Systematic way of visiting nodes in a tree

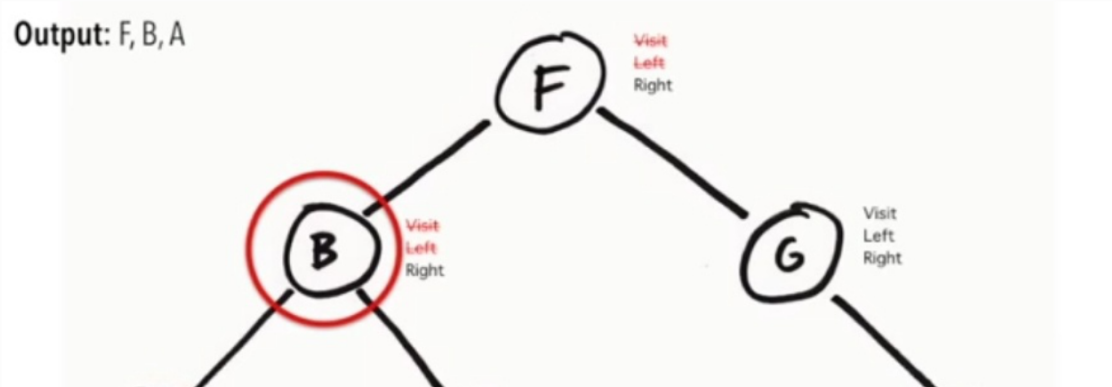
1. Depth-first -> Stack
2. Breadth-first - Queue

