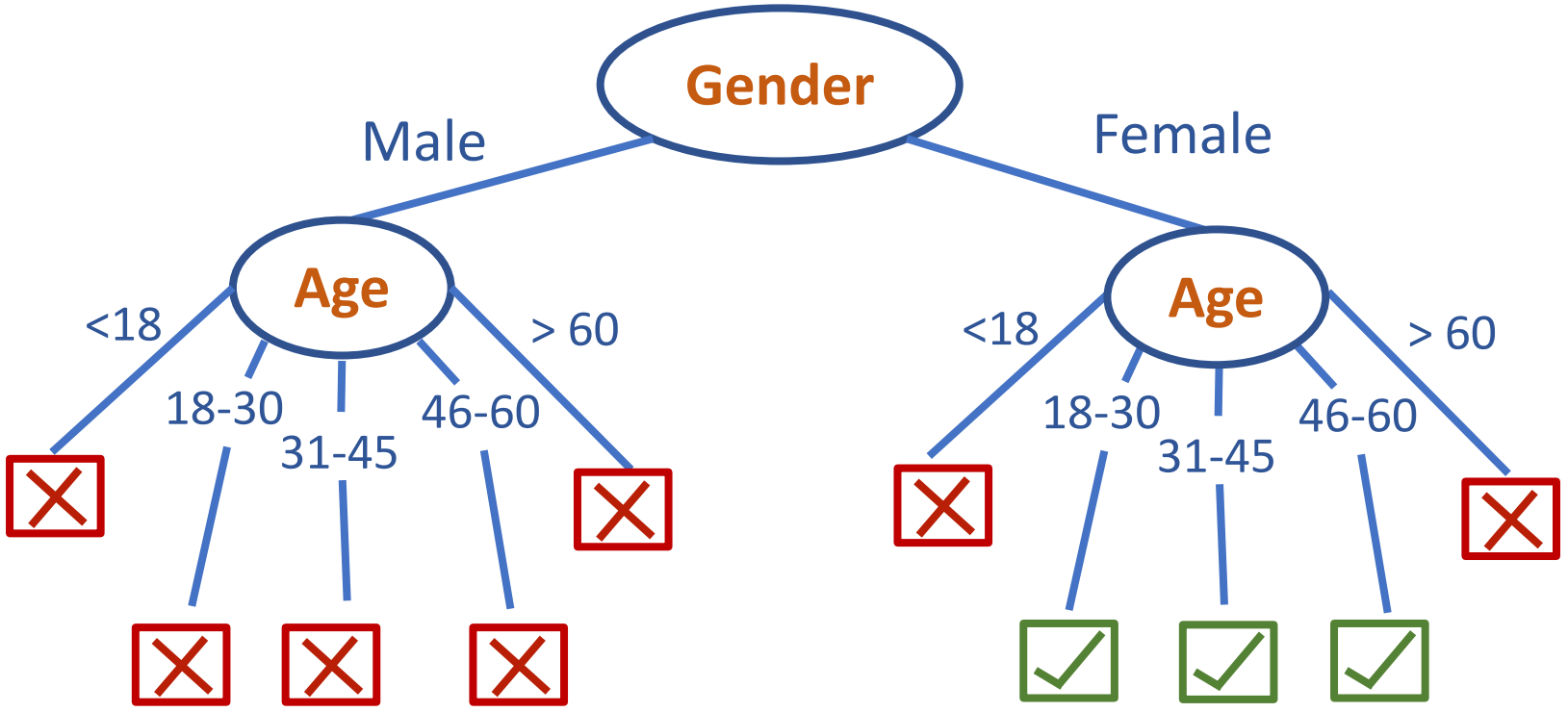
Introduction to Trees

Example: To improve the probability of purchase of Women's Formal Wear in Less Time

Name: abc Gender: M Age: 25 email id: abc@xyz.com	**Name: def** **Gender: F** **Age: 21** **email id:** **def@xyz.com**	Name: ghi Gender: F Age: 10 email id: ghi@xyz.com	**...**	**Name: pqr** **Gender: F** **Age: 60** **email id:** **pqr@xyz.com**
👉 **0**	👉 **1**	👉 **2**	👉 **...**	👉 **9999**
0	**1**	**2**	**...**	**9999**

Introduction to Trees

Example: To improve the probability of purchase of Women's Formal Wear in Less Time



