

파이썬으로 배우는 데이터 구조



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학습 목표

트리 순회(Tree traversal)의 종류를 학습하고
간단하게 구현할 수 있다

Data Structures in Python

Chapter 7 - 1

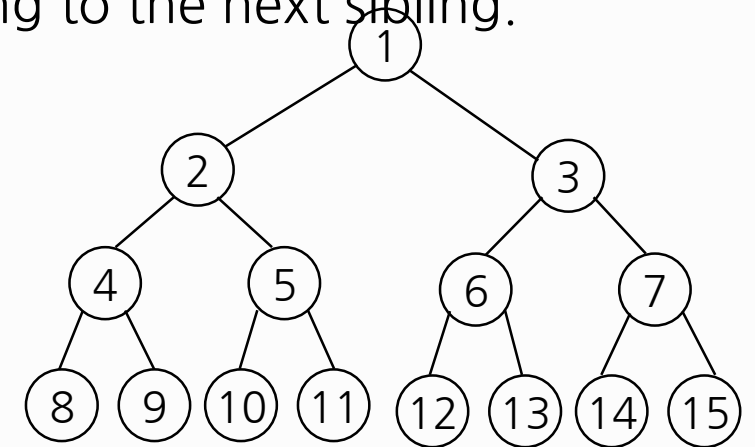
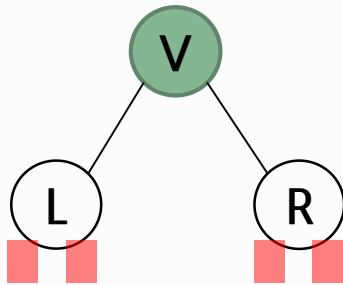
- Tree Introduction
- **Tree Traversals**
- Tree Algorithms

Agenda & Readings

- Binary Tree Traversals
 - Preorder
 - Inorder
 - Postorder
 - Level order
- Reference:
 - Problem Solving with Algorithms and Data Structures
 - Chapter 6 - Tree

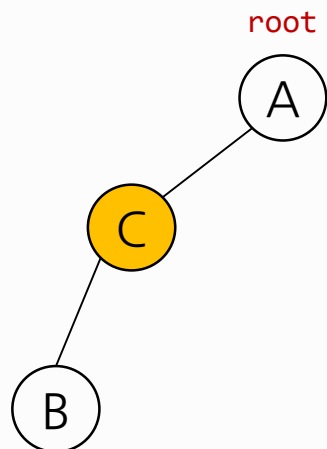
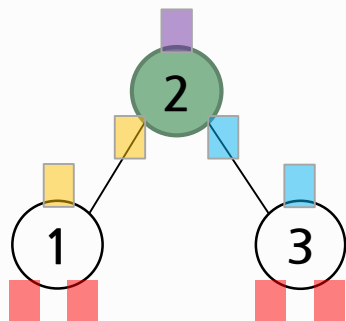
Binary tree traversals

- **Tree traversal** (known as **tree search**) refers to the process of visiting each node in a tree, **exactly once**, in a systematic way.
- DFS (Depth-first Search)
 - There are three possible moves if we traverse left before right:
LVR - inorder
LRV - postorder
VLR - preorder
 - They are named according to the position of **V** (the visiting node) with respect to the L and R.
 - These searches are referred to as **depth-first search (DFS)** since the search tree is deepened as much as possible on each child before going to the next sibling.



Inorder traversal(LVR) Example

- Step 1 – Recursively traverse left subtree.
- Step 2 – Visit root node. (print or save it.)
- Step 3 – Recursively traverse right subtree.



```
def inorder(node):  
    if node != None:  
        inorder(node.left)      L  
        print(node.key)        V  
        inorder(node.right)    R
```

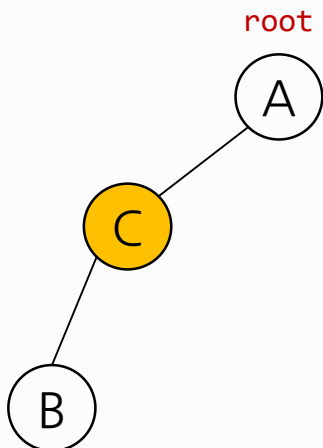
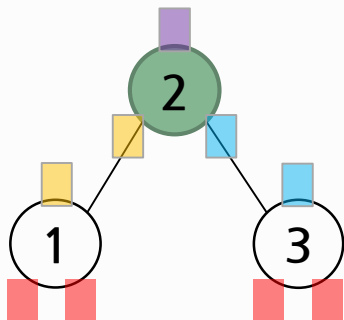
Is this a method in Node or an external function?