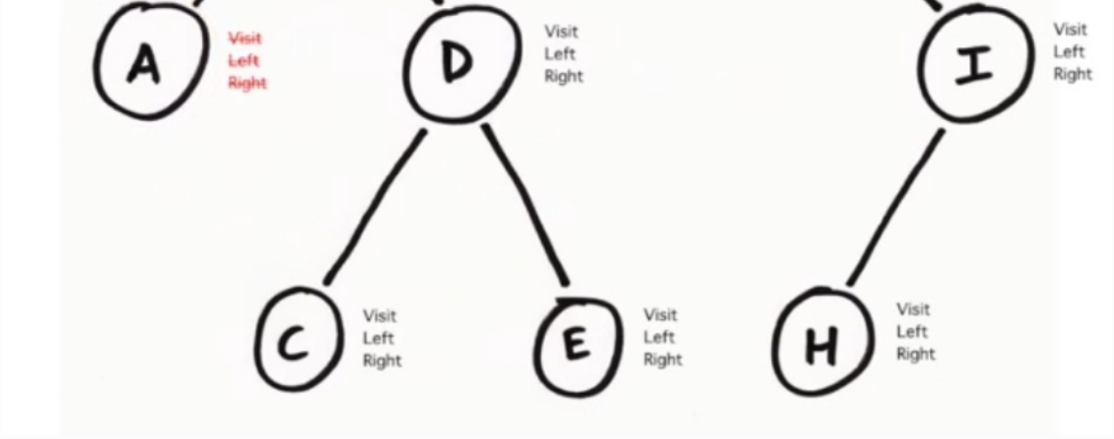
- Pre-order
- In-order
- Post-order

- Level-order

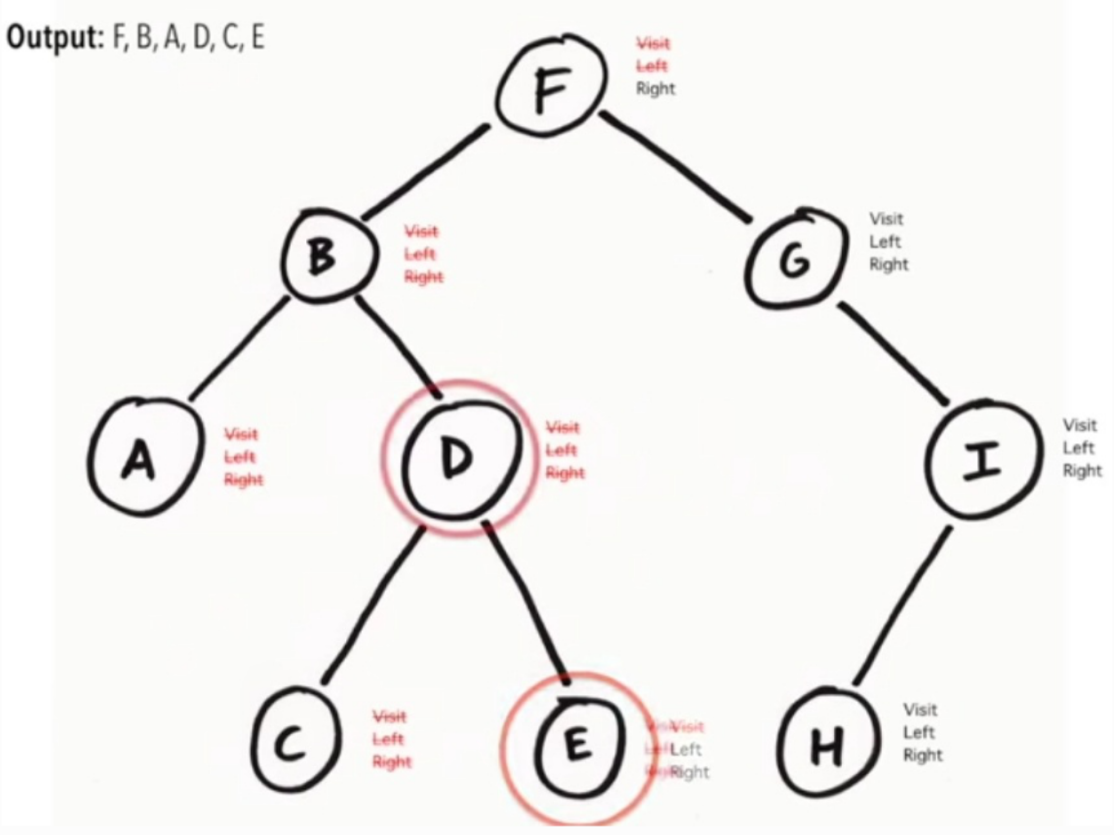
PRE-ORDER

1. Visit node
2. Traverse left
3. Traverse right

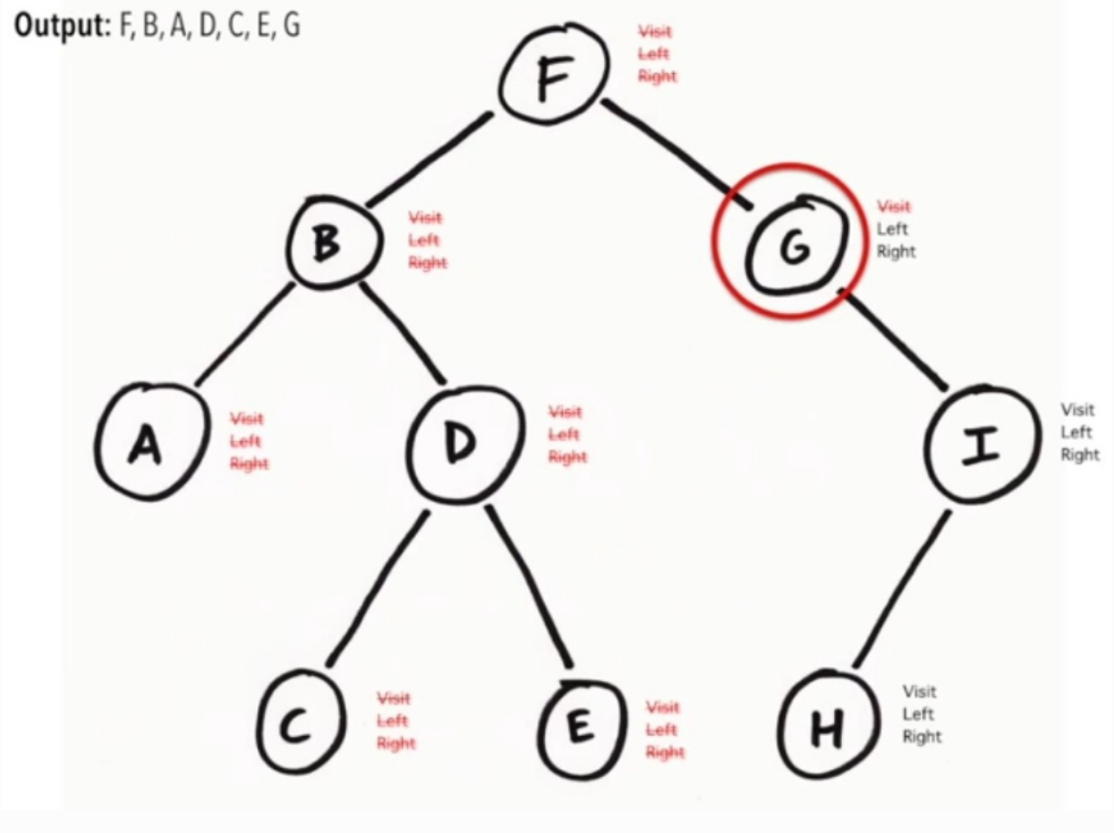




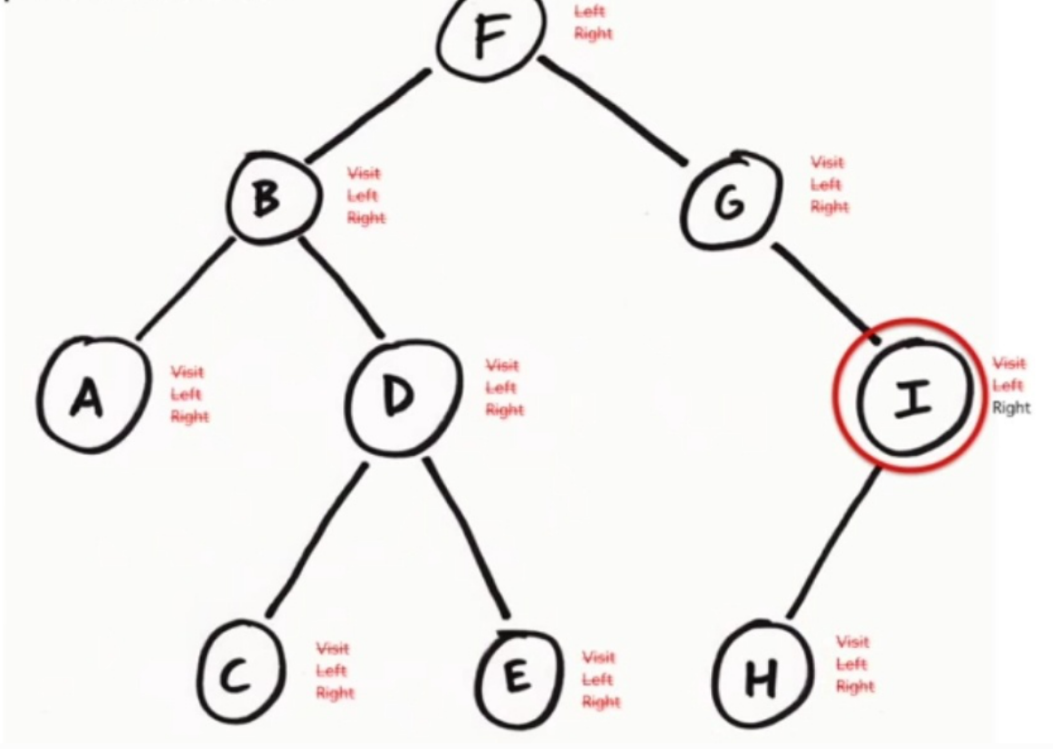