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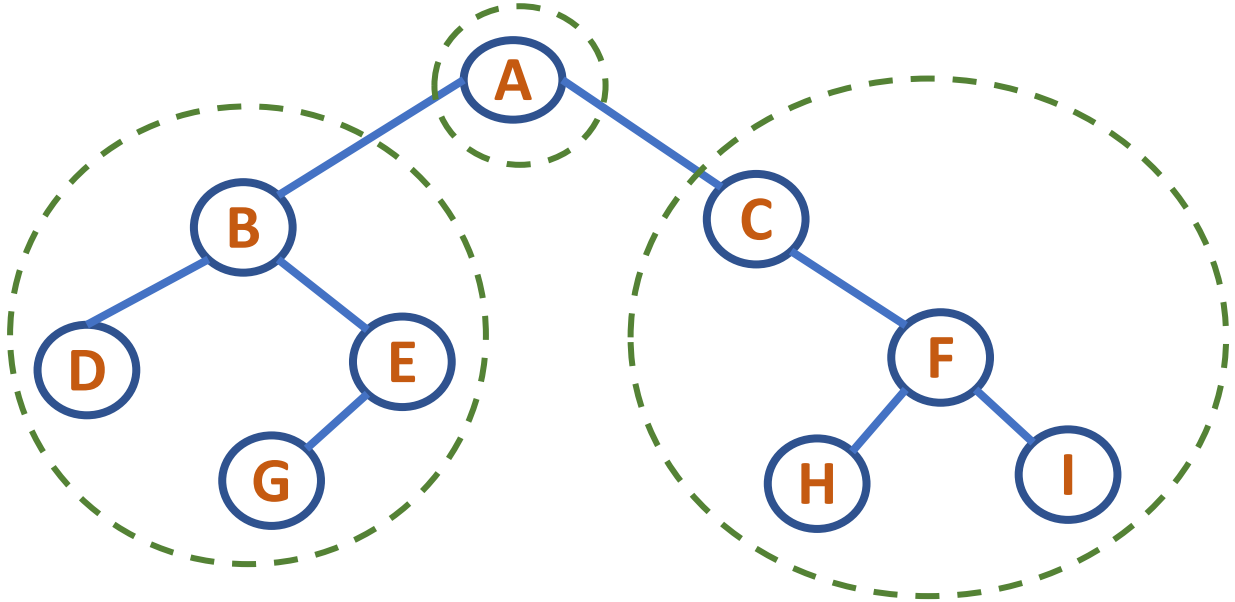
DATA STRUCTURES AND ITS APPLICATIONS

Binary Trees

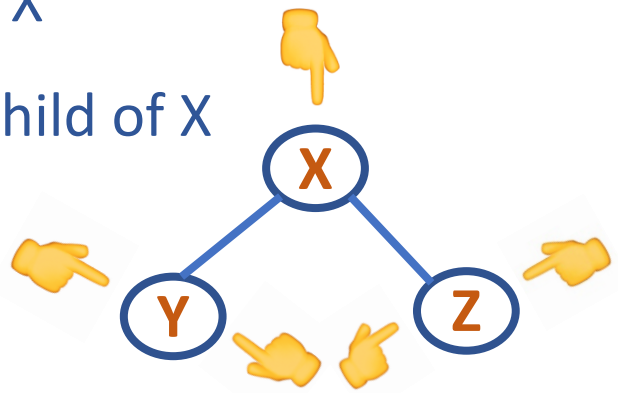
- Non Linear Data Structure
- Finite set of elements that is either empty or is partitioned into three subsets
- First subset: is a single element, called the root
- Second subset: is a binary tree, called the left binary tree
- Third subset: is a binary tree, called the right binary tree



DATA STRUCTURES AND ITS APPLICATIONS

Binary Trees: Terminologies

- Each element of a binary tree is called a node of the tree
- Left node Y of X is called left child of X
- Right node Z of X is called the right child of X
- X is called the parent of Y and Z
- Y and Z are called siblings



