

## THREADED BINARY TREES

(3)

In the linked representation of a binary tree  $T$ , approximately half of the pointer fields (left and right fields that hold the address of the left child and right child respectively) contain NULL entries in these fields.

The space occupied by these NULL entries can be utilized to store some kind of valuable information.

One possible way to utilize this space is that we can store special pointer that points to nodes higher in the tree i.e. ancestors.

These special pointers are called threads, and the binary tree having such pointers is a threaded binary tree.

Threads in a binary tree must be distinguished from normal pointers. In the graphical representation of a threaded binary tree, the threads are shown by dotted lines.

In computer memory, an extra field called tag or flag is used to distinguish a thread from a normal pointer.

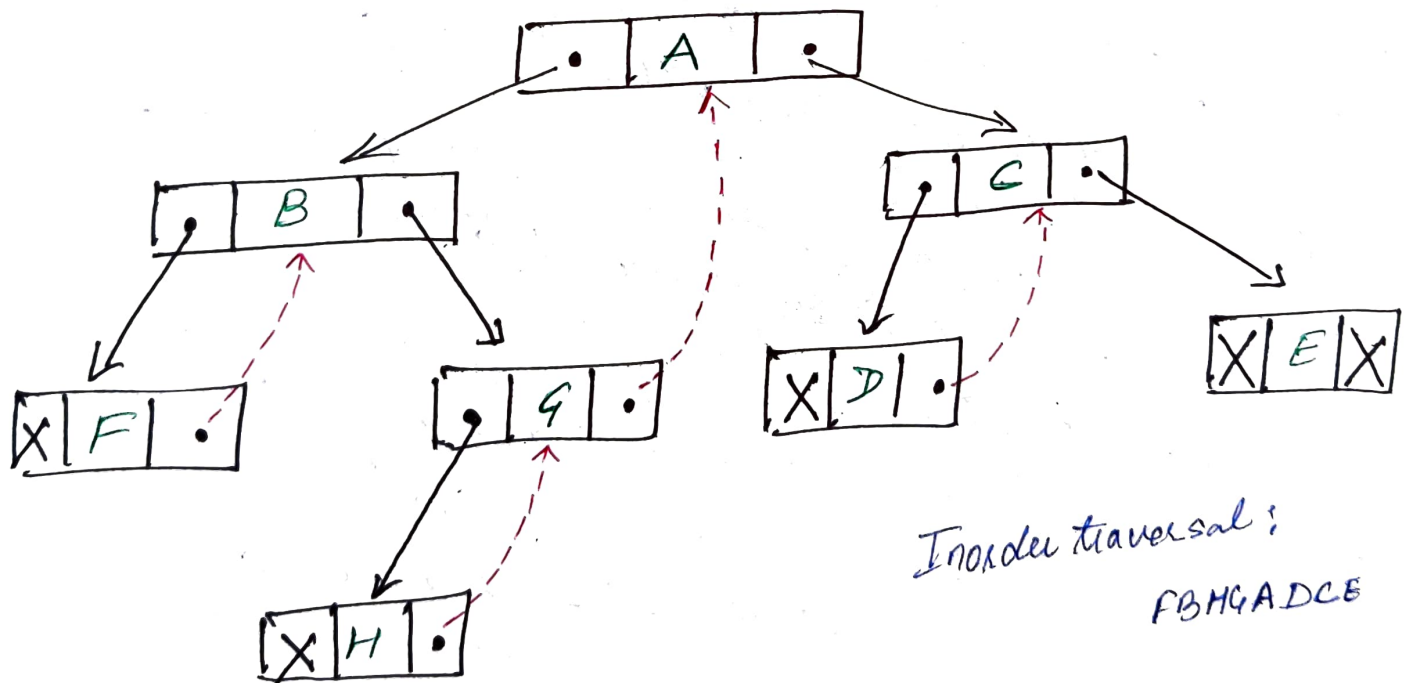
There are many ways to thread a binary tree. There are:

- (1) The right NULL pointer of each node can be replaced by a thread to the successor of that node under inorder traversal called a right thread, and the tree will be called a right threaded tree.