Output: F, B, A, D, C, E



Output: F, B, A, D, C, E, G



Output: F, B, A, D, C, E, G, I, H



Pseudocode

```
preorder(node)
  if node == null then return
  visit(node)
  preorder(node.left)
  preorder(node.right)
```

Time complexity

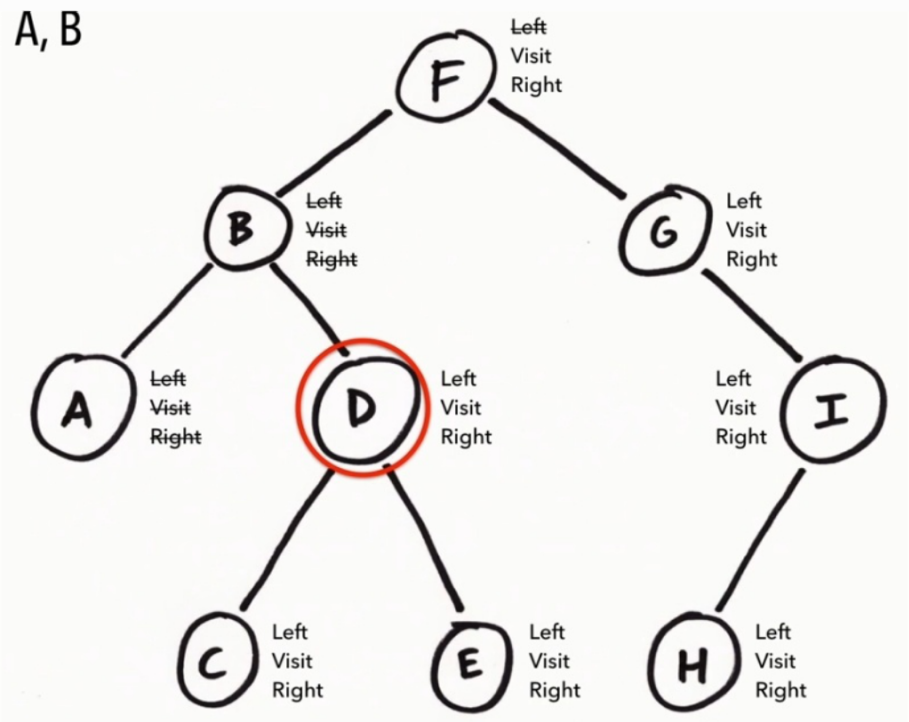
O(n)

