Data Structures & Algorithms
(PCC-CS 301)

Dr. Debashis Das
Associate Professor
Department of CSE
Techno India University, Kolkata

Department of CSE, Techno India University West Bengal

Topics Covered

1. Non-linear DS: Tree
   a. Basic terminology
   b. Types of tree
   c. Tree traversal
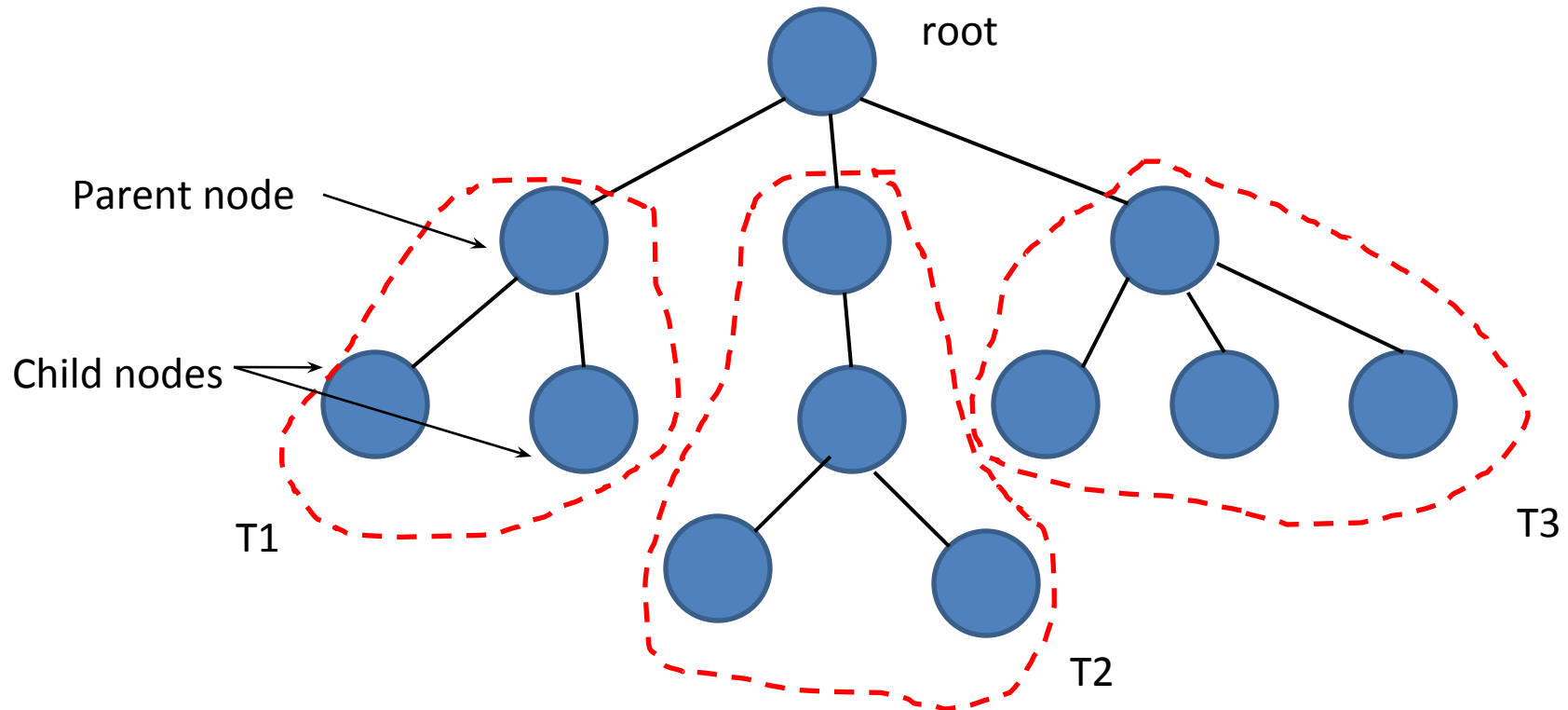
Non-linear Data Structure: Tree

