SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING-IOT Including CS&BCT

COURSE NAME : **19CS307** - DATA STRUCTURES

II YEAR / III SEMESTER

Unit III- **NON LINEAR DATA STRUCTURES - Tree**

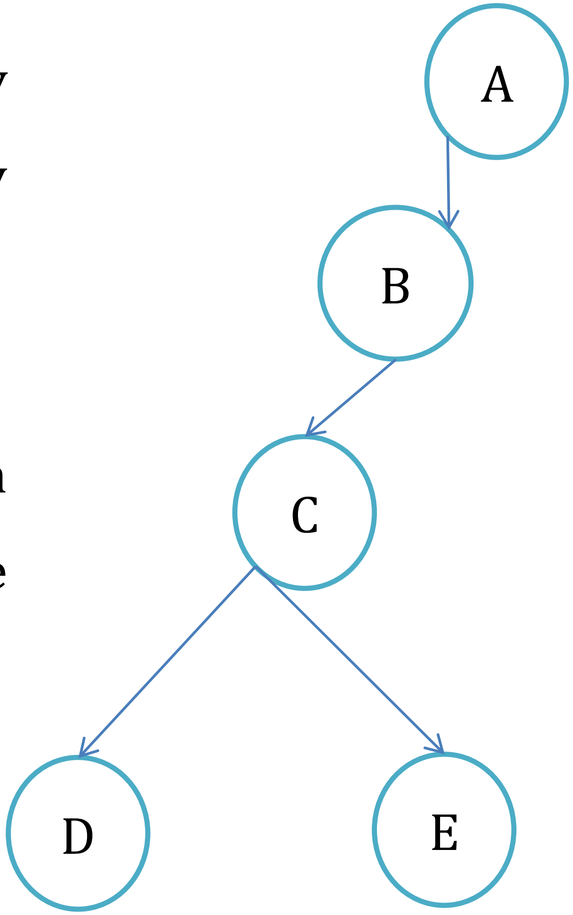
Topic 1&3 : Tree ADT&Binary Tree

Problem

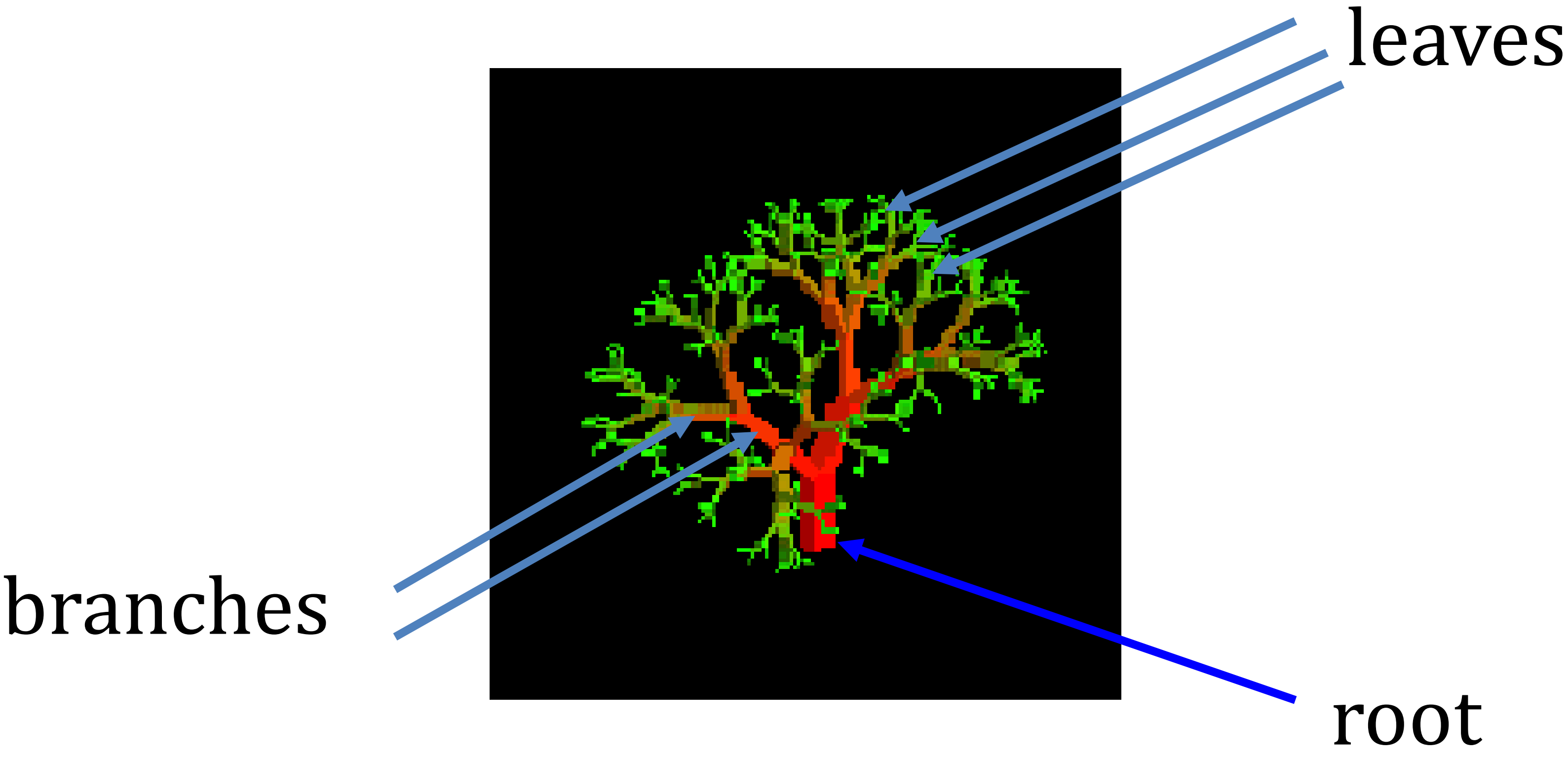
- 1. For the given data draw a binary tree and show the array representation of the same