Output(LVR):
No. of inorder() calls made:

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        inorder(node.right)     R
```

Is this a method in Node or an external function?

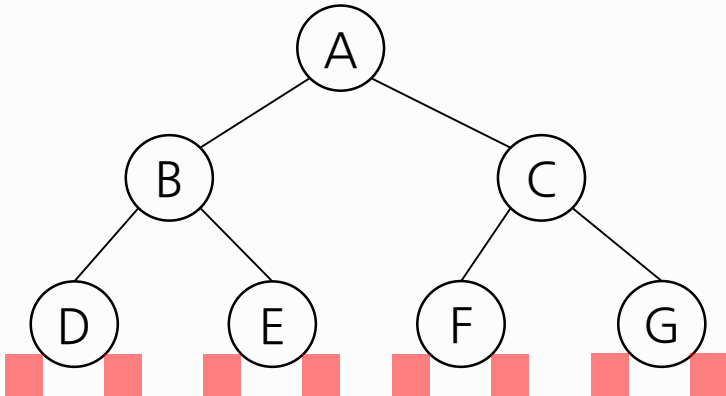
Output(LVR): 1 2 3
No. of inorder() calls made: 7

Output(LVR): B C A
No. of inorder() calls made: 7

Inorder traversal(LVR) Exercise

- Step 1 – Recursively traverse left subtree.
- Step 2 – Visit root node. (print or save it.)
- Step 3 – Recursively traverse right subtree.

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def inorder(node):  
    if node != None:  
        inorder(node.left)      L  
        print(node.key)         V  
        inorder(node.right)     R
```

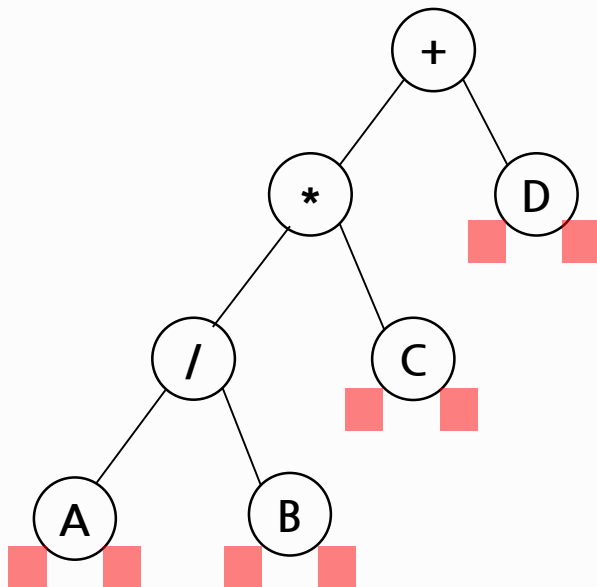


Output(LVR):
No. of inorder() calls made:

Inorder traversal(LVR) Exercise

- Step 1 – Recursively traverse left subtree.
- Step 2 – Visit root node. (print or save it.)
- Step 3 – Recursively traverse right subtree.