- Tree

  - Definition

    A tree **T** is defined as a finite set of elements each of which called as node that makes a hierarchical relationship such that:

    - **T** may be empty or consists of one or more elements
    - **T** contains a distinguished node called **root**
    - T_1 , T_2 , ... , T_n are called sub-trees if those are connected with the root of **T**
    - Any node **n** branches with the nodes n_1 , n_2 , ... , n_k ; **n** is termed as parent node where {n_1 , n_2 , ... , n_k} are termed as child nodes

Non-linear Data Structure: Tree

- Tree
  - ☐ Structure

root

Parent node

Child nodes

T1

T2

T3

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Non-linear Data Structure: Tree

- Terminology
  - Sibling
    child nodes of same parent. Ex. – E , F
  - Leaf node
    nodes which have no children.
    Ex. – E, F, K, L, H, I, J
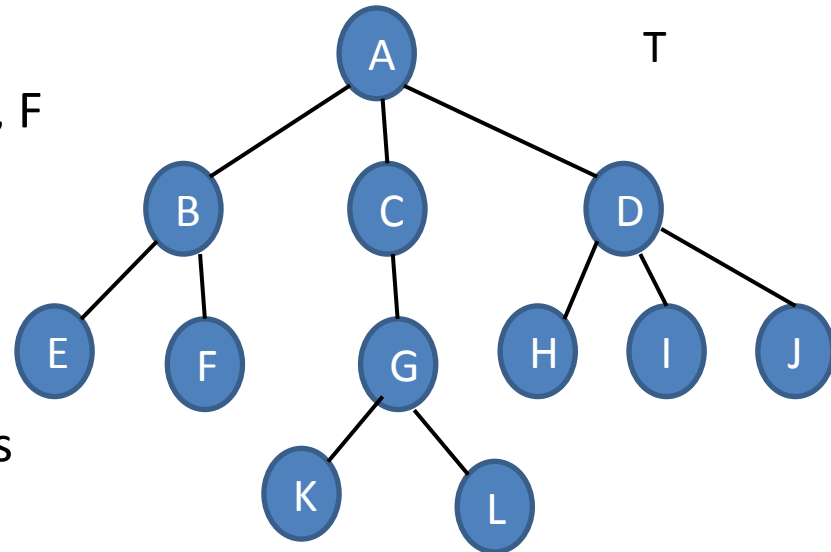 - Internal node
    all nodes except root and leaf nodes
  - Path
    sequence of consecutive edges between any two nodes
  - Height
    Maximum path length from root to a leaf node. Height of *T* is 3
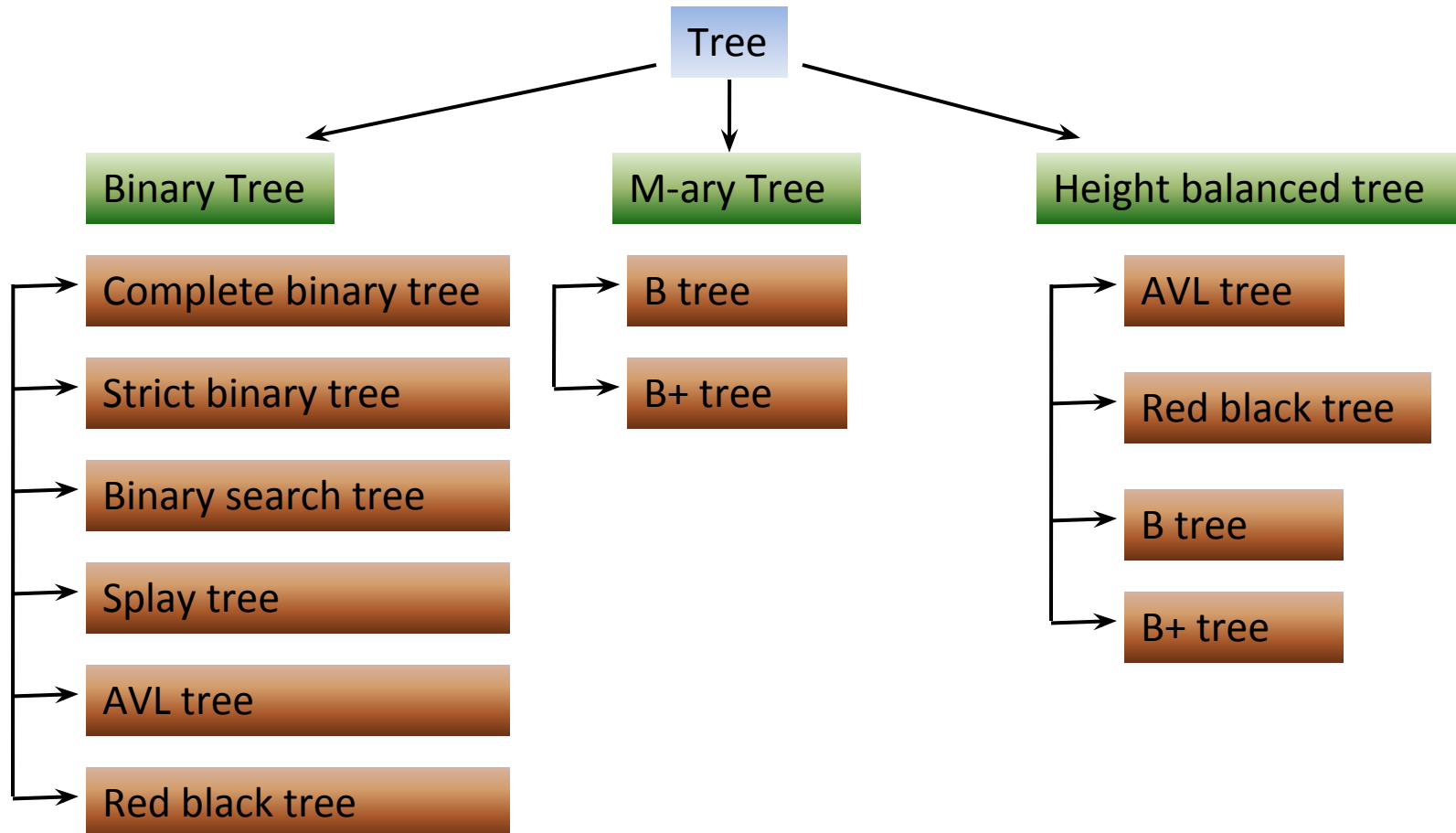 - Level / depth
    distance of any node from the root. Root is at 0th level.
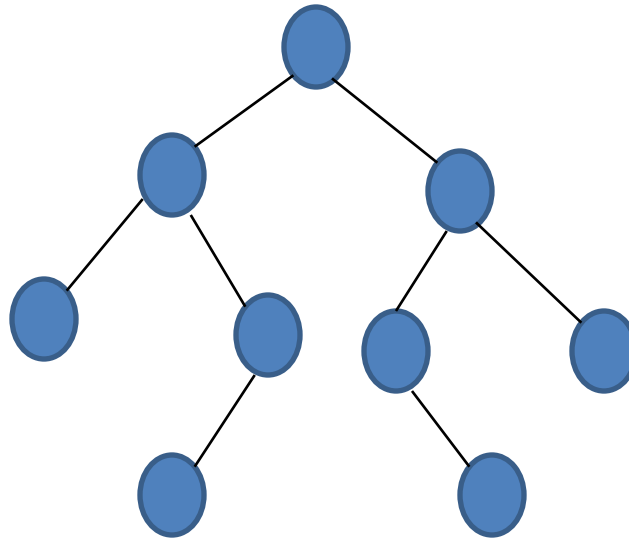
Non-linear Data Structure: Tree

