The Tree ADT

Objectives

- Define trees as data structures
- Define the terms associated with trees
- Discuss tree traversal algorithms
- Discuss a binary tree implementation
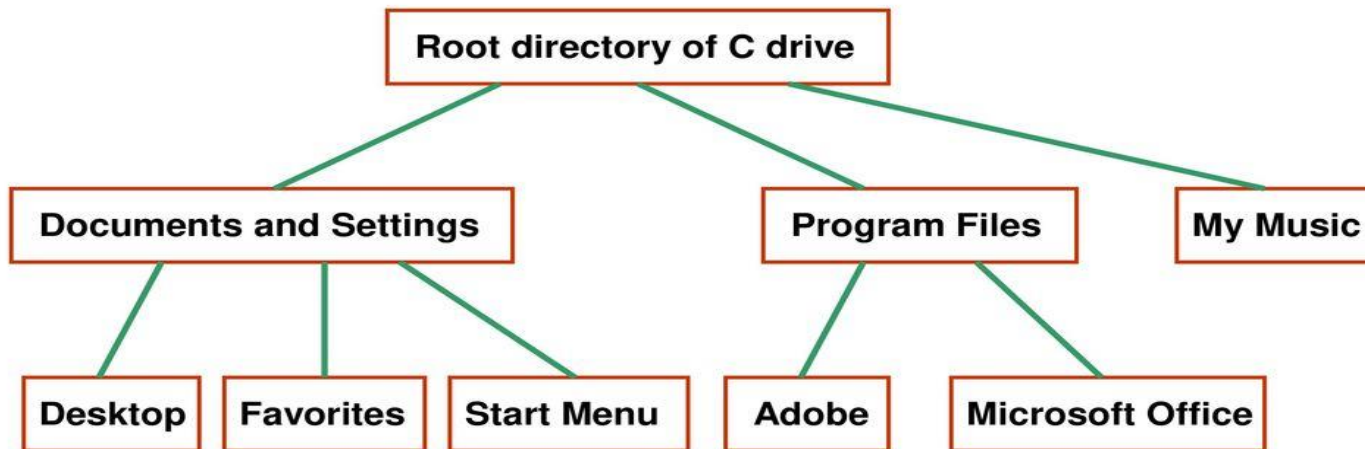- Examine a binary tree example

10-2

Trees

- A **tree** is a *nonlinear* abstract data type that stores elements in a hierarchy.
- *Examples* in real life:
    - Family tree
    - Table of contents of a book
    - Class inheritance hierarchy in Java
    - Computer file system (folders and subfolders)
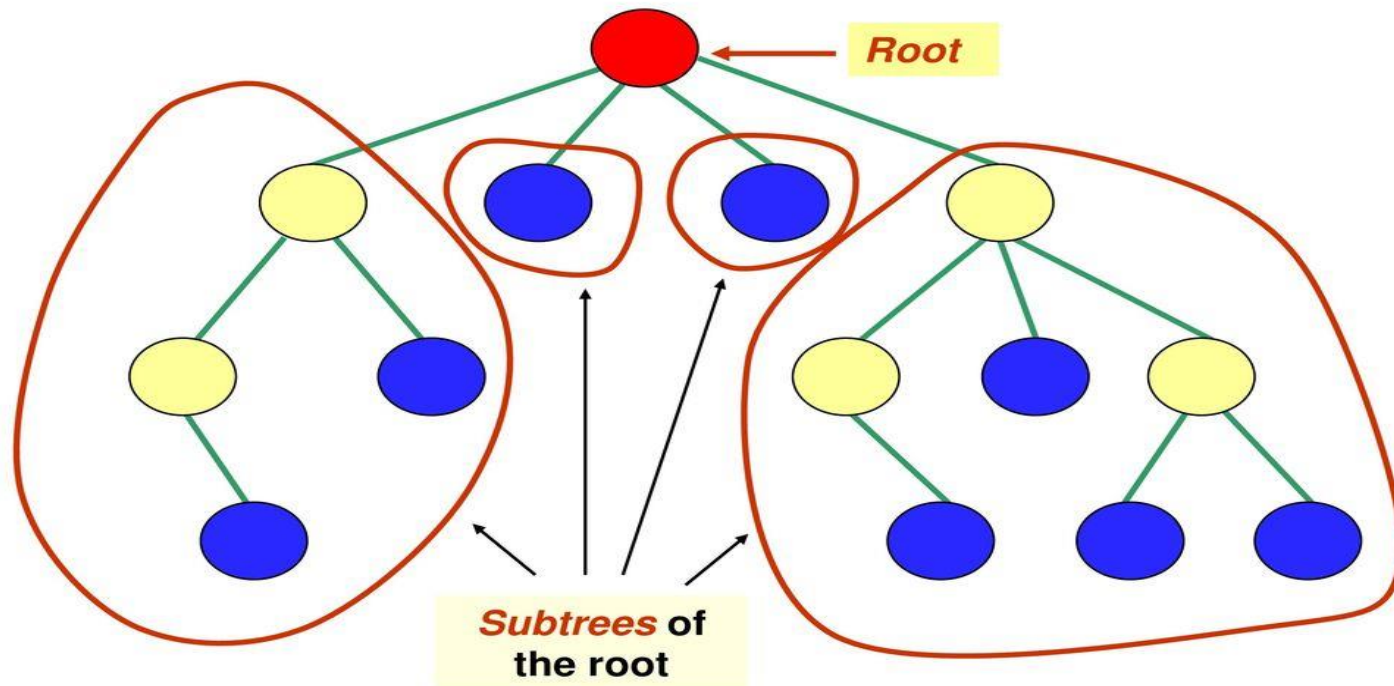   - Decision trees

10-3

Example: Computer File System

10-4

Tree Definition

- *Tree:* a set of elements that either
    - it is empty
    - or, it has a distinguished element called the *root* and zero or more *trees (called subtrees of the root)*
- What kind of definition is this?
    - What is the base case?
    - What is the recursive part?

10-5

Tree Definition

Root

Subtrees of the root

10-6

Tree Terminology

- *Nodes*: the elements in the tree
- *Edges*: connections between nodes
- *Root*: *the* distinguished element that is the origin of the tree
  - There is only one root node in a tree
- *Empty tree* has no nodes and no edges

10-7

Tree Terminology

10-8

Department of CSE / 19ITT102 / DSA / Unit
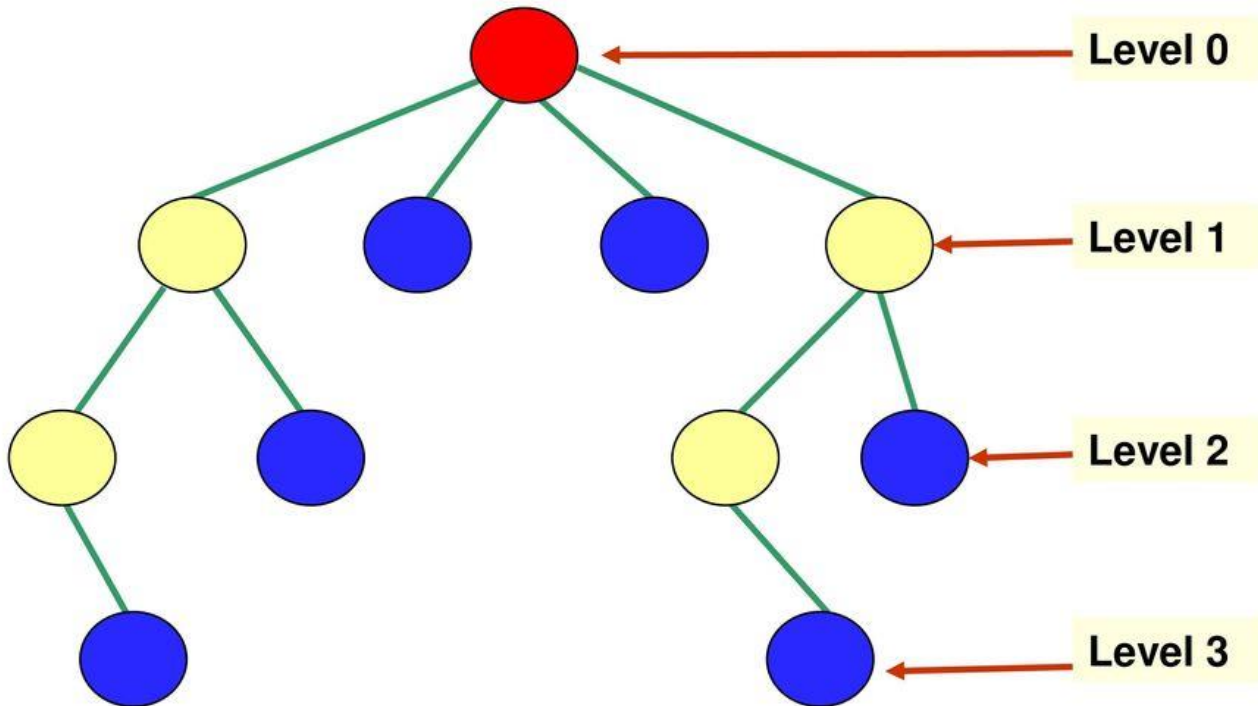-III / Non Linear Data Structure –
Devi.G,AP/CSE
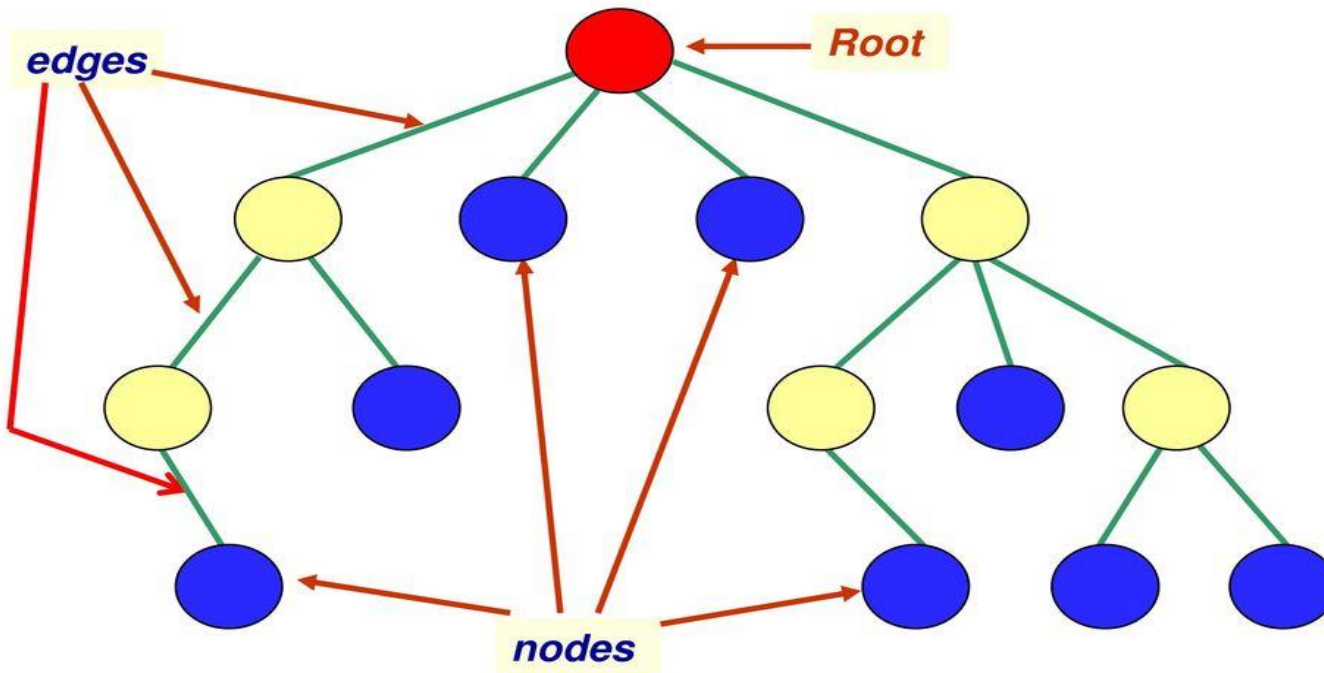
Level of a Node

- **Level of a node:** number of **edges** between root and the node
- It can be defined **recursively**:
  - Level of root node is **0**
  - Level of a node that is not the root node is **level of its parent + 1**
- **Question:** What is the level of a node in terms of path length?
- **Question:** What is the height of a tree in terms of levels?
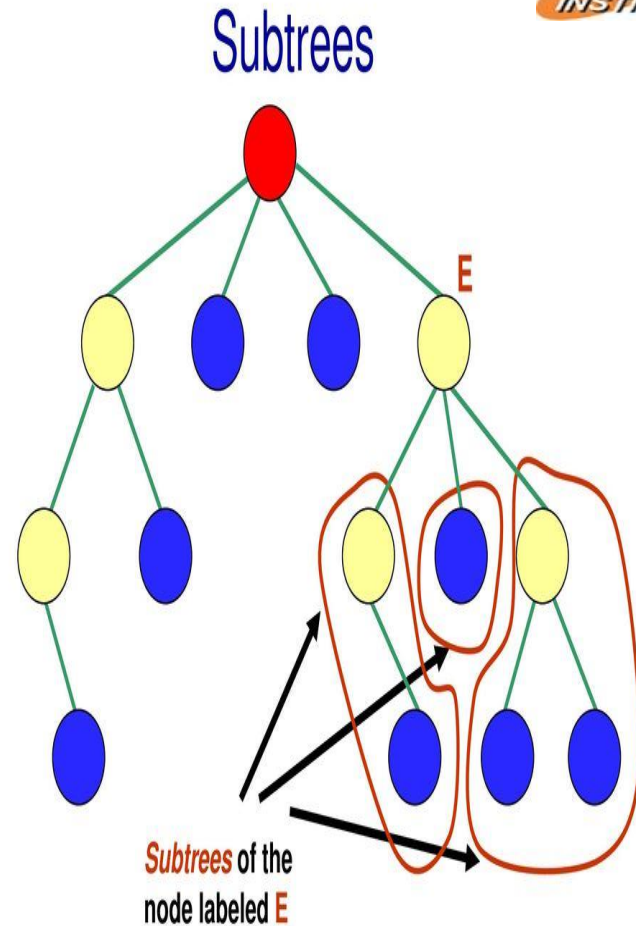
10-14

Level of a Node

10-15

Subtrees

- **Subtree** of a node: consists of a child node and all its descendants
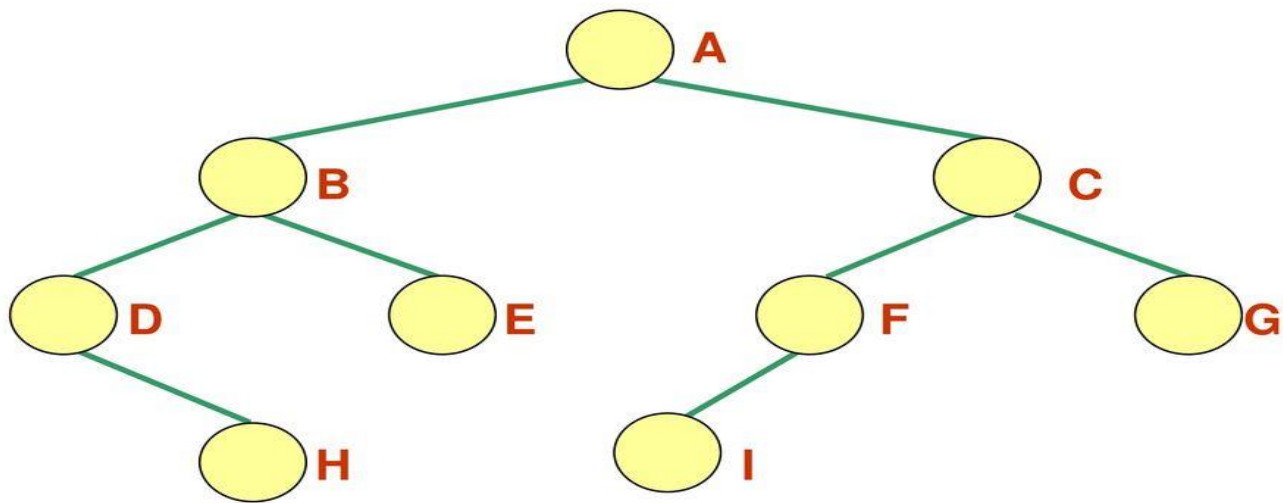 - A subtree is itself a tree
  - A node may have many subtrees

Subtrees of the node labeled **E**

10-17

Binary Trees

- *General tree*: a tree each of whose nodes may have any number of children
- *n-ary tree*: a tree each of whose nodes may have no more than *n* children
- *Binary tree*: a tree each of whose nodes may have no more than *2* children
  - *i.e.* a binary tree is a tree with *degree (arity) 2*
  - The children (if present) are called the *left child* and *right child*

10-19

Binary Tree

10-21