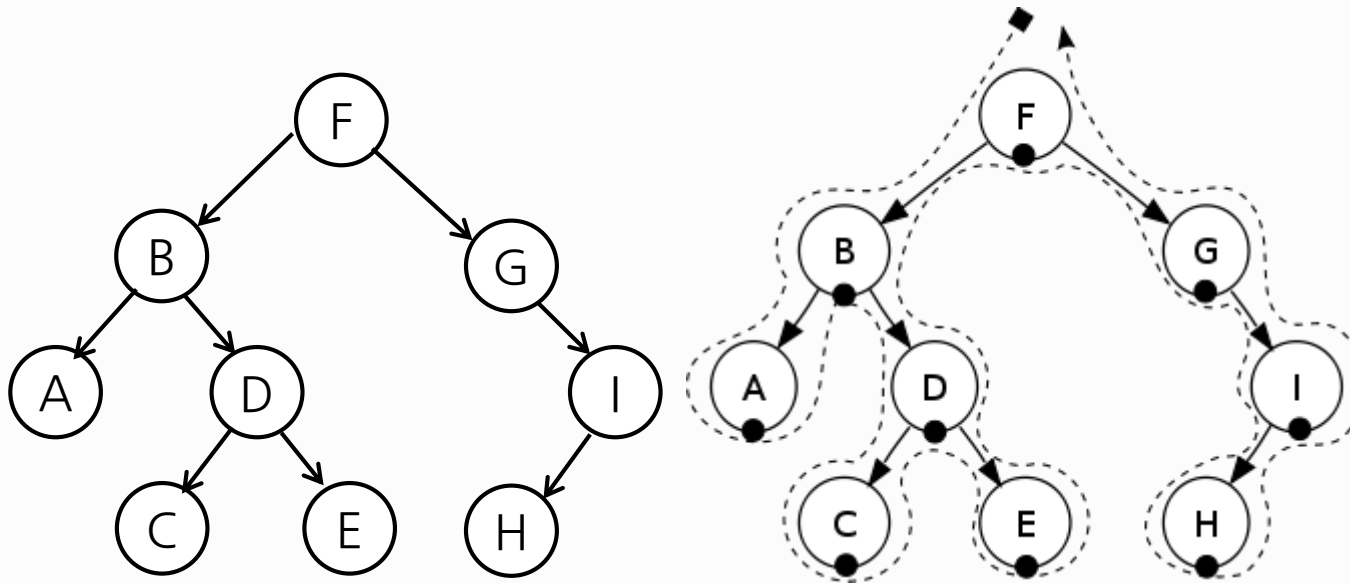
```
def inorder(node):  
    if node != None:  
        inorder(node.left)      L  
        print(node.key)         V  
        inorder(node.right)     R
```



Output(LVR):
No. of inorder() calls made:

Inorder traversal(LVR) Exercise

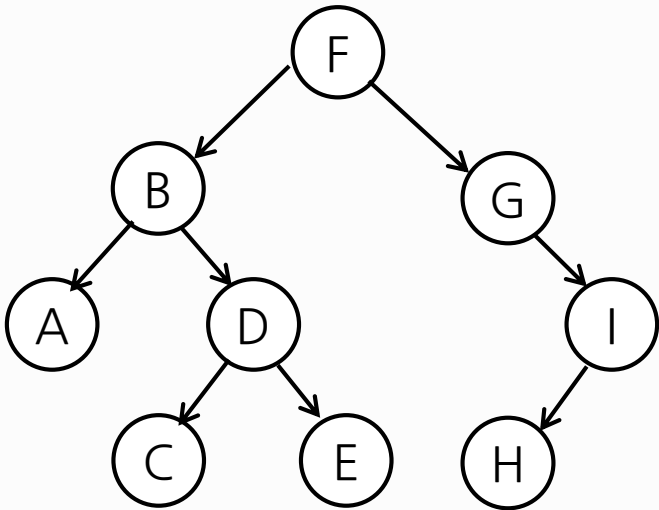
- Traverse the left subtree.
- Visit the root.
- Traverse the right subtree.



Output:

Preorder traversal(VLR) Example

- Step 1 — **Visit root node**.
- Step 2 — Recursively traverse left subtree.
- Step 3 — Recursively traverse right subtree.

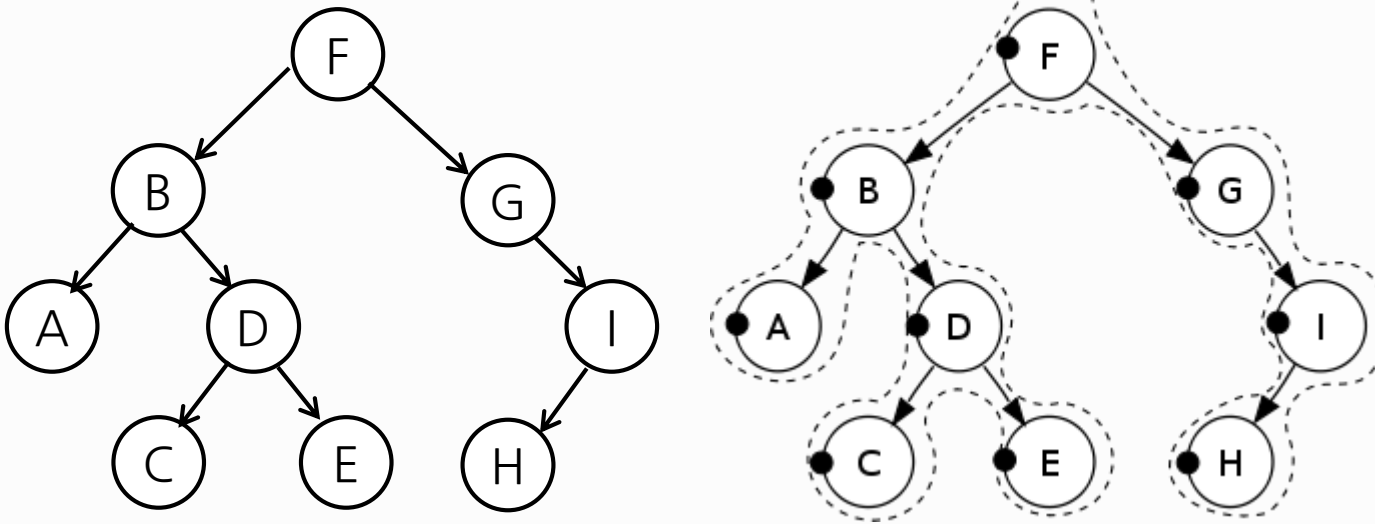


```
def preorder(node):  
    if node != None:  
        print(node.key)           V  
        preorder(node.left)      L  
        preorder(node.right)     R
```

Output(VLR):

Preorder traversal(VLR) Example

- Step 1 — **Visit root node.**
- Step 2 — Recursively traverse left subtree.
- Step 3 — Recursively traverse right subtree.

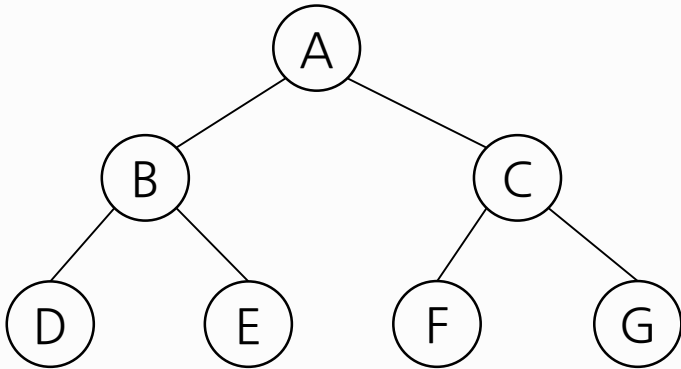


```
def preorder(node):  
    if node != None:  
        print(node.key)      V  
        preorder(node.left)  L  
        preorder(node.right) R
```

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

Preorder traversal(VLR) Exercise

- Step 1 — Visit root node.
- Step 2 — Recursively traverse left subtree.
- Step 3 — Recursively traverse right subtree.