where **n** is the number of nodes in the tree

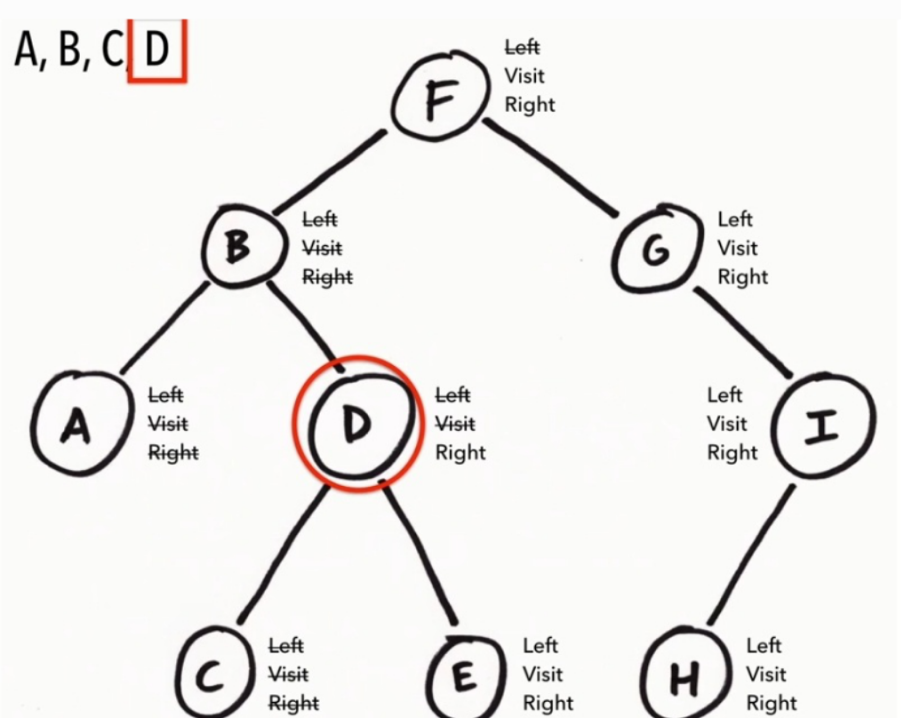
IN-ORDER

1. Traverse left
2. Visit node
3. Traverse right

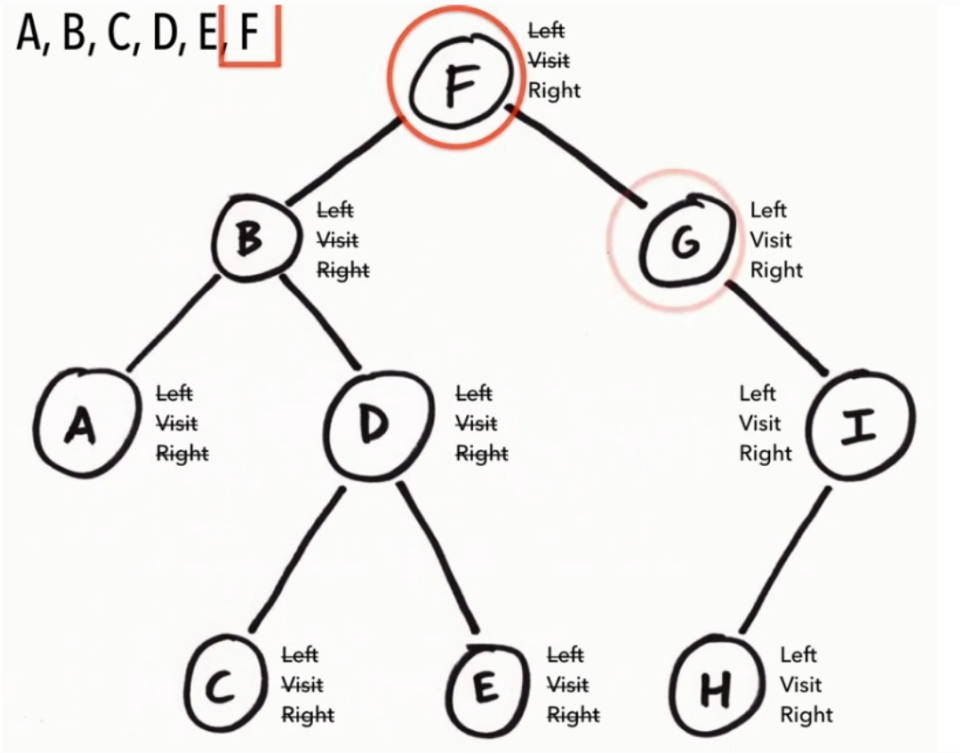
Output: A, B



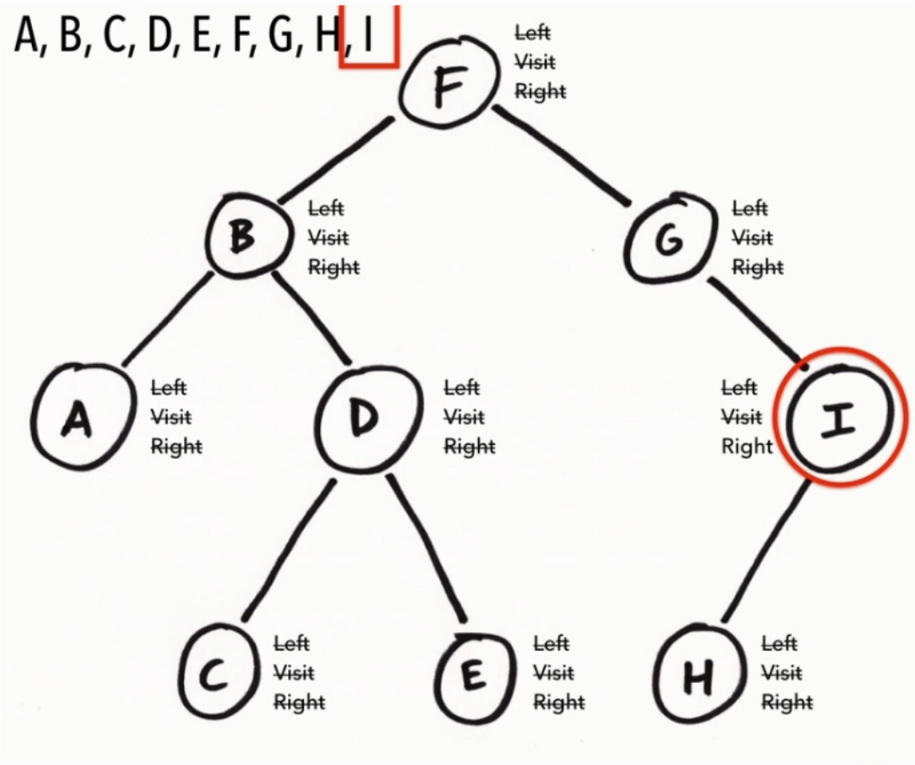
Output: A, B, C D



Output: A, B, C, D, E, F



Output: A, B, C, D, E, F, G, H, I