✓ 100,80,45,55,110,20,70,65

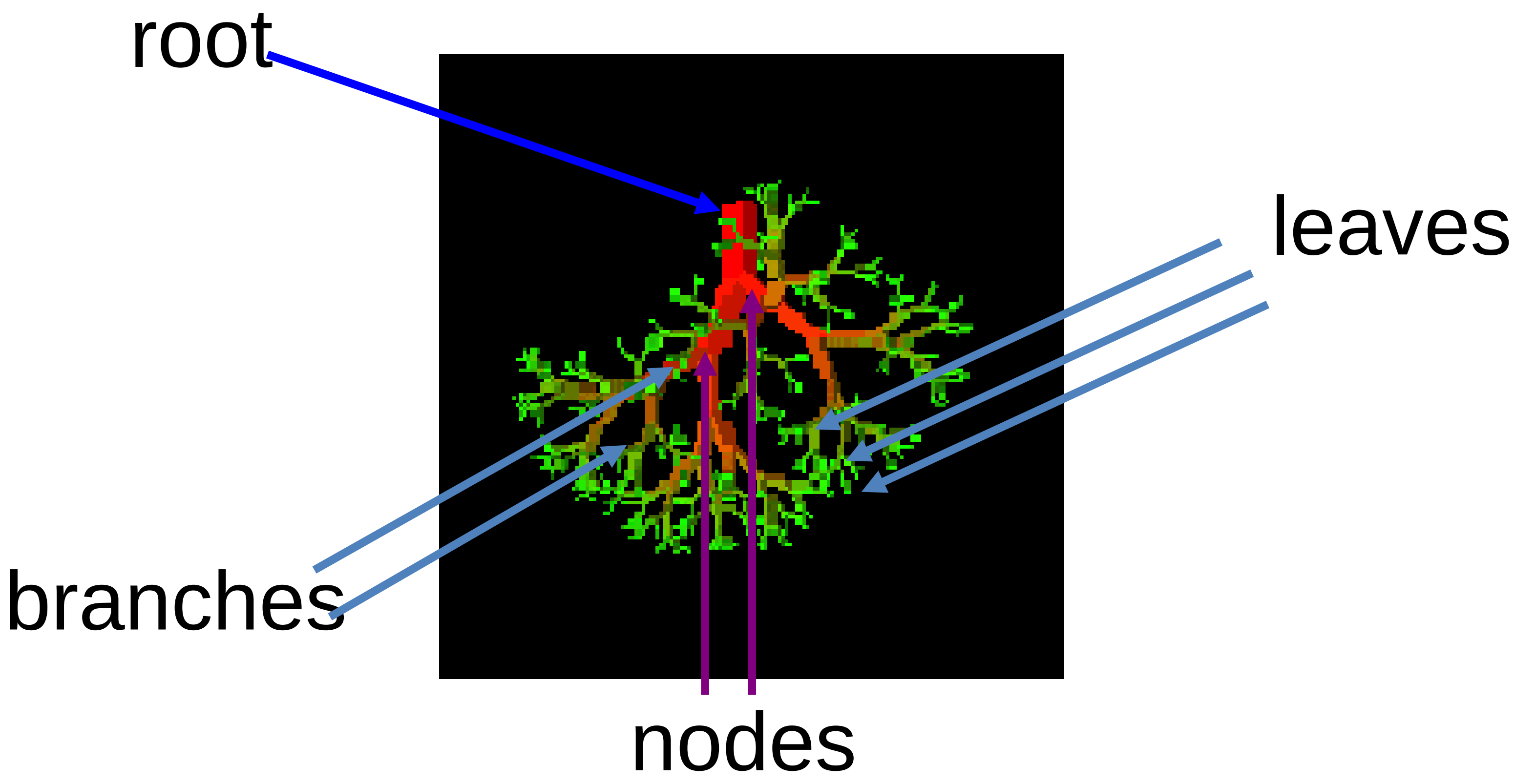
✓ Show the array representation and linked representation for the following binary tree



Nature View of a Tree



Computer Scientist's View



Tree ADT

- A tree is a finite set of one or more nodes

such that:

- There is a specially designated node called the root.
- The remaining nodes are partitioned into n>=0 disjoint sets T1, ..., Tn,

where each of these sets is a tree.