- Types of Tree

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                                Tree
           ┌──────────────────────┼──────────────────────┐
           ▼                      ▼                      ▼
     Binary Tree             M-ary Tree         Height balanced tree

   Complete binary tree       B tree                 AVL tree

   Strict binary tree         B+ tree                Red black tree

   Binary search tree                                B tree

   Splay tree                                        B+ tree

   AVL tree

   Red black tree
```

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Non-linear Data Structure: Tree

- Types of Tree
  - Binary Tree

    A tree is called binary tree if it is empty or each node contains maximum 2 children
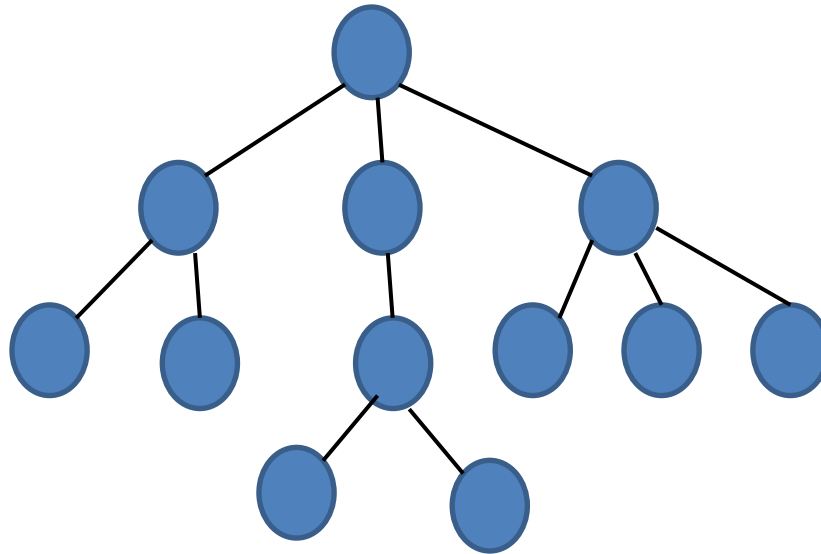
Non-linear Data Structure: Tree

- Types of Tree
    - M-ary Tree

        A tree is called M-ary tree if it is empty or each node contains maximum M number of children