Pseudocode

```
inorder(node)
  if node == null then return
  inorder(node.left)
  visit(node)
  inorder(node.right)
```

Time complexity

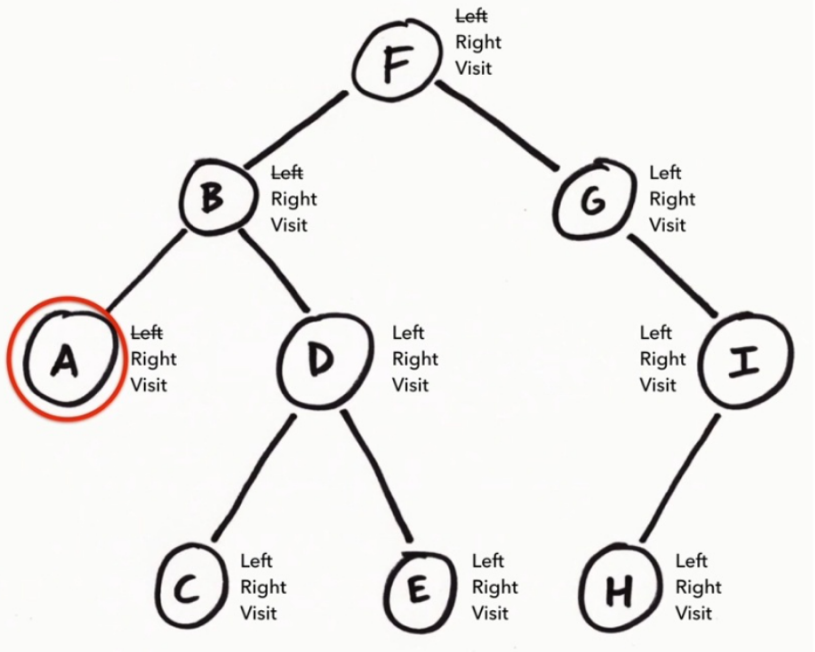
O(n)

where **n** is the number of nodes

POST-ORDER

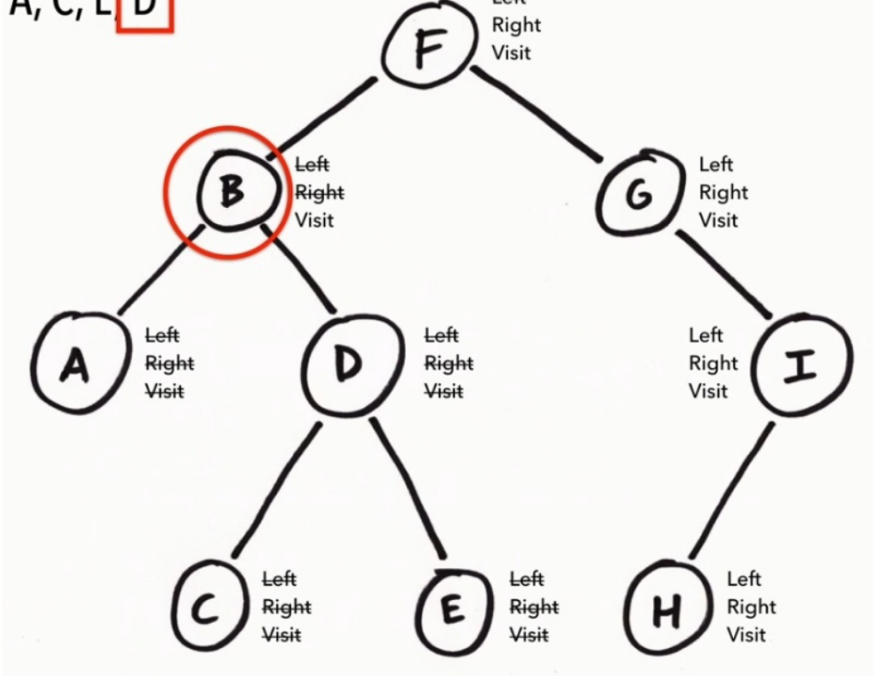
1. Traverse left
2. Traverse right
3. Visit node

Output:

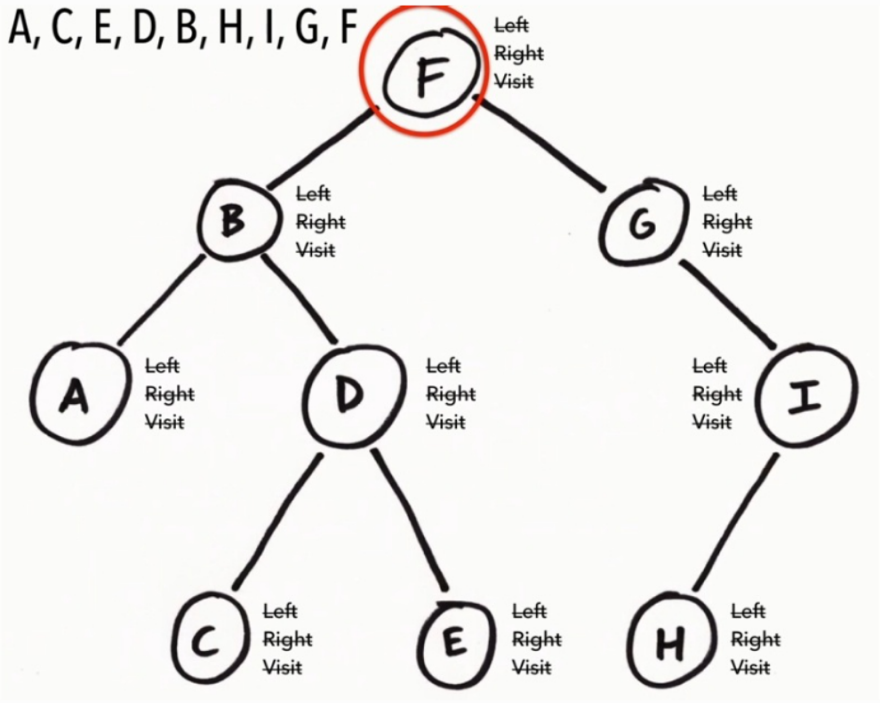


Output: A, C, E, D,

Output: A, C, E, D



Output: A, C, E, D, B, H, I, G, F



Pseudocode

```
postorder(node)
   if node == null then return
   postorder(node.left)
   postorder(node.right)
   visit(node)
```

Time complexity

$O(n)$

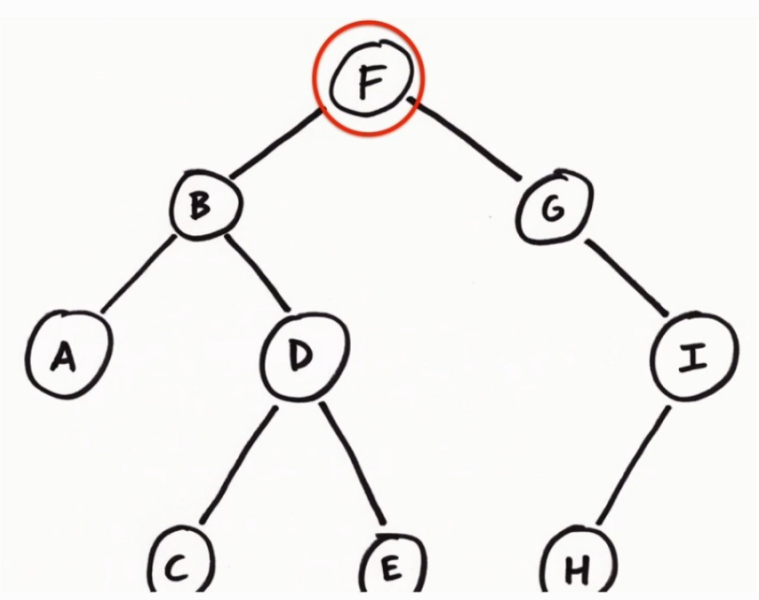
O(n)

where **n** is the number of nodes

LEVEL ORDER

```
levelorder(root)
  q ← empty queue
  q.enqueue(root)
  while (not q.isEmpty())
    node ← q.dequeue()
    visit(node)
    if (node.left ≠ null)
      q.enqueue(node.left)
    if (node.right ≠ null)
      q.enqueue(node.right)
```