- We call T1, ..., Tn the subtrees of the root.

Binary Tree

- A binary tree is defined as a tree in which no node can have more than two children. The highest degree of any node is two.
- This indicates that the degree of a binary tree is either zero or one or two.

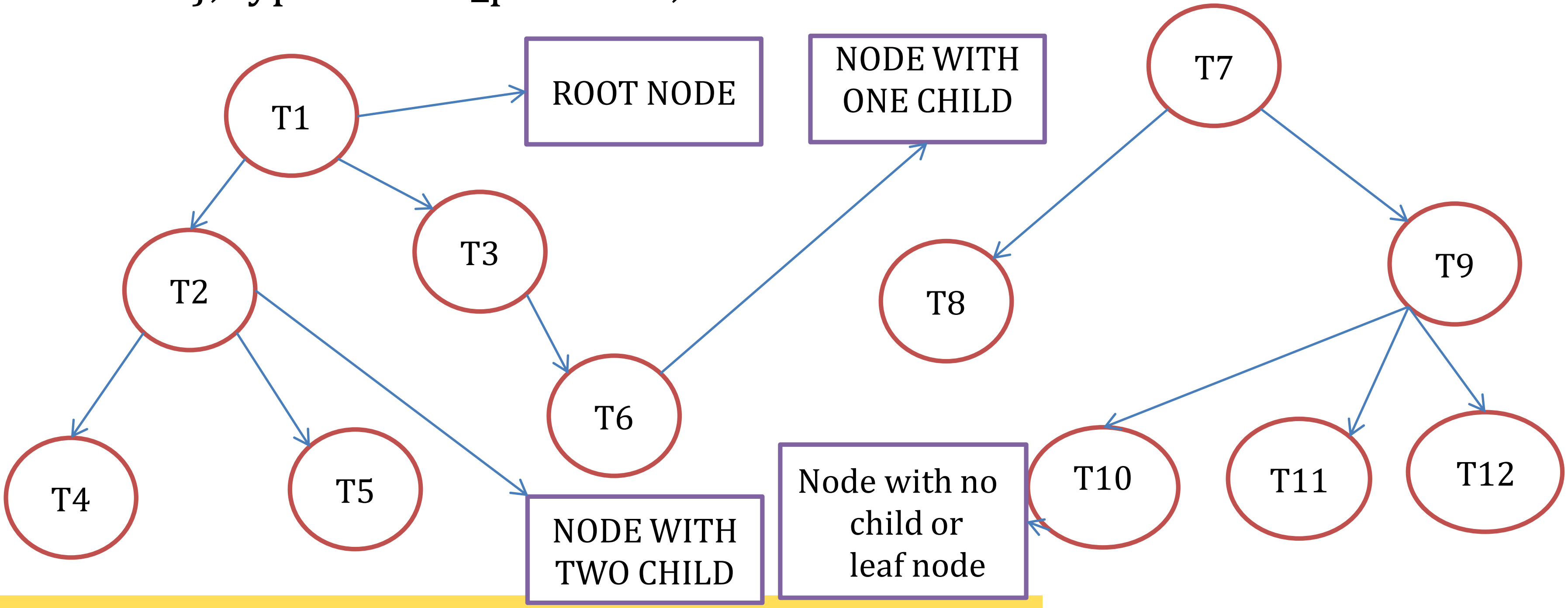
Binary Tree–Cont..

Binary Tree node declaration

typedef struct tree_node *tree_ptr; struct tree_node

{ element_type element1; tree_ptr left1; tree_ptr right1;

}; typedef tree_ptr TREE;



- Types of binary tree
- Full binary tree
- A full binary tree which is also called as proper binary tree or 2-tree is a tree in which all the node other than the leaves has exact two children
- Complete binary tree
- A complete binary tree is a binary tree in which at every level, except possibly the last, has to be filled and all nodes are as far left as possible.

Tree–Cont..

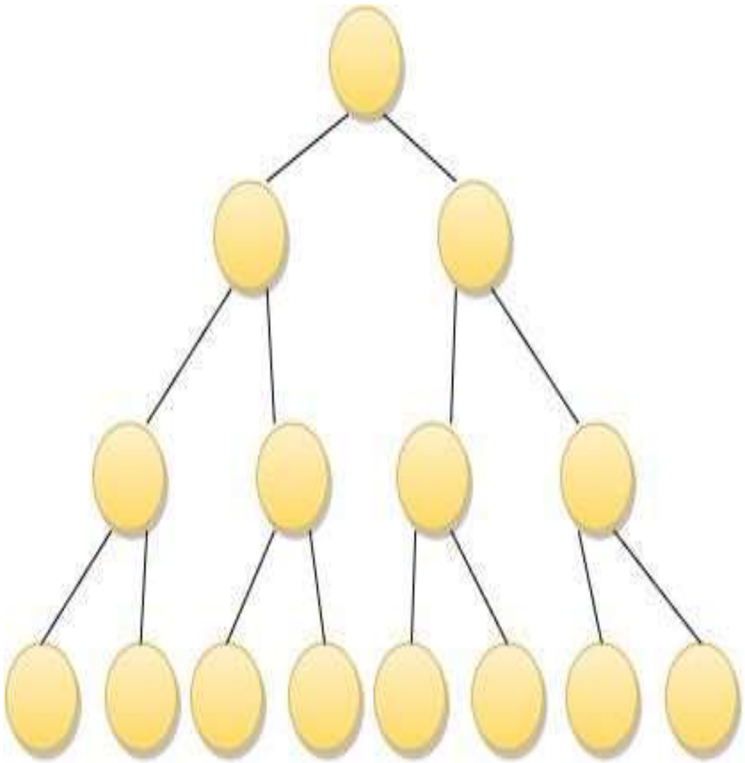


Fig: Full Binary Tree

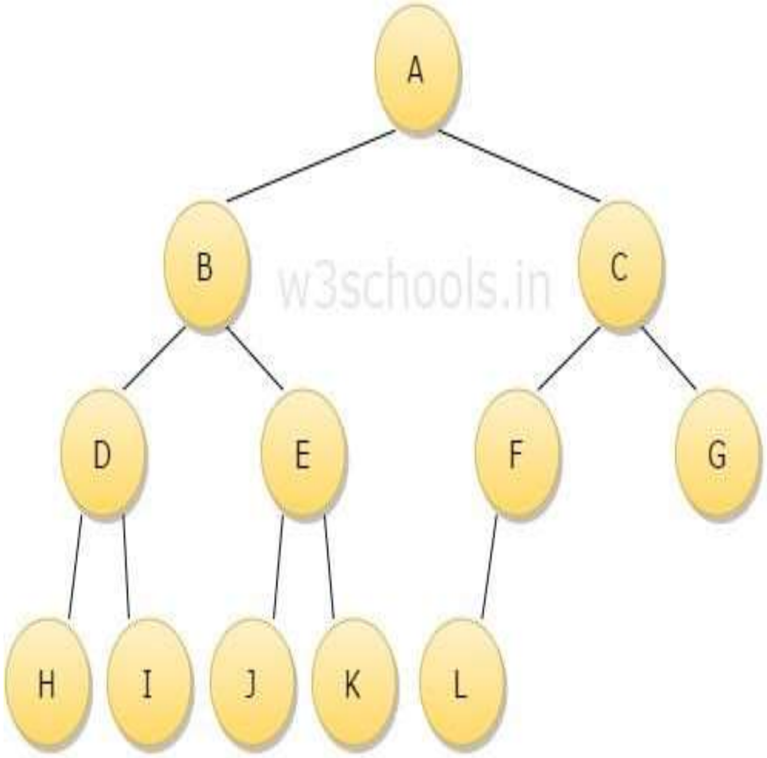


Fig: Complete Binary Tree

Binary Tree –Cont..

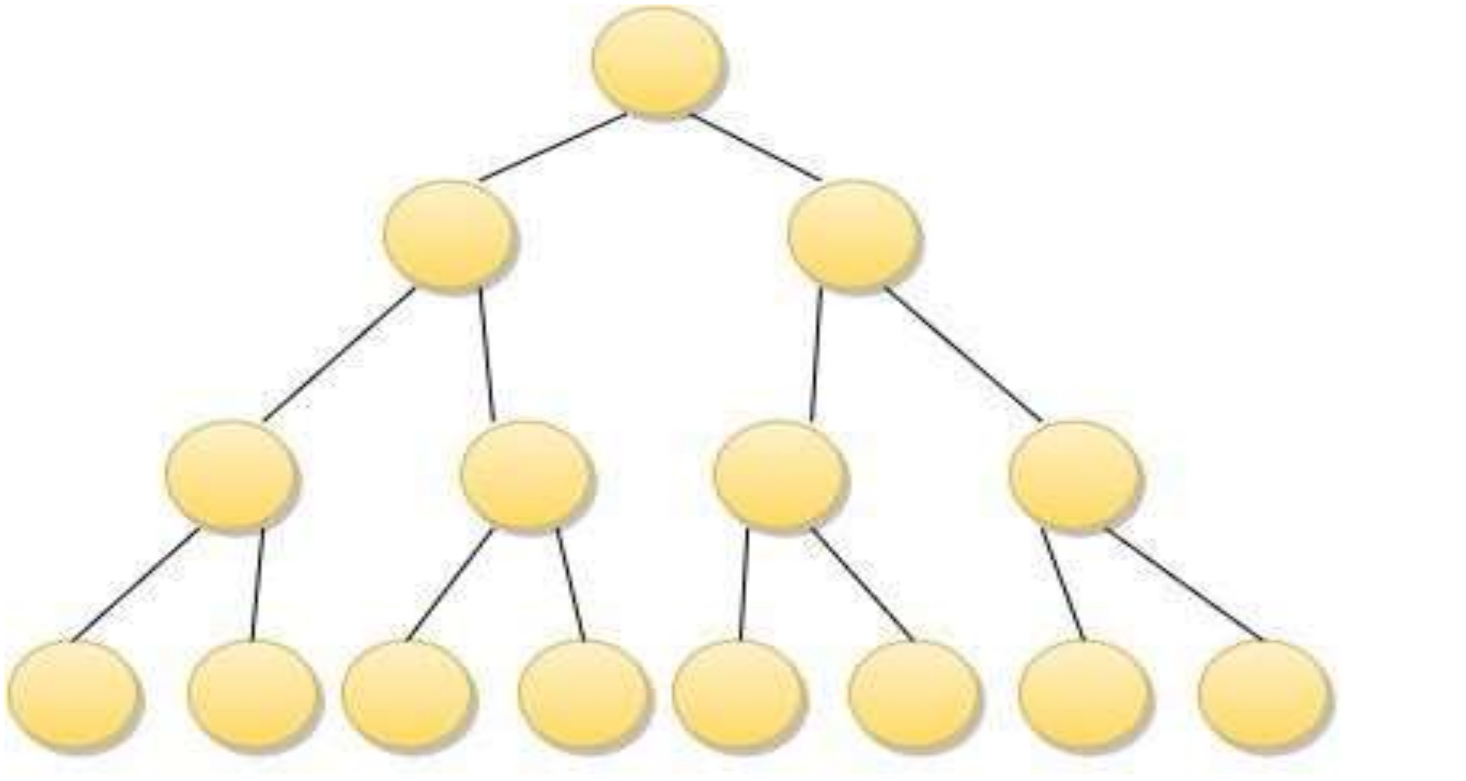


Fig: Full Binary Tree

Binary Tree –Cont..

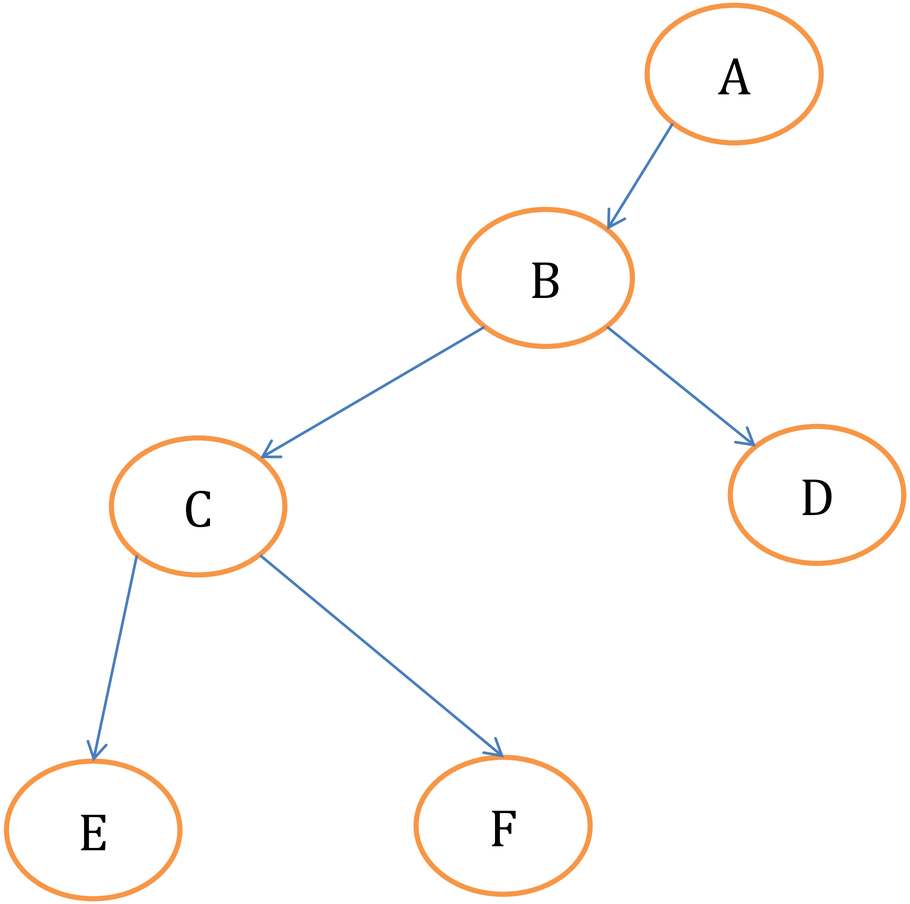
Representation of tree

- There are two ways of representing the binary tree
- Sequential representation
- Linked representation
- Sequential representation
- Each node sequential arranged from top to bottom and from left to right .

Binary Tree –Cont..

- The array size can be >=n, the root will be at index 0
- Its left child will be at index 1
- Its right child will be at index 2
- Other we can applying the formula as shown below
- When n=0 the root node will placed at 0th location
- Parent(n) =floor(n-1)/2
- Left(n)=(2n+1)
- Right (n)=(2n+2)

Array implementation of tree



	Array
1	
2	
3	
4	
5	
6	

Binary Tree-Cont..

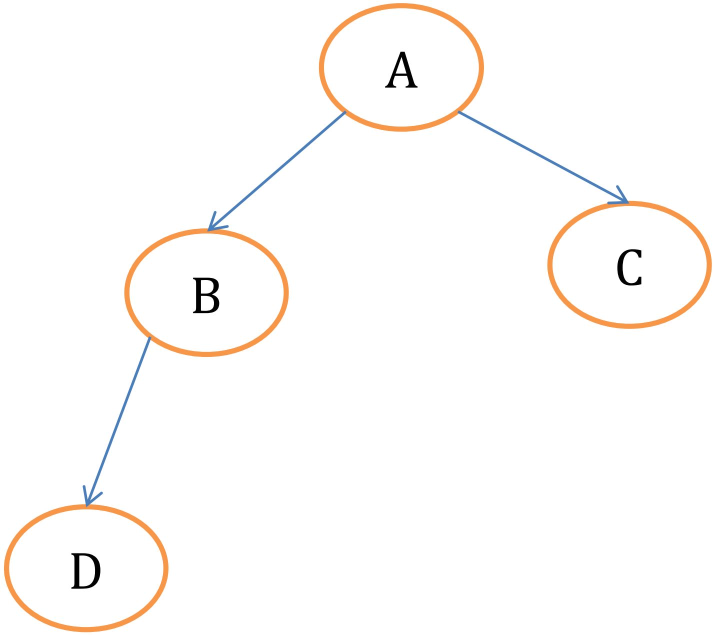
EXAMPLE

- Below is an example of a tree node with an integer data
- struct node
- {
- int data;
- struct node *left;
- struct node *right;
- };

Binary Tree-Cont..

- **First Simple Tree in C**

Let us create a simple tree with 4 nodes in C. The created tree would be as following.

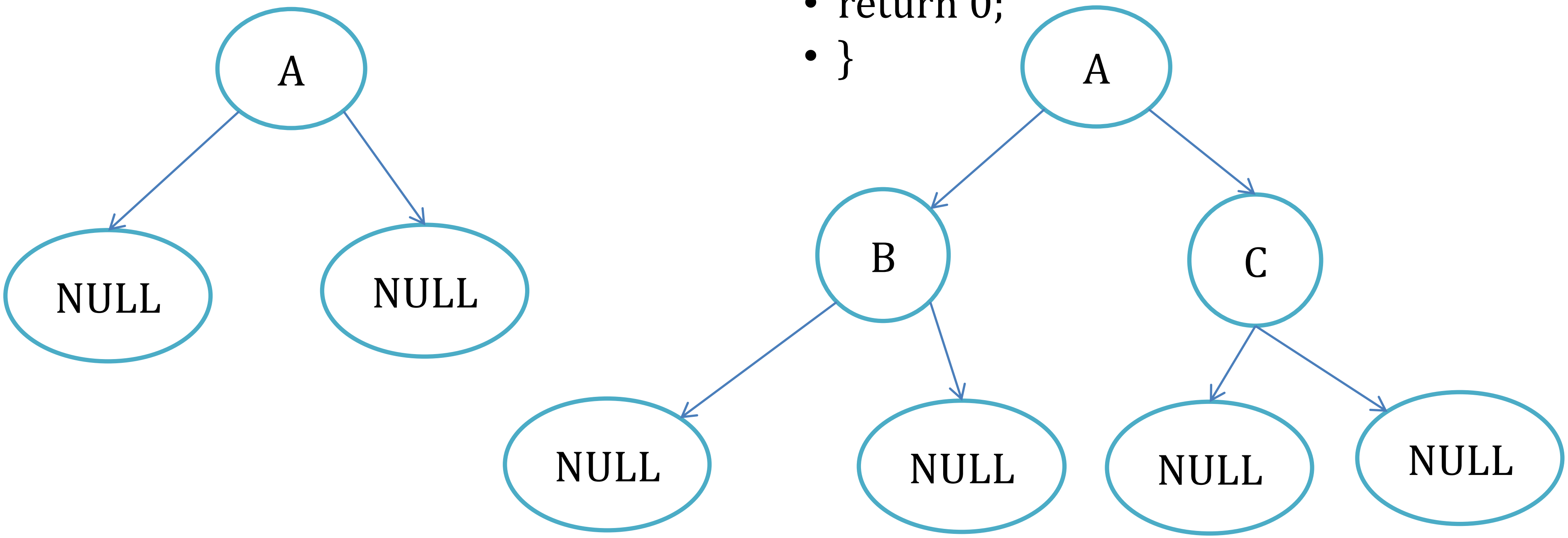


- /* newNode() allocates a new node with the given data and NULL left and right pointers. */
- struct node* newNode(int data)
- {
- // Allocate memory for new node
- struct node* node = (struct node*)malloc(sizeof(struct node));
- // Assign data to this node
- node->data = data;
- // Initialize left and right children as NULL
- node->left = NULL;
- node->right = NULL;
- return(node);
- }

Binary Tree-Cont..

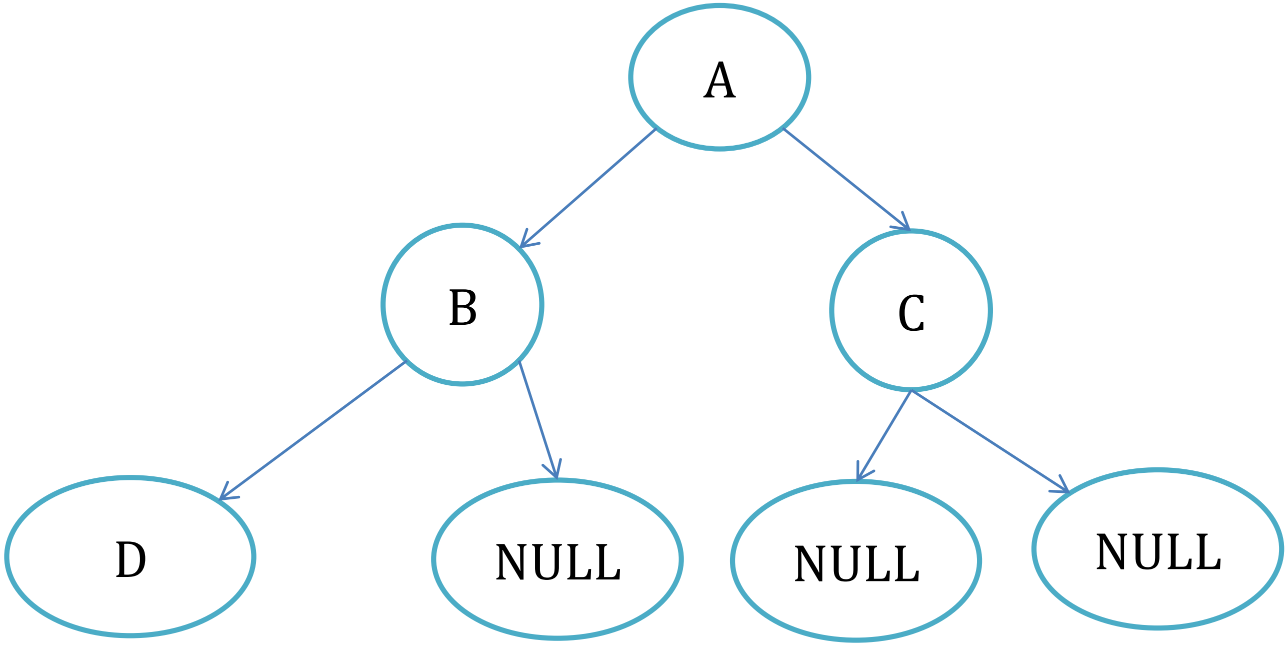
- int main()
- {
- /*create root*/
- struct node *root = newNode(1);
- /* following is the tree after above statement

- root->left = newNode(2);
- root->right = newNode(3);
- /* 2 and 3 become left and right children of 1
- getchar();
- return 0;
- }



Binary Tree-Cont..

- root->left->left = newNode(4);
- /* 4 becomes left child of 2



Binary Tree-Cont..

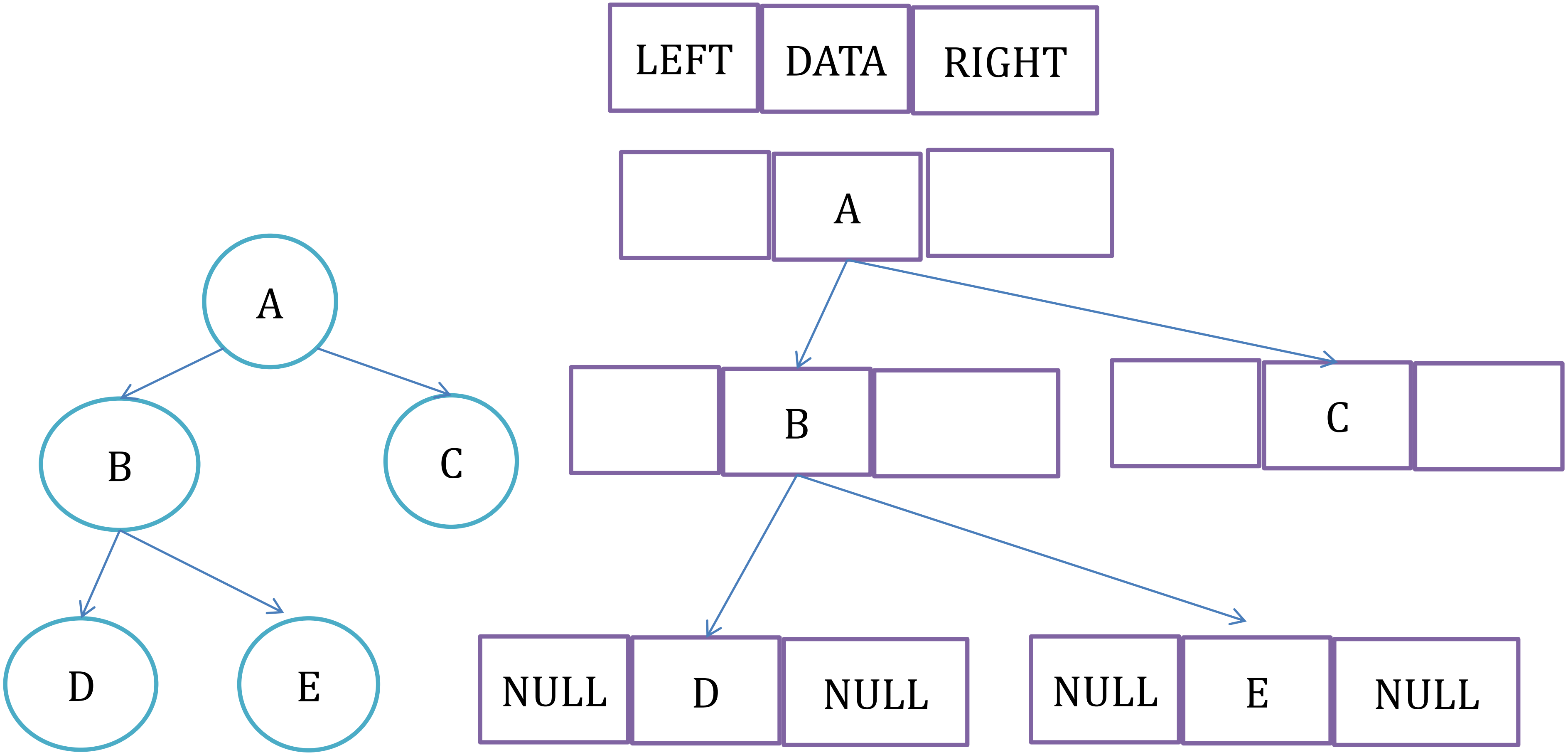
Linked list implementation of tree

LEFT	DATA	RIGHT

- Left link which points to some address of left subtree
- Right link which points to some address of left subtree

```
Typedef struct node
{
Int data;
Struct node *left;
Struct node *right;
}
```

Binary Tree-Cont..



LEFT DATA RIGHT

A

B C

D E

NULL D NULL

NULL E NULL

Activity

MCQ

1. What is a complete binary tree?

a)Each node has exactly zero or two children

b)A binary tree, which is completely filled, with the possible exception of the bottom level, which is filled from right to left

c)A binary tree, which is completely filled, with the

possible exception of the bottom level, which is filled from left to right

d)None of the mentioned

2.The height of a BST is given as h. Consider the height of the tree as the no. of edges in the longest path from root to the leaf. The maximum no. of nodes possible in the tree is?

a) $2^{h-1}-1$
b) $2^{h+1}-1$
c) $2^{h}+1$
d) $2^{h-1}+1$

Advantages

- Direct access to any node can be possible
- Finding the parent, left and right children of any particular node is fast because of the random access

Disadvantages

- Wastage of memory
- The insertion and deletion of any in the tree will be costlier

Assessment 1

1. List out the advantages of Binary Tree

a)________________________________

b)________________________________

c)________________________________

d)________________________________

2. Identify the disadvantages of Binary Tree

a)________________________________

b)________________________________

c)________________________________

d)________________________________

REFERENCES

1. M. A. Weiss, “Data Structures and Algorithm Analysis in C”, Pearson Education, 8th Edition, 2007. [Unit I, II, III, IV,V]

2. A. V. Aho, J. E. Hopcroft and J. D. Ullman, “Data Structures and Algorithms”, Pearson Education, 2nd Edition, 2007 [Unit IV].

3. A.M.Tenenbaum, Y. Langsam and M. J. Augenstein, “Data Structures using C”,PearsonEducation, 1st Edition, 2003.(UNIT I,II,V)

4.https://www.geeksforgeeks.org/queue-set-1introduction-and-array-implementation/

THANK YOU