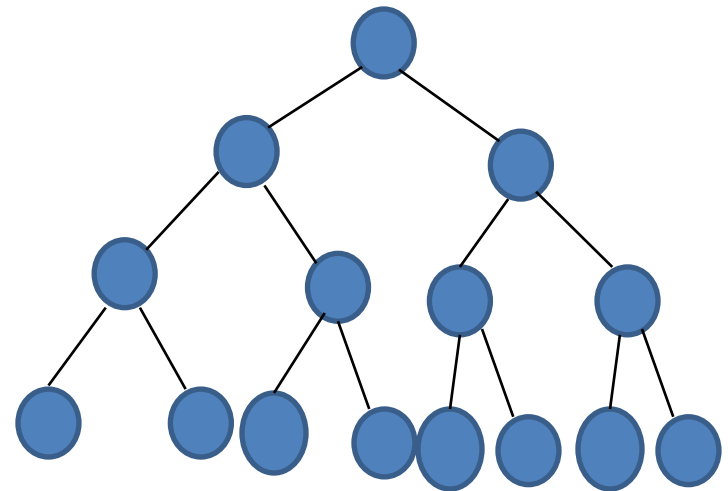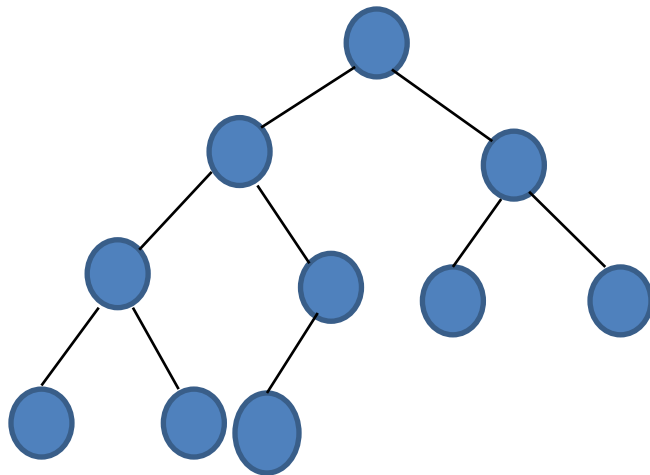
Non-linear Data Structure: Tree

- Types of Tree
  - Complete Binary Tree

    A binary tree is called as complete if all its levels except possibly the last, have maximum number of possible nodes and all the nodes at the last level appear as far left as possible
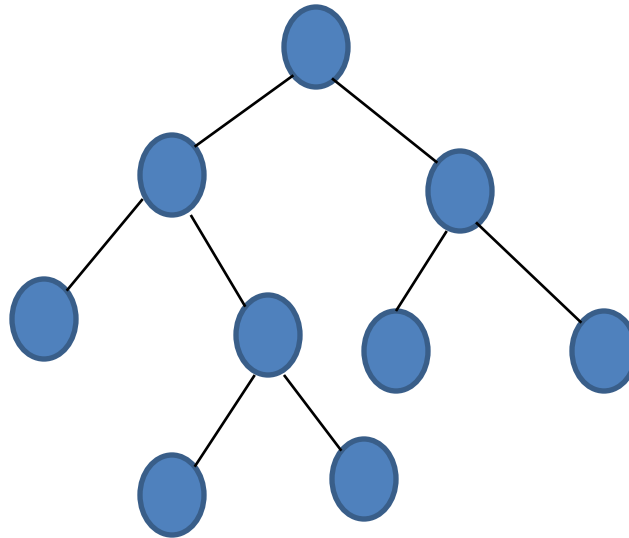
Non-linear Data Structure: Tree

- Types of Tree
  - Strict Binary Tree

    A binary tree is called strict binary tree if it is empty or each node contains either 0 or 2 children

Non-linear Data Structure: Tree

- Tree Traversal

  It refers to discover or traverse all the nodes of a tree

  ☐ There are 3 types of tree traversal
    - Pre-order
    - In-order
    - Post-order

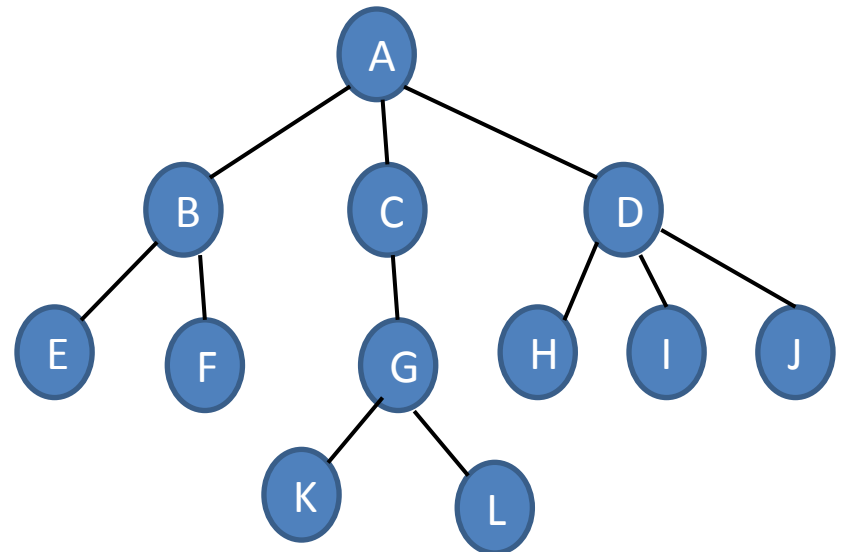# Non-linear Data Structure: Tree

- ## Tree Traversal
    - Pre-order traversal
        - The root node is discovered first