Output: F

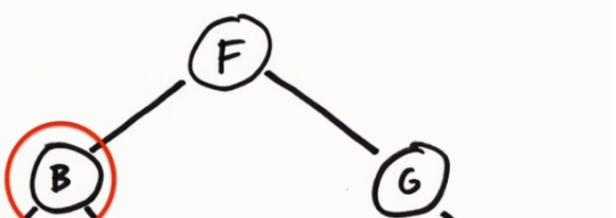


Queue

B B G

[First ----- Last

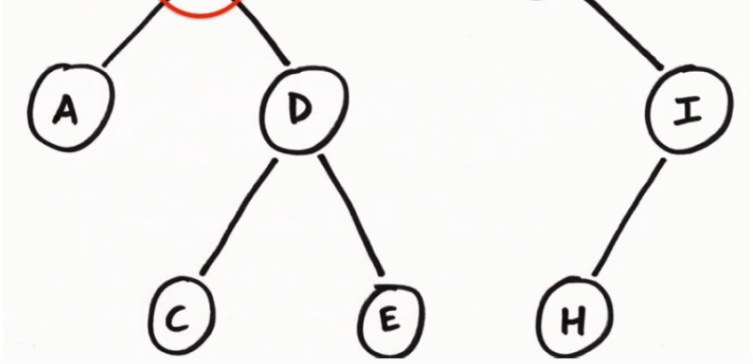
Output: F



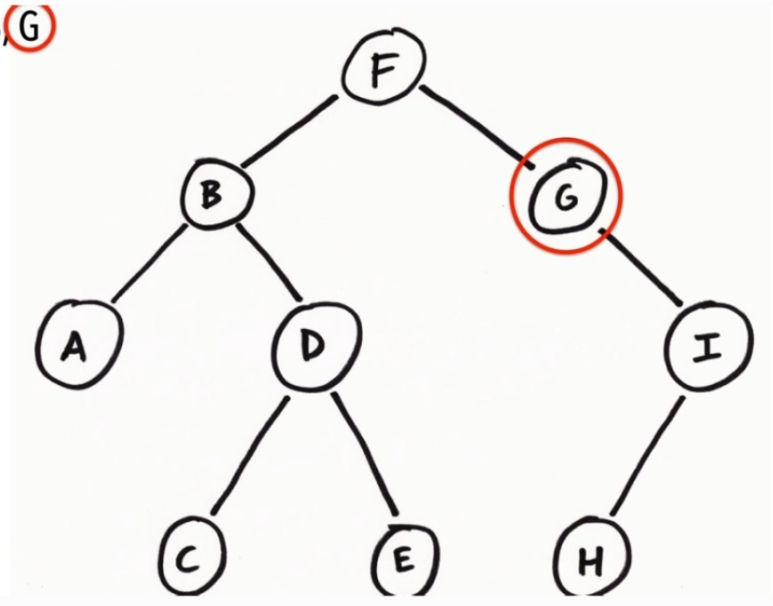
Queue

B G

[First ----- Last]

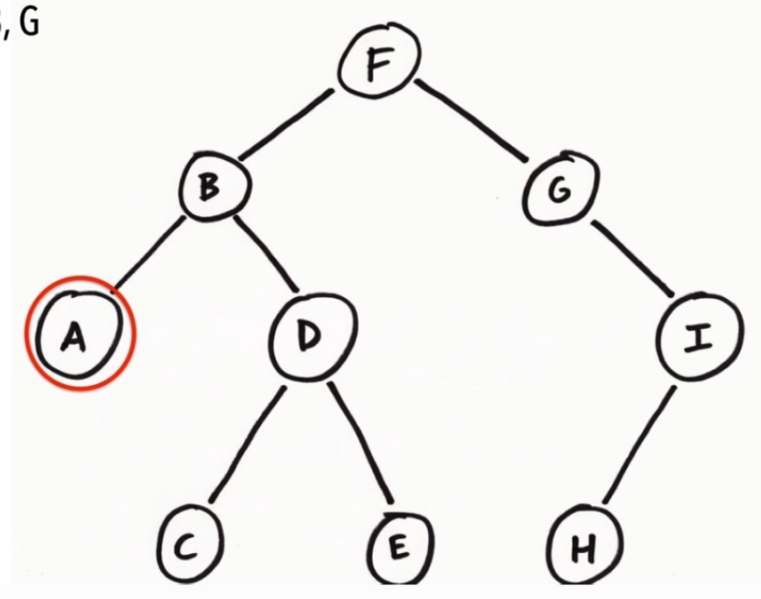


Output: F, B, G



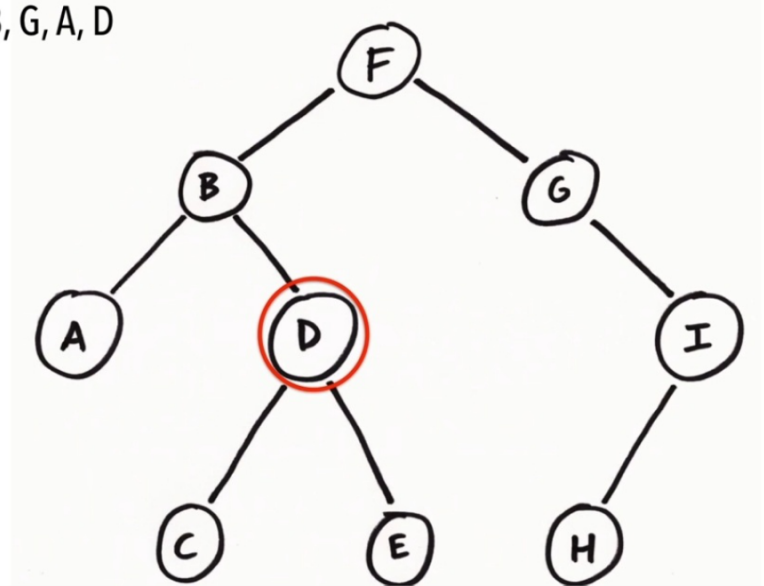
Queue
A, D
[First ------ Las

Output: F, B, G



Queue
A, D, I
[First ------ Last]

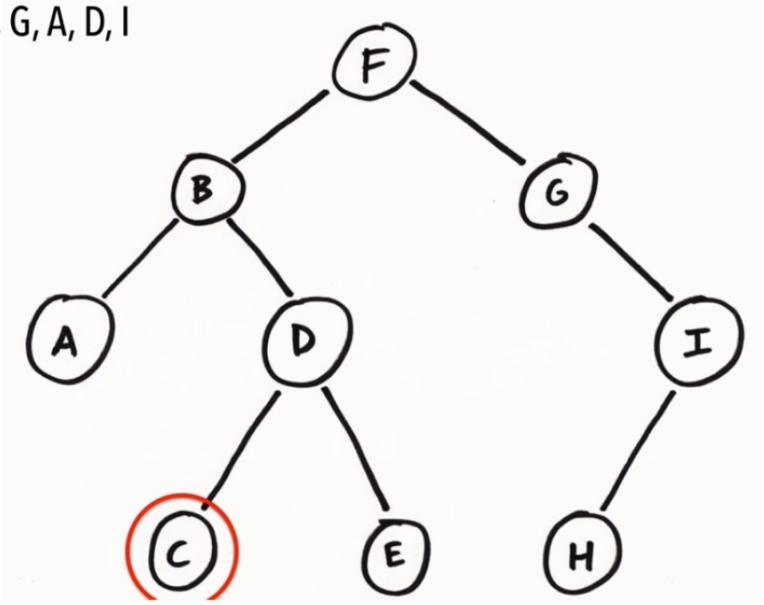
Output: F, B, G, A, D



Queue
I, C, E
[First ------ Last]

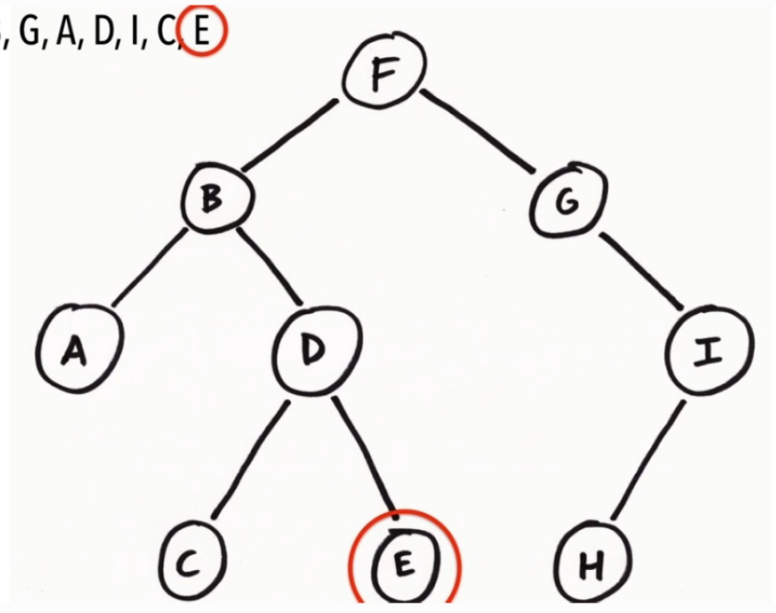
Output: F, B, G, A, D, I

Queue
C, E, H
[First ----- Last



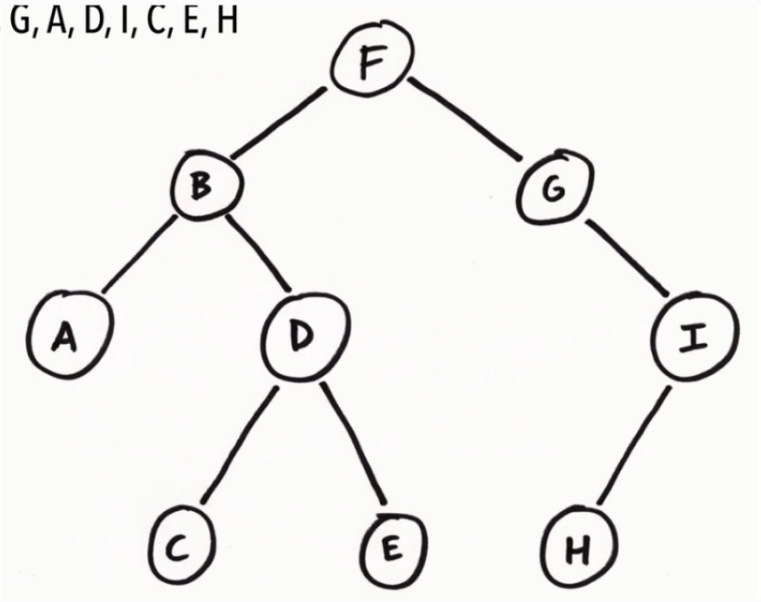
Output: F, B, G, A, D, I, C, E

Queue
H
[First ----- Last



Output: F, B, G, A, D, I, C, E, H

Queue



Time complexity

$O(n)$

where **n** is the number of nodes