(2) The left NULL pointer of each node can be replaced by a thread to the predecessor of node under in order traversal called a left thread, and the tree will be called a left threaded tree.

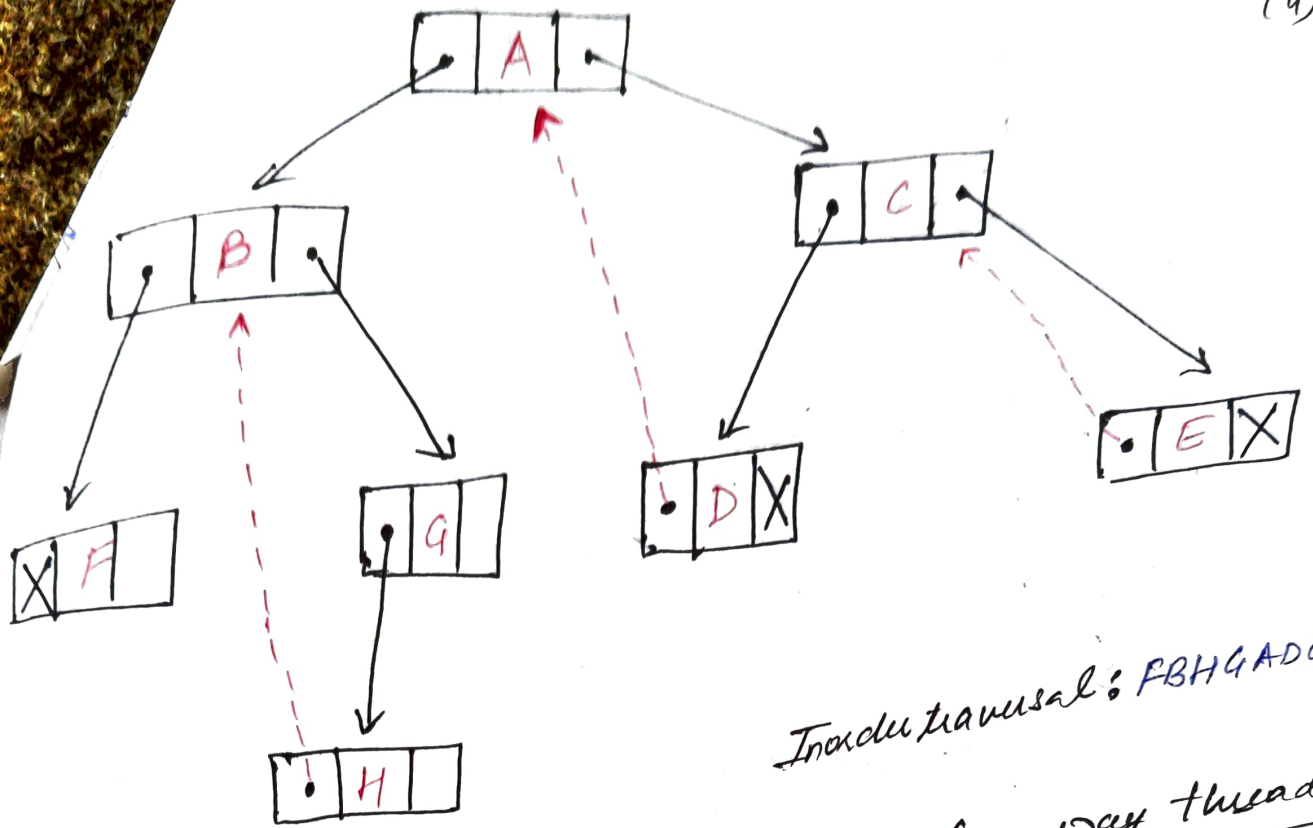
(3) Both left and right NULL pointers can be used to point to predecessor and successor of that node, respectively, under in order traversal. Such a tree is called a fully threaded tree.

A Threaded binary tree where only one thread is used is also known as one way threaded tree and where both the threads are used is also known as two way threaded tree.



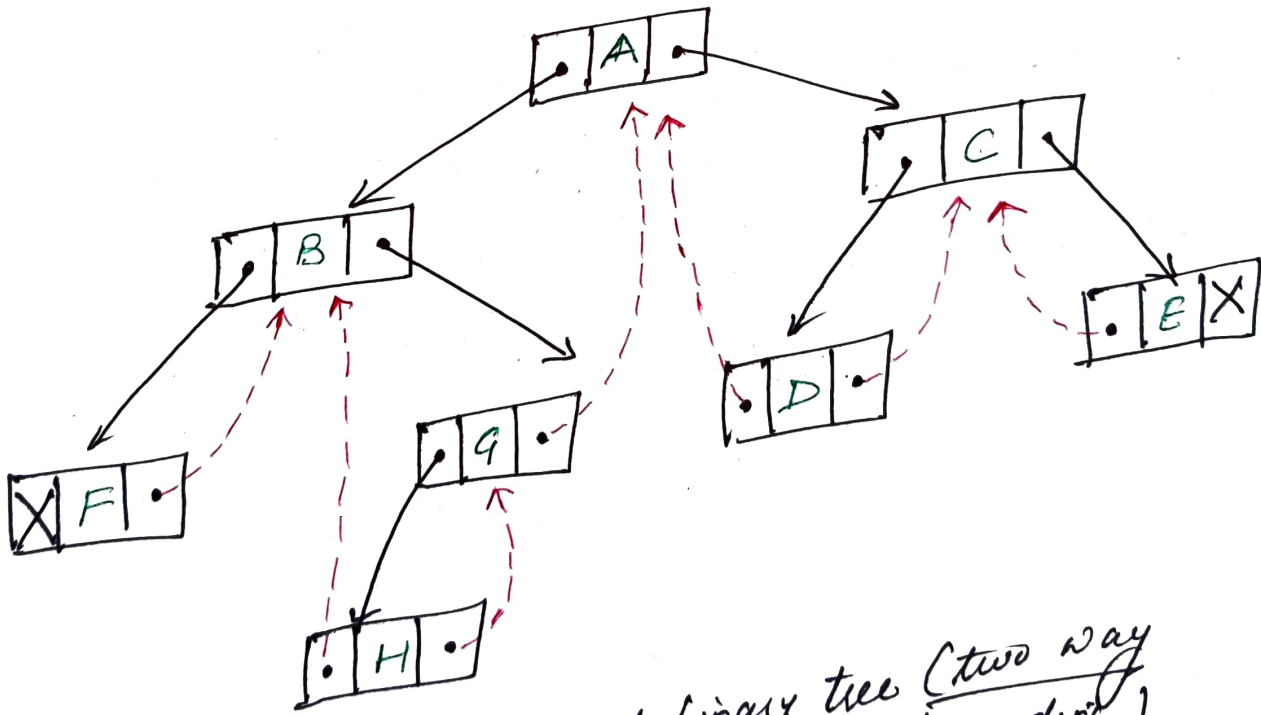
Inorder traversal:  
FBHGADCE

Right-threaded binary tree (one way threading)



Inorder traversal: FBHGDCE

Left threaded binary tree (one way threaded)



A fully threaded binary tree (two way threading)

## Representing a Threaded Binary tree in Memory

```
typedef struct nodeType  
{  
    struct nodeType *left;  
    int info;  
    char thread;  
    struct nodeType *right;  
}  
TBST;  
TBST *root;
```

In this representation, we have used char field thread as a tag. The character '0' will be used for normal right pointer and character '1' will be used for thread.