        - Each sub-trees of the root is traversed in pre-order

Pre-order:

A -> B -> E -> F -> C -> G -> K -> L -> D-> H -> I -> J
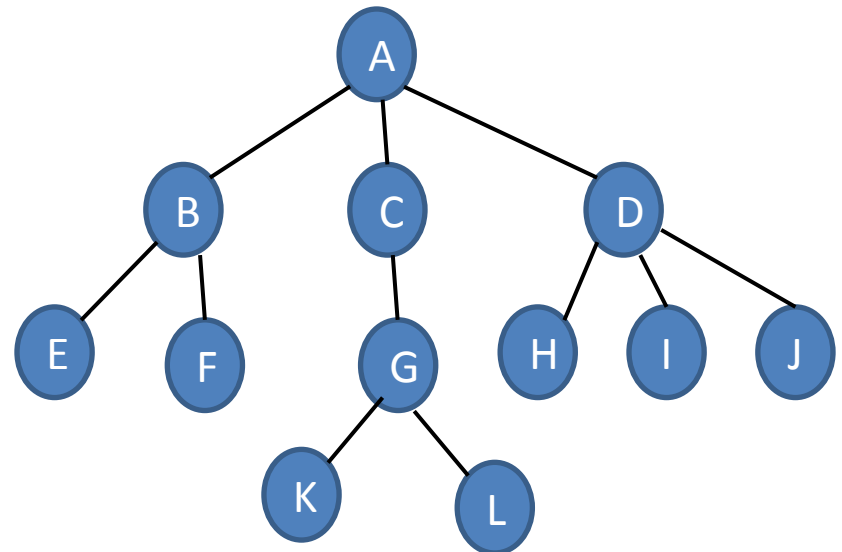
Non-linear Data Structure: Tree

- ## Tree Traversal
  - In-order traversal
    - o Left most sub-tree is discovered by following in-order traversal
    - o The root is traversed
    - o All other right sub-trees of the root are traversed by following in-order

In-order:

E -> B -> F -> A -> K -> G -> L -> C -> H -> D -> I -> J
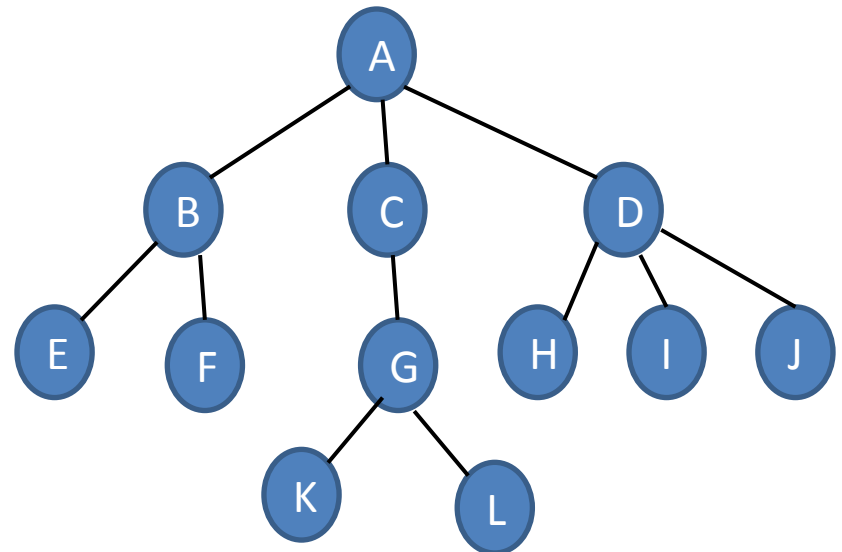
Non-linear Data Structure: Tree

- ## Tree Traversal
  - ⬜ Post-order traversal
    - o Left most sub-tree is discovered by following post-order traversal
    - o All other right sub-trees of the root are traversed by following post-order
    - o The root is traversed

Post-order:
E -> F -> B -> K -> L -> G -> C -> H -> I -> J -> D -> A

Queries?

Problem

Q. Find the pre, in and post order traversal of the following tree: