PRESENTATION ON

# Tree

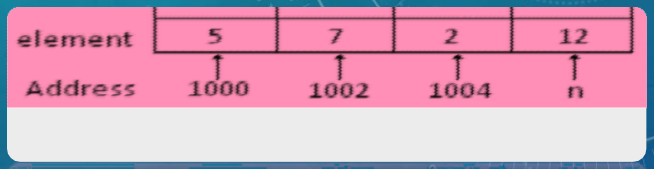
in

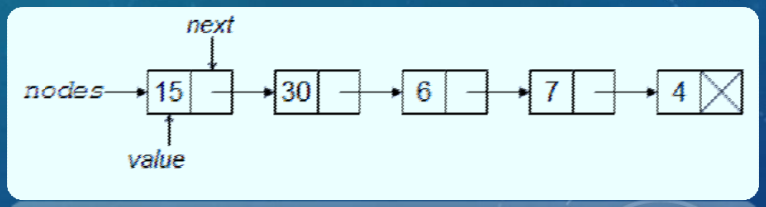
Data Structure

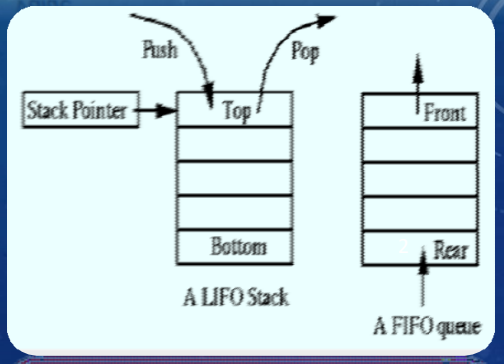
# DATA STRUCTURE

Store and organize data in computer.

- **Linear Data Structure**
  - Arrays
    - Linked List
      - Stacks
        - Queues



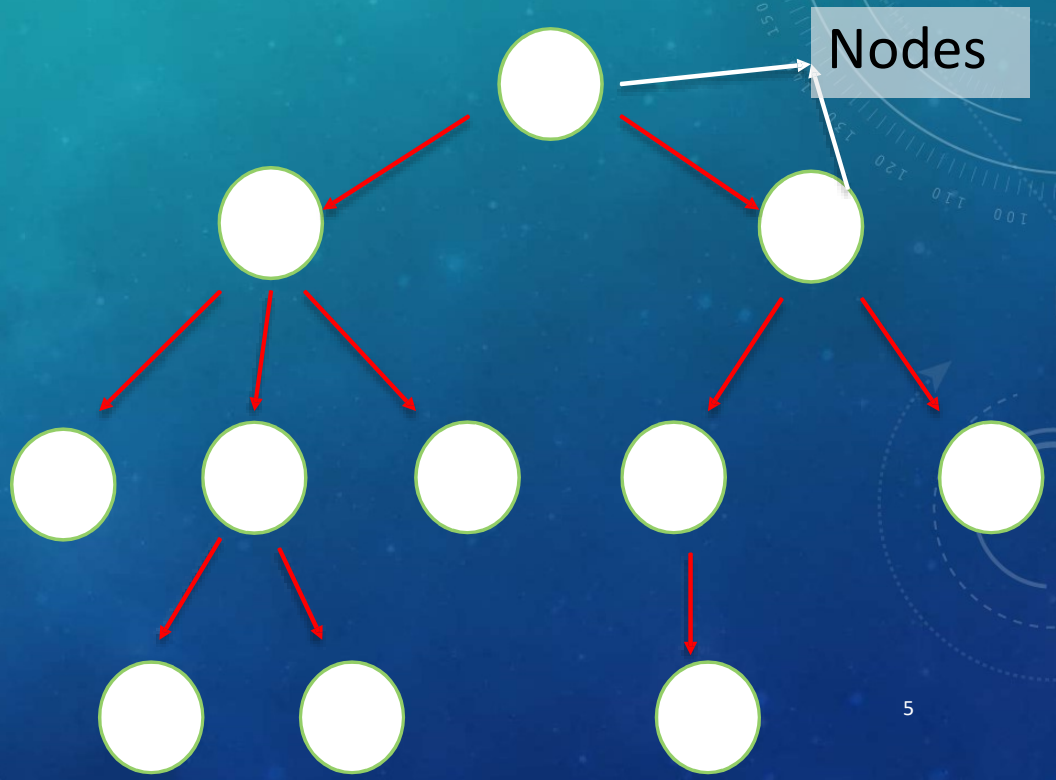
# LOGIC OF TREE

- Used to represent hierarchica data.


- Used to represent hierarchical data.

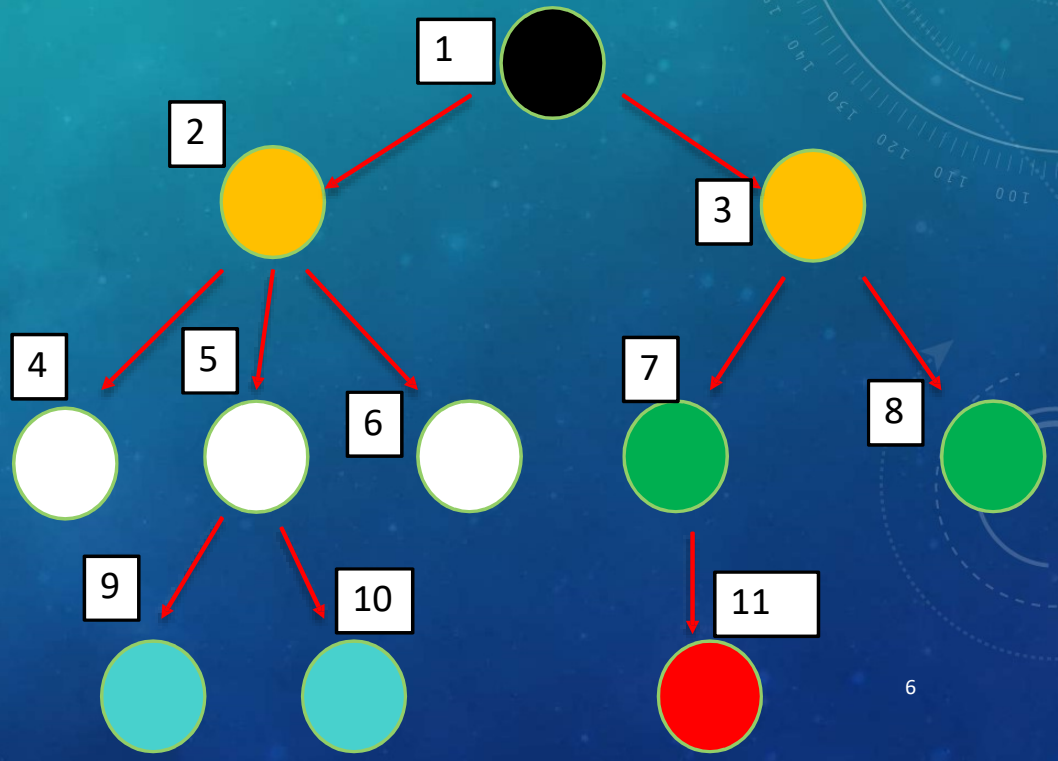

# TREE

- A  Collection of entities called Nodes.
- Tree is a **Non-Linear Data Structure.**
- It's a **hierarchica Structure**.



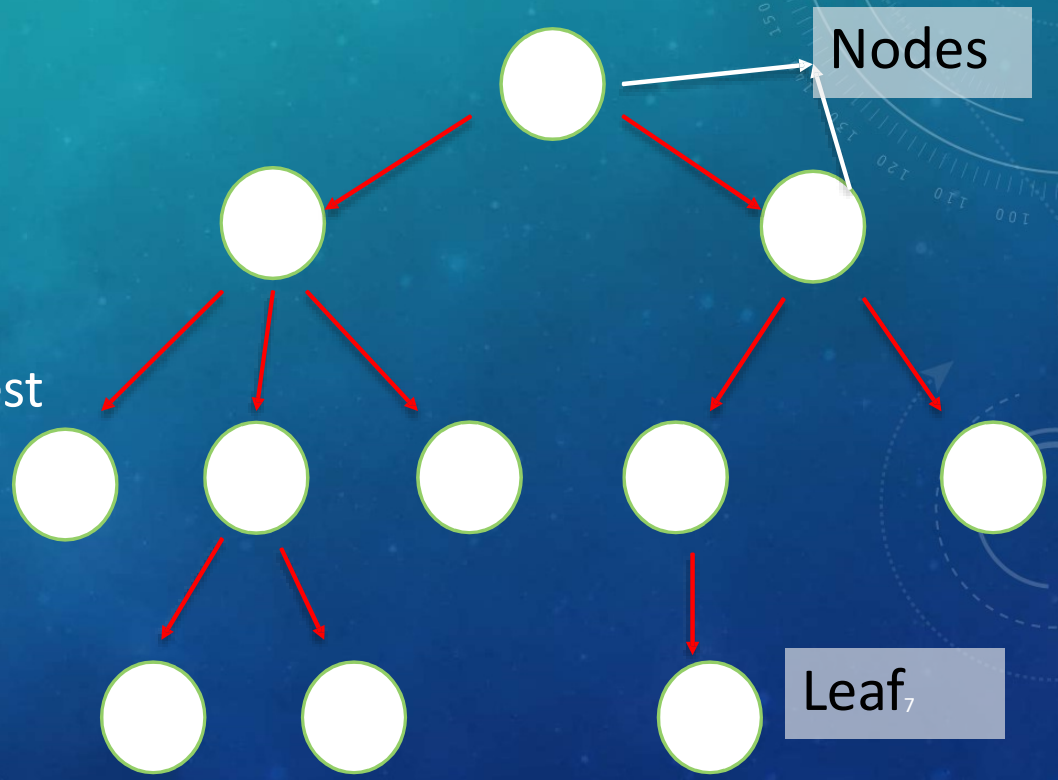
# RELATION OF TREE

- **Root-**The top most Node.
- **Children**
- **Parents**
- **Siblings**- Have same parents.
- **Leaf**- Has no Child.



# EDGES, DEPTH, HEIGHT

- **Edges:** If a tree have N nodes
  It have N-1 edges.
- **Depth of x:** Length of path from
  Root to x.
- **Hight of x:** No. Of edges in longest
  Path from x to a leaf

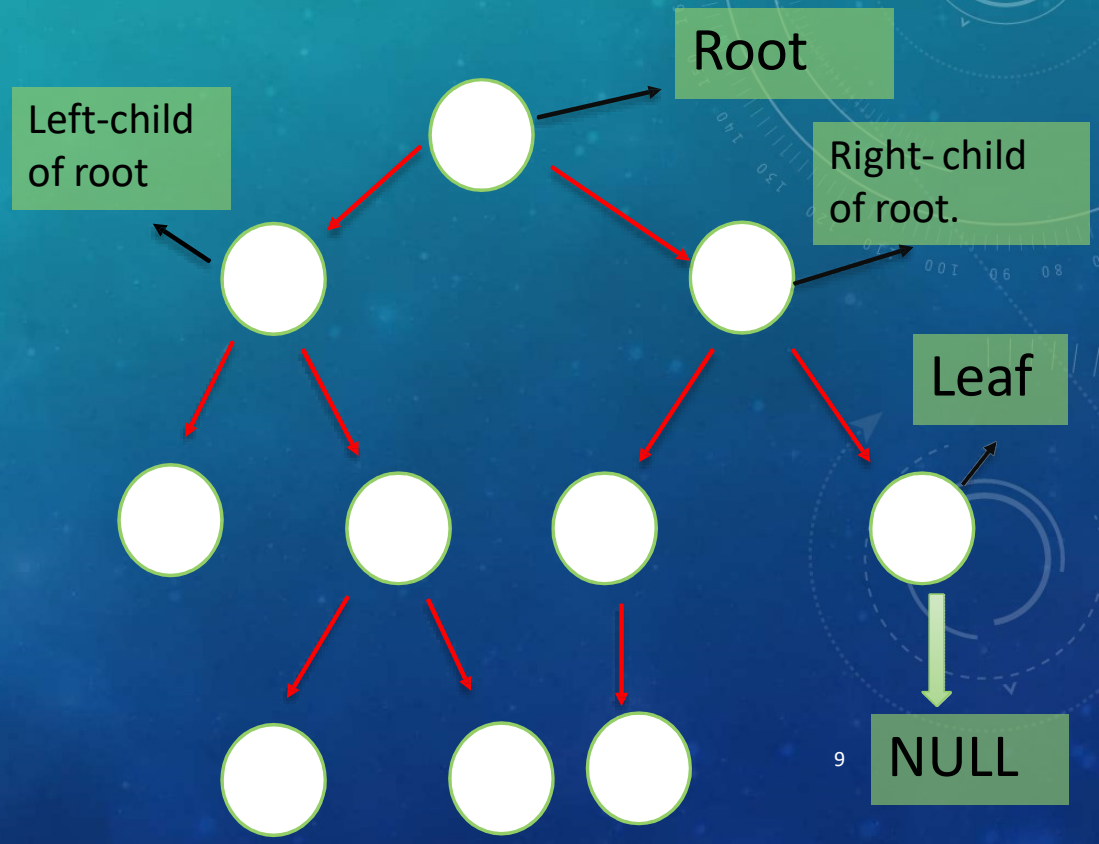


# SOME APPLICATION OF TREE IN COMPUTER SCIENCE

1. Storing naturally hierarchicl data- File system.
2. Organige data for quick search, insertion, deletion- Binary search tree.
3. Dictionary
4. Network Routing Algorithm.

# BINARY TREE

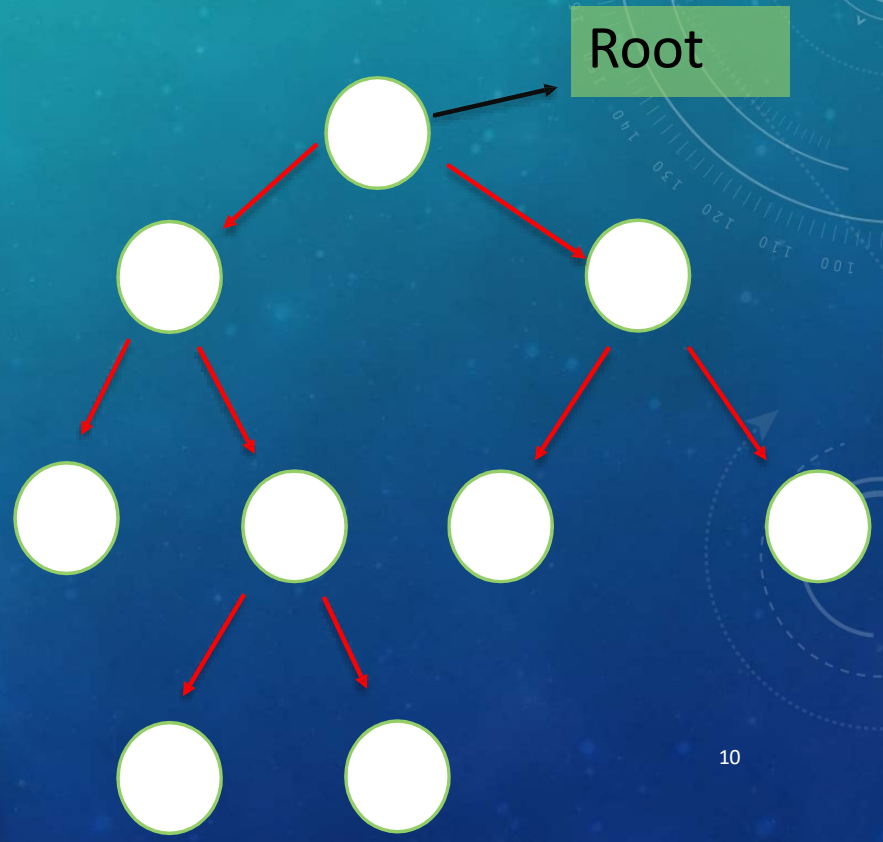
- Each node can have at most 2 childern.
- A node have only left and right child or
- Only left child or
- Only right child.
- A leaf node has no left or right child.
- A leaf node has only NULL.



# STRICT/PROPER BINARY TREE

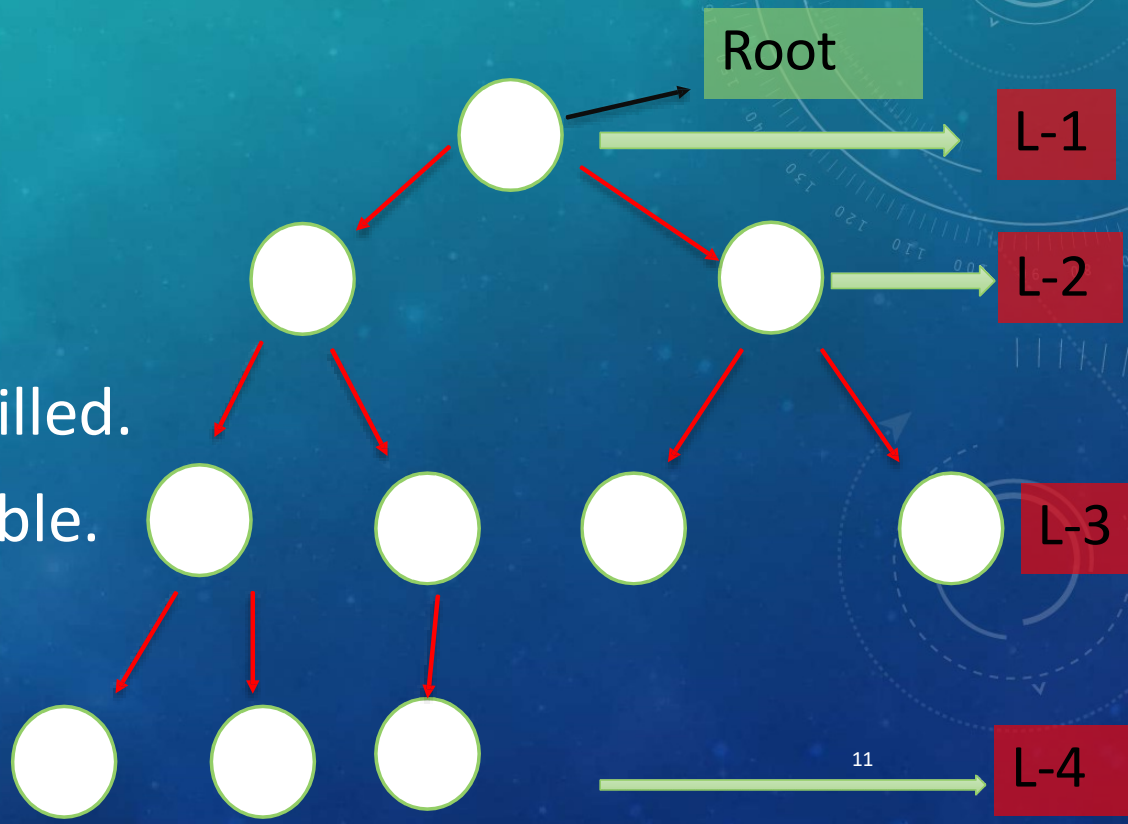
Each node can have either

2 or 0 child



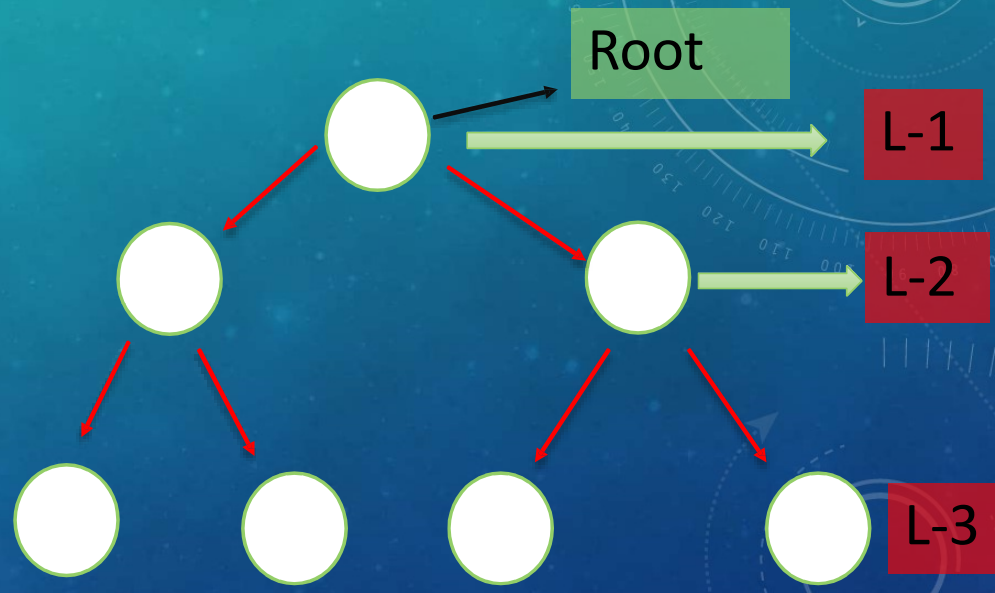
# COMPLETE BINARY TREE

- The last level is completely filled.
- All nodes are as left as possible.



# PARFECT BINARY TREE

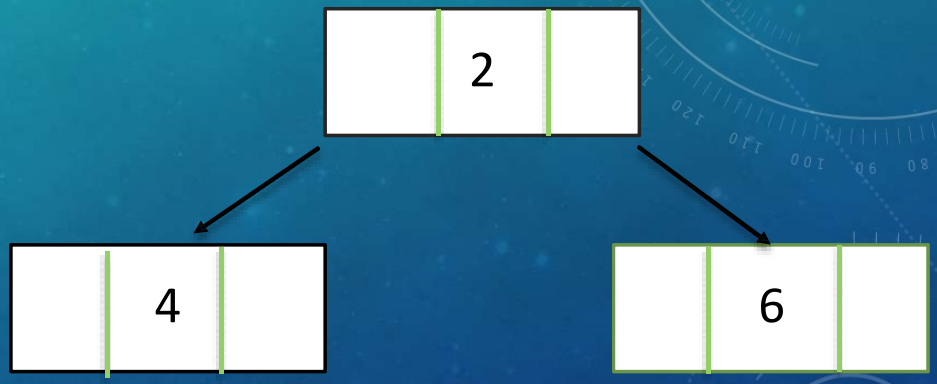
All the levels are comletely filled.



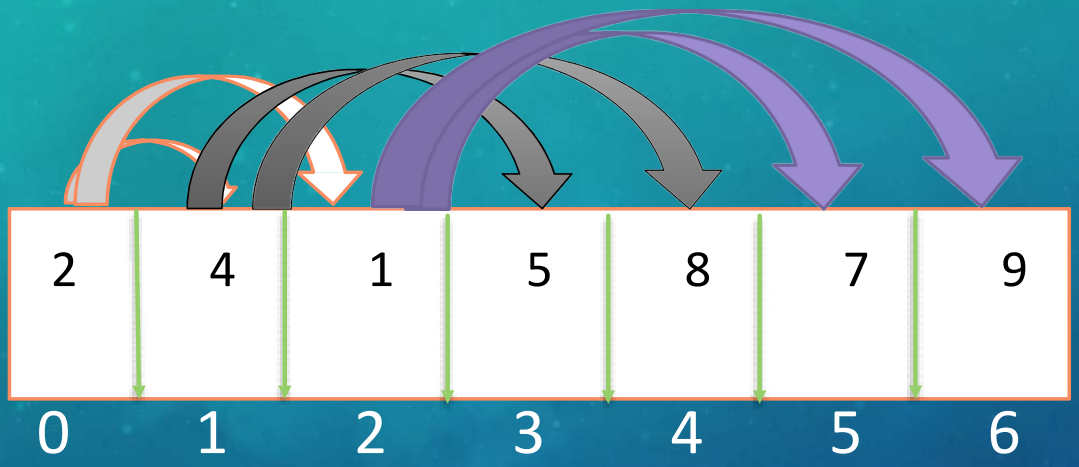
# WE CAN IMPLEMENT BINARY TREE USING

## A) Dynamically created nodes.

```
struct node
{
    int data;
    struct node* left;
    struct node* right
}
```



OR




**B) Arrays:** It only works “complete Binary tree”.

For node at index i;

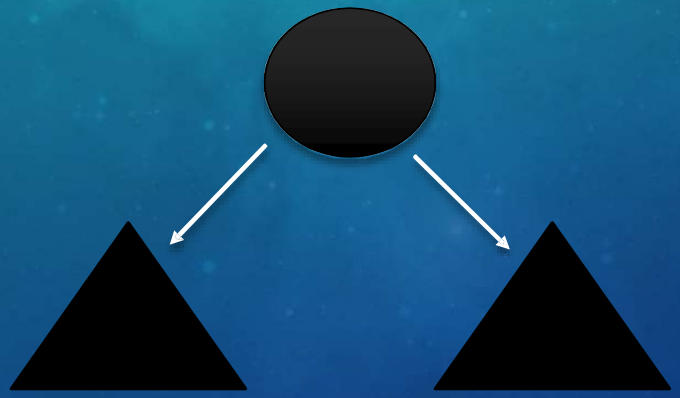
Left-child-index=2i+1

Right-child-index=2i+2

# IMPLEMENT OF BINARY SEARCH TREE

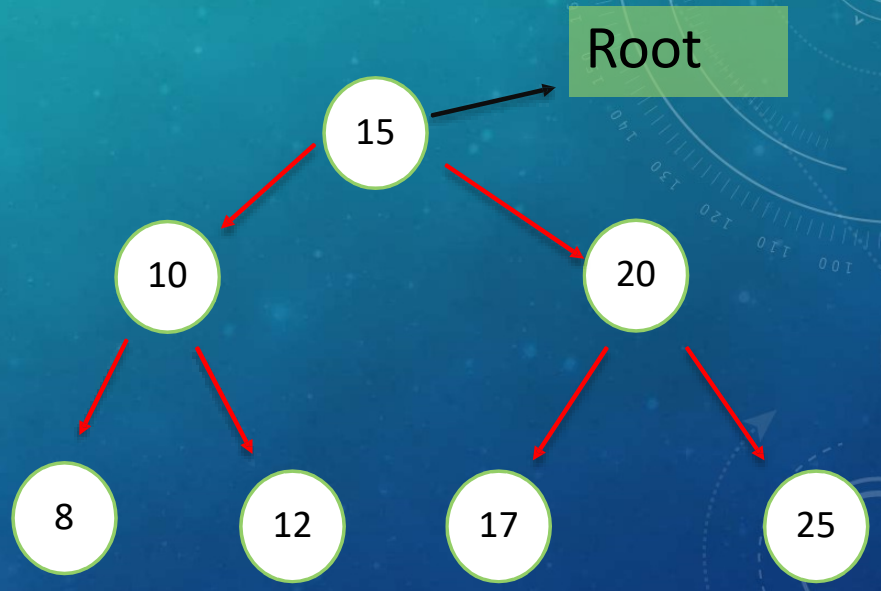
Value of all the nodes in left subtree is Lesser or Equal.

Value of all the nodes in right subtree is greater.



# EXAMPLE

- 15>10-Left
- 15<20-Right
- 10>8-Left
- 10<12-Right
- 20>17-Left
- 20<25-Right



# BINARY TREE TRAVERSAL

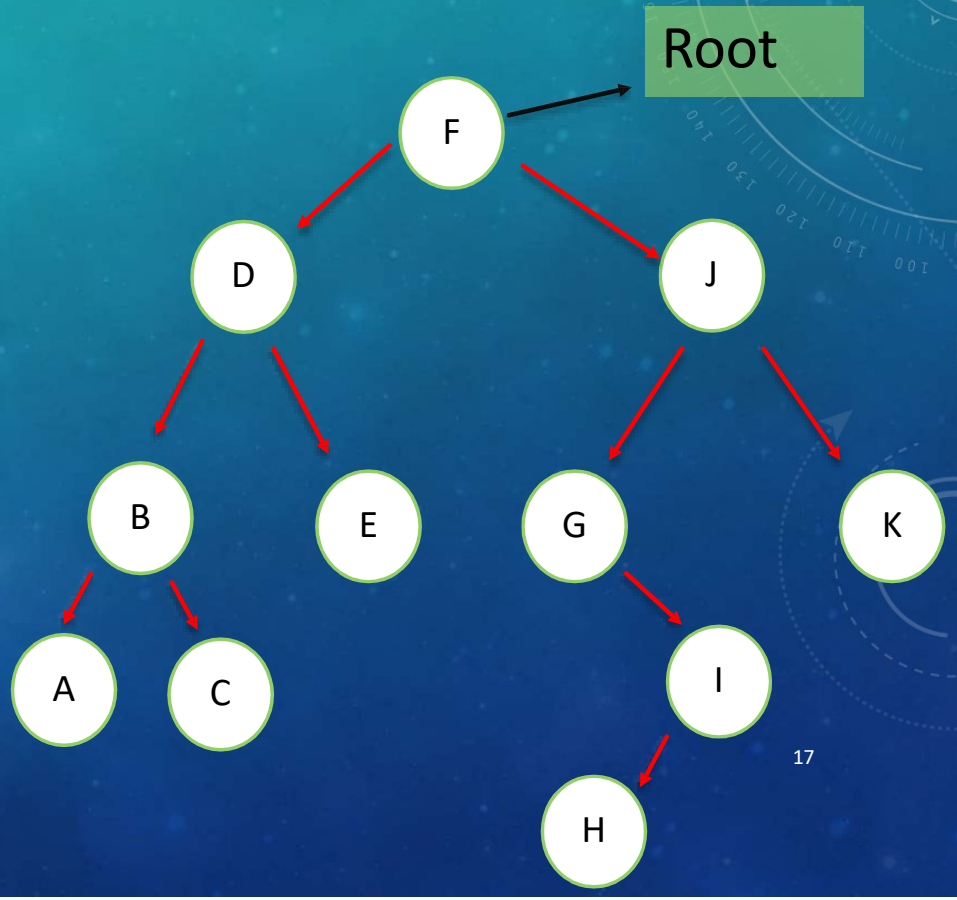
Tree traversal

- Breadth-first or Lever-order

  F,D,J,B,E,G,K,A,C,I,H

- Depth-first

  Preorder, Inorder & Postorder



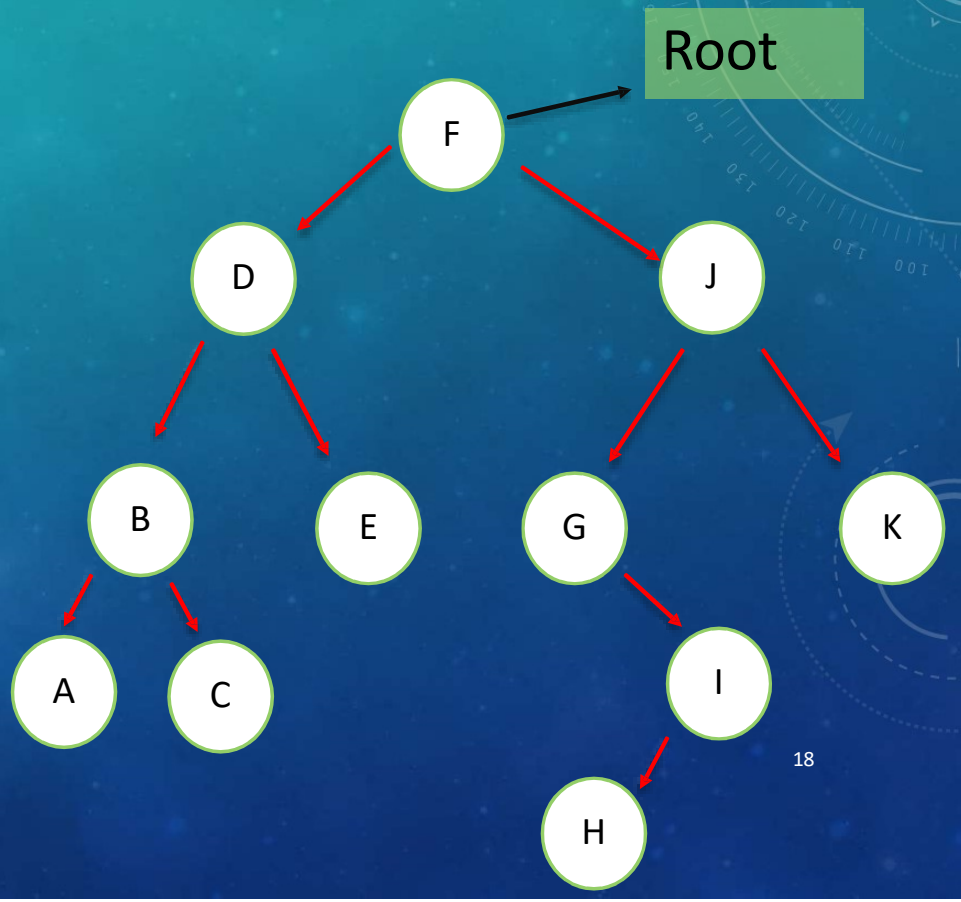
# PREORDER(SLR)

Start(Data) Left Right

<root><left><right>

F,D,B,A,C,E,J,G,I,H,K

```
Void Postorder(struct bstnode* root)
{
    if(root==NULL)
    Postorder(root->right);
    Postordrt(root->right);
    printf("%c",root->data);
}
```



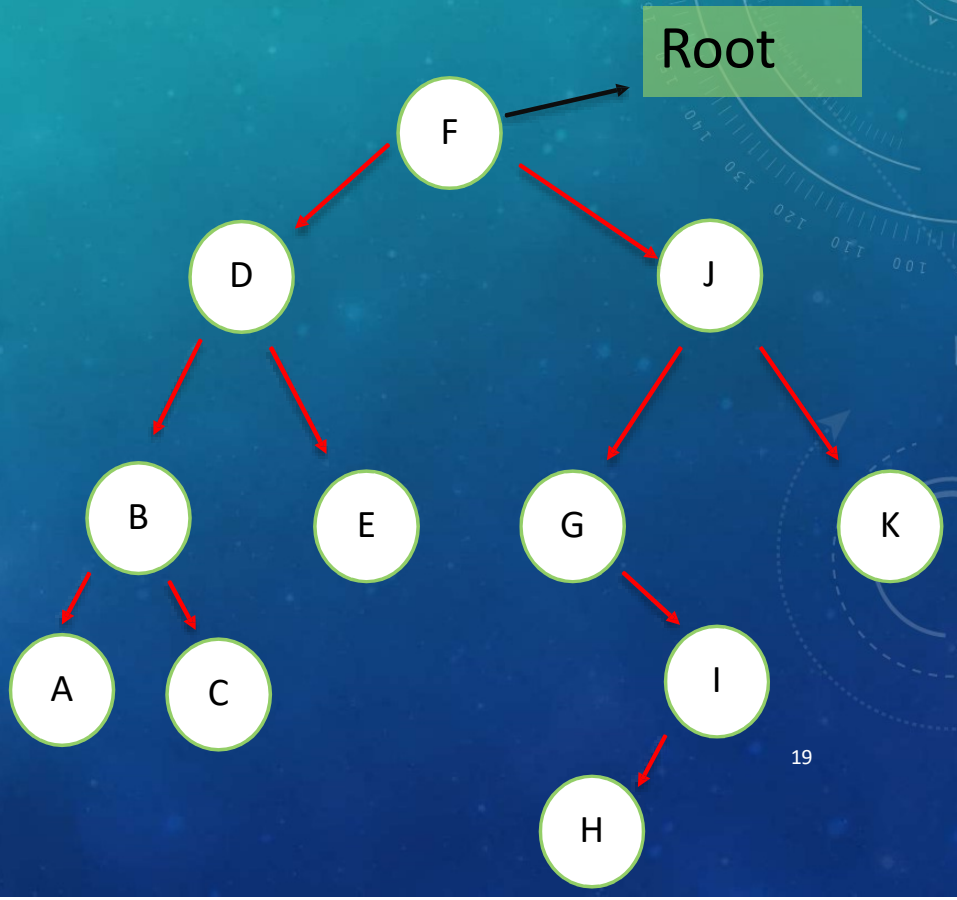
# INORDER(LSR)

Left S(Data)Right

<left><root><right>

A,B,C,D,E,F,G,H,I,J,K

```
Void Inorder(struct bstnode* root)
{
    if(root==NULL) return;
    Inorder(root->left);
    printf("%c",root->data);
    Inorder(root->right);
}
```

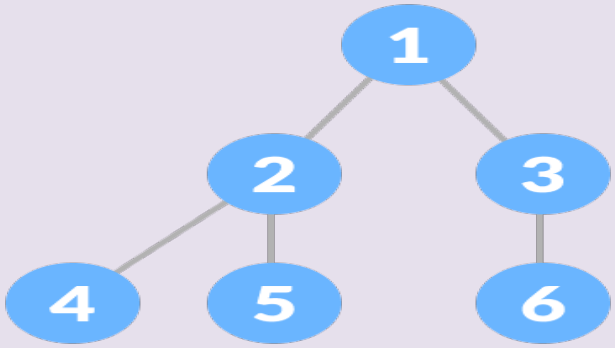


C Examples

```
// Tree traversal in C

#include <stdio.h>
#include <stdlib.h>

struct node {
 int item;
 struct node* left;
 struct node* right;
};
 // Create a new Node
  struct node*
createNode(value) {
   struct node* newNode =
malloc(sizeof(struct node));
   newNode->item = value;
   newNode->left = NULL;
   newNode->right = NULL;
   return newNode;
}
```

```
// Insert on the left of the node
struct node* insertLeft(struct node* root, int value)
 {
   root->left = createNode(value);
   return root->left;
}

// Insert on the right of the node
struct node* insertRight(struct node* root, int value)
{
root->right = createNode(value);
   return root->right;}
```

```
// Preorder traversal
void preorderTraversal(struct node* root) {
  if (root == NULL) return;
  printf("%d ->", root->item);
  preorderTraversal(root->left);
  preorderTraversal(root->right);}124536
 // Postorder traversal
void postorderTraversal(struct node* root) {
  if (root == NULL) return;
  postorderTraversal(root->left);
  postorderTraversal(root->right);
  printf("%d ->", root->item);}452631
// Inorder traversal
void inorderTraversal(struct node* root) {
  if (root == NULL) return;
 inorderTraversal(root->left);
  printf("%d ->", root->item);
  inorderTraversal(root->right); } 4 2 5 1 3 6
```




```
int main() {
struct node* root = createNode(1);
  insertLeft(root, 2);
  insertRight(root, 3);
  insertLeft(root->left, 4);
  printf("Inorder traversal \n");
  inorderTraversal(root);
  printf("\nPreorder traversal");
  preorderTraversal(root);
  printf("\nPostorder traversal\n");
  postorderTraversal(root);}
```

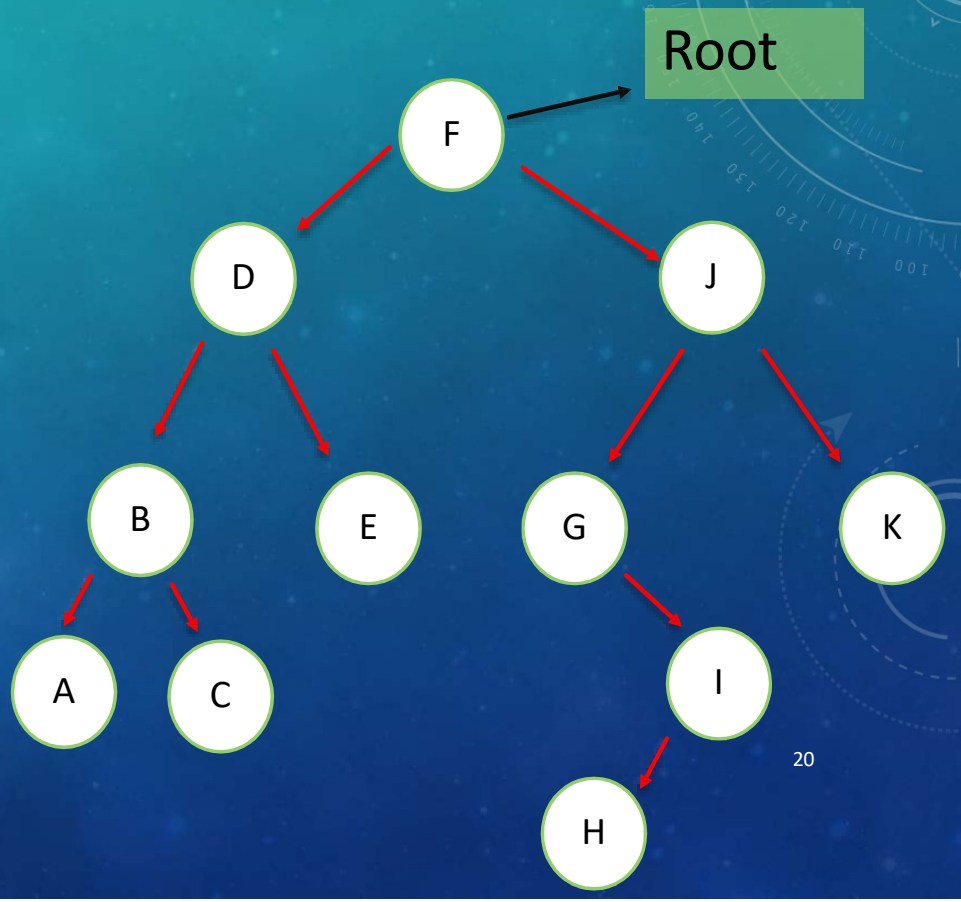
# POSTORDER(LRS)

Left Right (Data)Start

<left><right><root>

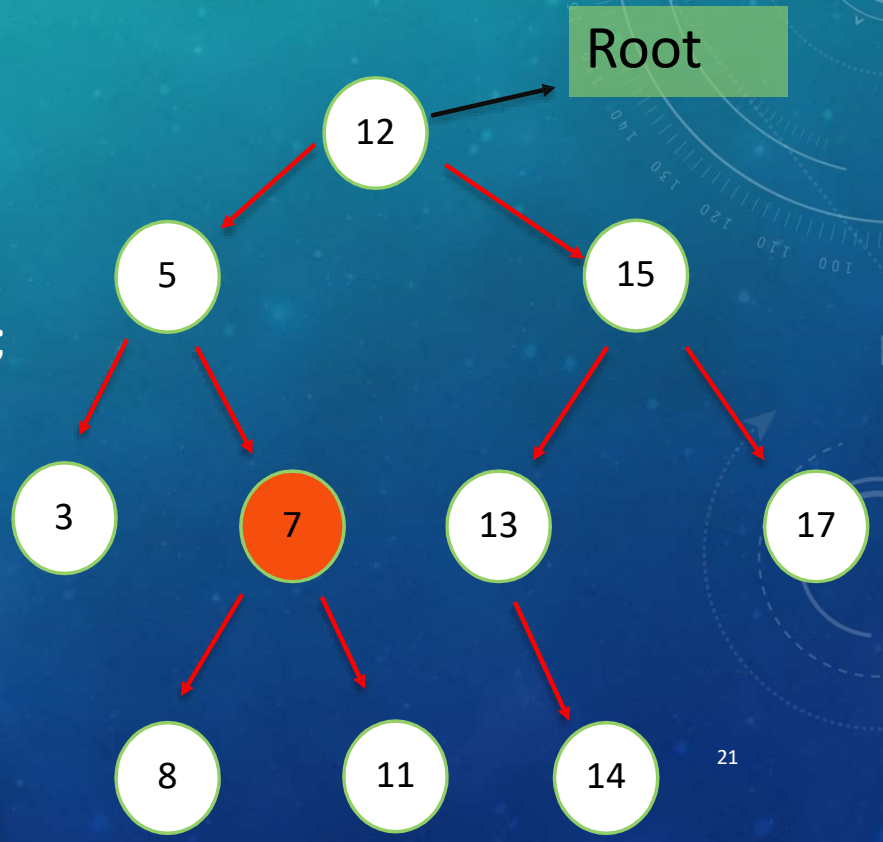
A,C,B,E,D,H,I,G,K,J,F

```
Void Postorder(struct bstnode* root)
{
    if(root==NULL)
    Postorder(root->right);
    Postordrt(root->right);
    printf("%c",root->data);
}
```



# SEARCH AN ELEMENT IN BST

```
bool Search( bstnode* root, data type)
{
    if (root==NULL) return false;
    else if(root->data == data) return true;
    else if(root->data <= data)
    return Search(root->left, data);
    else
        return Search(root->right, data);
}
```



# RUNNING TIME OF OPERATION

| Operation | Array | Link List | Binary Search Tree(average case) |
|---|---|---|---|
| Search(x)-Search for an element x. | O(Log n) | O(n) | O(Log n) |
| Insertion(x)-Insert an element x. | O(n) | O(1) | O(Log n) |
| Remove(x)-Remove an element x. | O(n) | O(n) | O(Log n) |