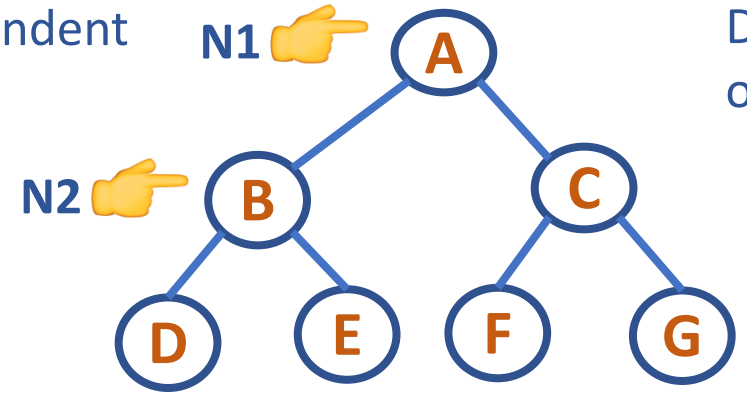
- A node which has no children is called leaf node/external node
- A node which has a child is called the non leaf node/internal node

DATA STRUCTURES AND ITS APPLICATIONS

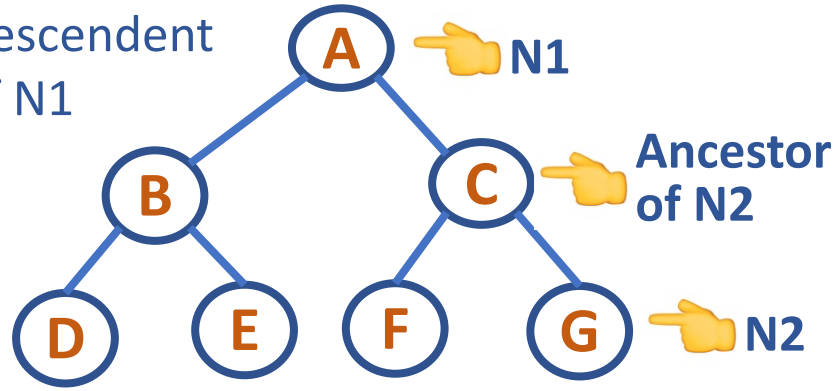
Binary Trees: Terminologies

- A node N1 is called the ancestor of a node N2 if
  - N1 is either the parent of N2 or
  - N1 is the parent of some ancestor of N2
- A node N2 becomes the descendent of node N1
- Descendent can be either the left descendent or the right descendent

N2 is the Left Descendent of N1



N2 is the Right Descendent of N1



Binary Trees: Terminologies

- Level of a node

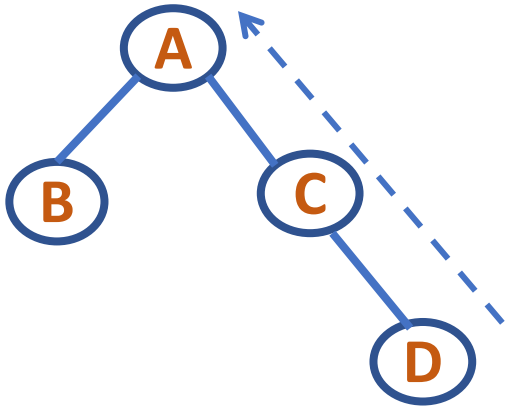
  Root has level 0; level of any other node is one more than its parent

- Depth of a tree

  Maximum level of any leaf in the tree (path length from the deepest leaf to the root)

- Depth of a node

  Path length from the node to the root

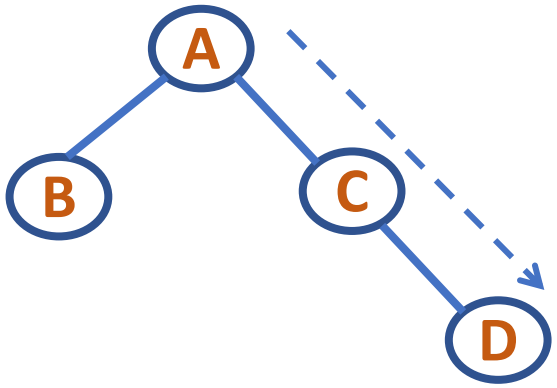


Level of node A – 0
Level of node B – 1
Level of node C – 1
Level of node D – 2

Depth of tree: 2
Depth of node A: 0
Depth of node B: 1
Depth of node C: 1
Depth of node D: 2

Binary Trees: Terminologies

- Height of a tree: Path length from the root node to the deepest leaf
- Height of a node: Path length from the node to the deepest leaf



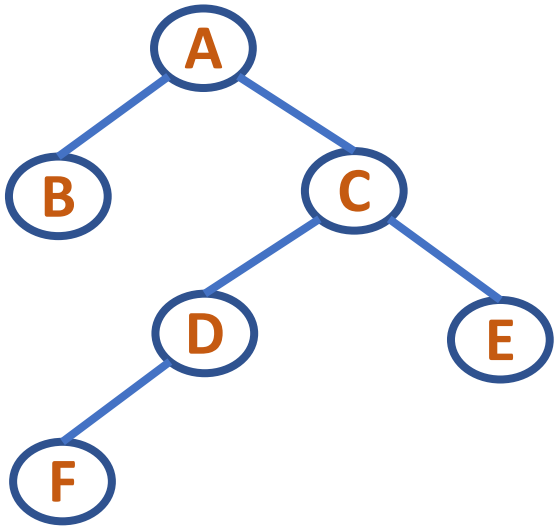
Height of Tree: 2

Height of Node A : 2
Height of Node B : 0
Height of Node C : 1
Height of Node D : 0

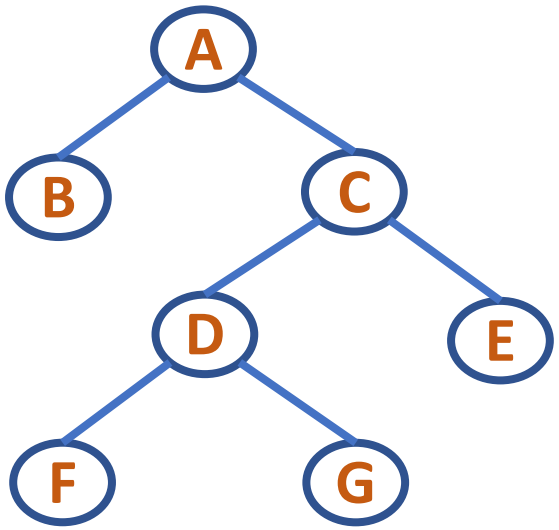
Binary Trees: Terminologies

Strictly Binary Tree

A Binary tree where every node has either zero/two children



Not a Strictly Binary Tree

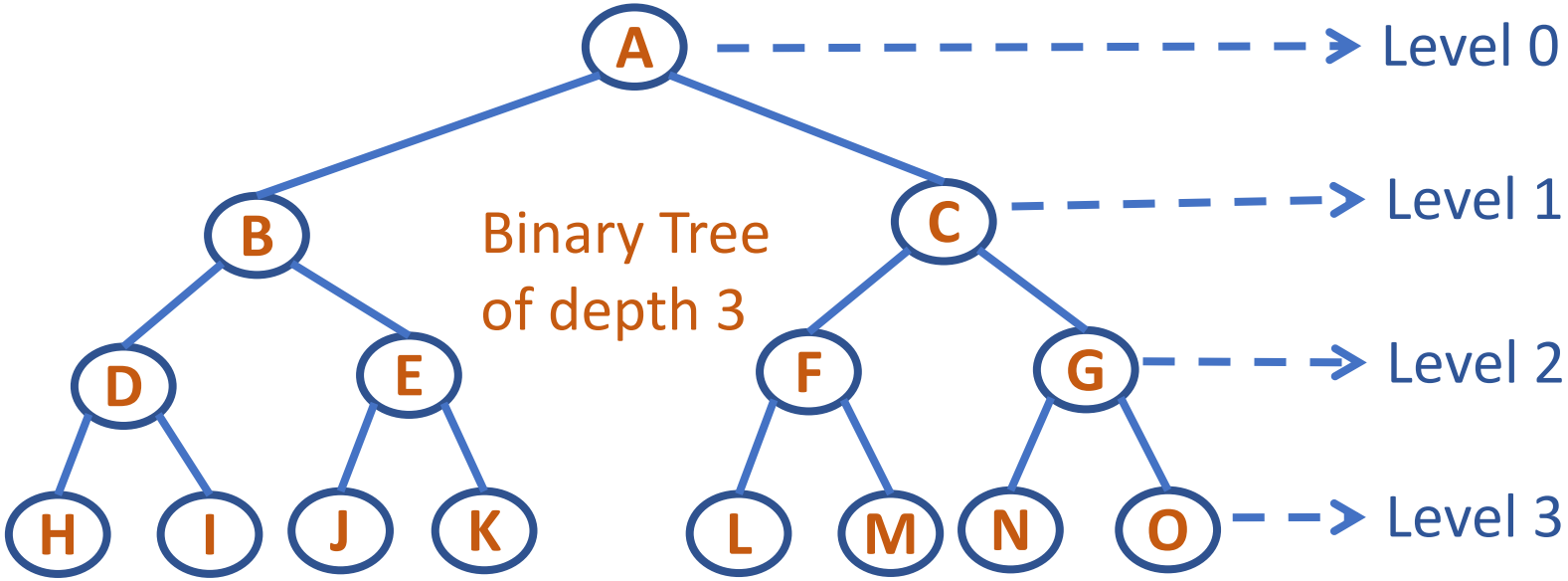


Strictly Binary Tree

Binary Trees: Terminologies

Fully Binary Tree

- A binary tree with all the leaves at the same level
- If the binary tree has depth d, then there are 0 to d levels
- Total no. of nodes = $2^0 + 2^1 + \ldots + 2^d = 2^{(d+1)} - 1$

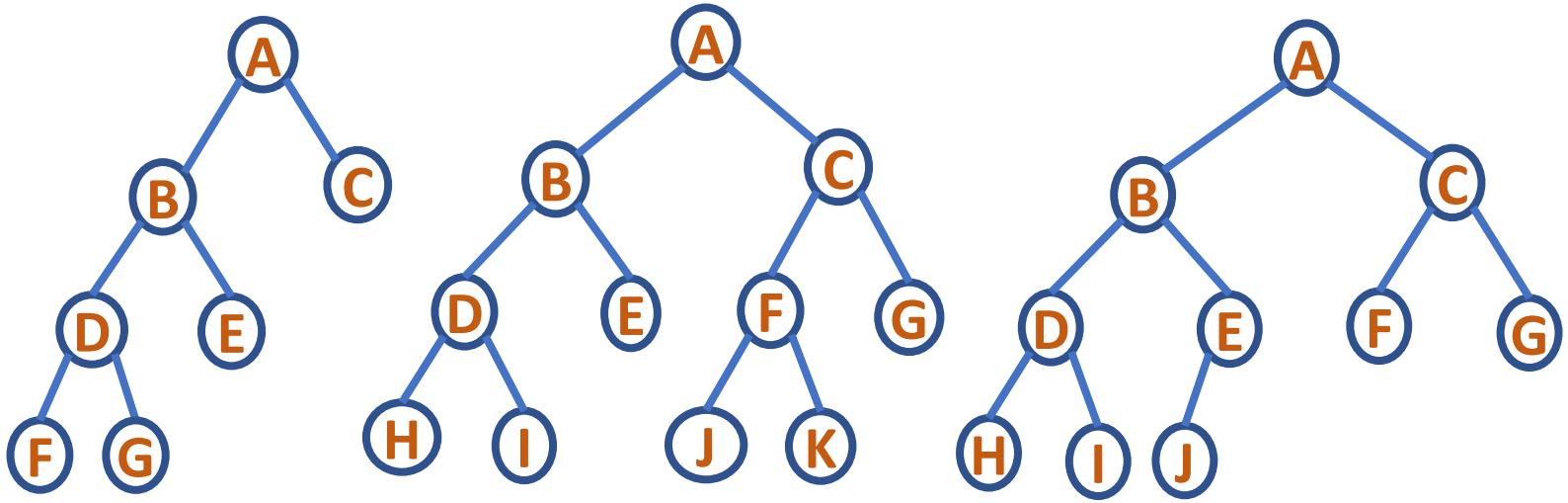


Binary Trees: Terminologies

Complete Binary Tree

For a Complete Binary Tree with n nodes and depth d:

- Any node nd at level less than d-1 has two children
- For any node nd of the tree with a right descendent at level d, nd must have a left child and every left descendent of nd is either a leaf at level d or has two children



Not Complete Binary Trees

Complete Binary Tree

Binary Tree Properties

- Every node except the root has exactly one parent
- A tree with n nodes has n-1 edges (every node except the root has an edge to its parent)
- A tree consisting of only root node has height of zero
- The total number of nodes in a full binary tree of depth d is $2^{(d+1)} - 1$, $d \geq 0$
- For any non-empty binary tree, if n_0 is the number of leaf nodes and n_2 the nodes of degree 2, then $n_0 = n_2 + 1$

THANK YOU

Shylaja S S

Department of Computer Science & Engineering

shylaja.sharath@pes.edu

+91 9449867804