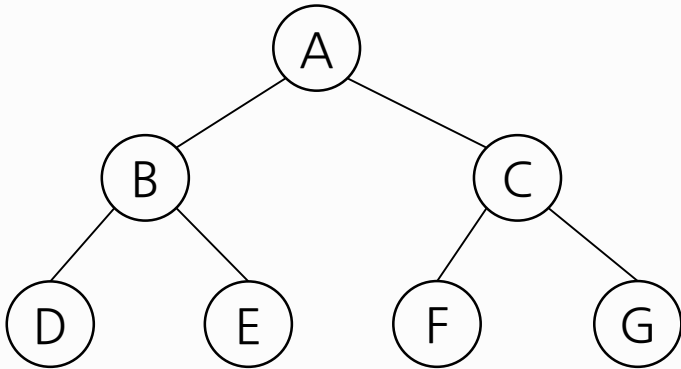


```
def preorder(node):  
    if node != None:  
        print(node.key)           V  
        preorder(node.left)      L  
        preorder(node.right)     R
```

Output(VLR):

Postorder traversal(LRV) Example

- Step 1 – Recursively traverse left subtree.
- Step 2 – Recursively traverse right subtree.
- Step 3 – Visit root node.

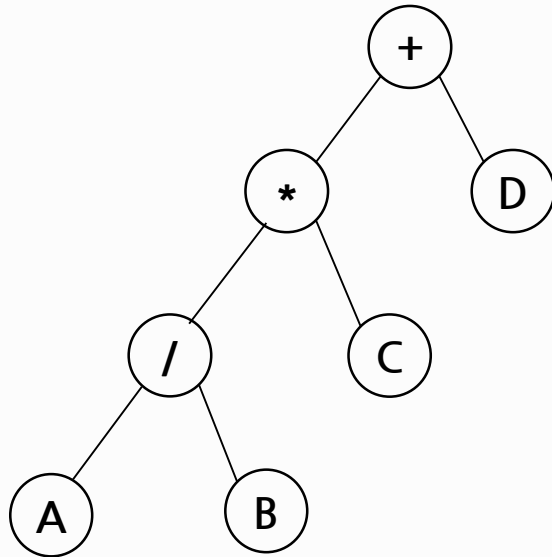


```
def postorder(node):  
    if node != None:  
        postorder(node.left)  
        postorder(node.right)  
        print(node.key)
```

Output(LRV): D E B F G C A

Postorder traversal(LRV) Exercise

- Step 1 – Recursively traverse left subtree.
- Step 2 – Recursively traverse right subtree.
- Step 3 – Visit root node.

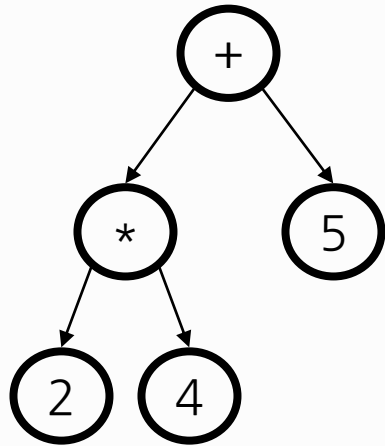


```
def postorder(node):
    if node != None:
        postorder(node.left)
        postorder(node.right)
        print(node.key)
```

Output(LRV):

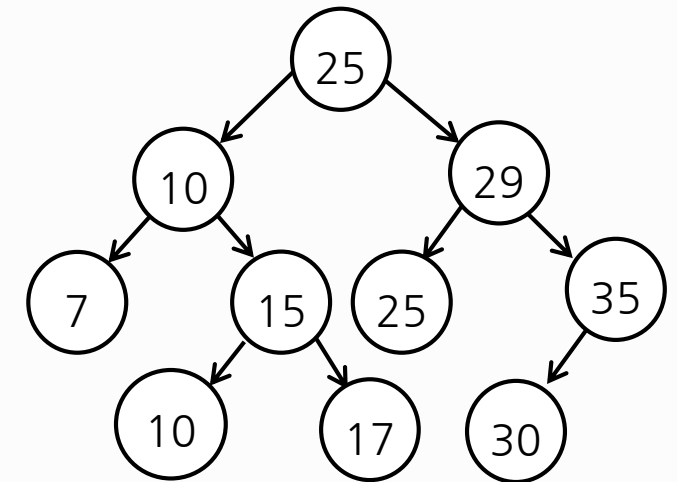
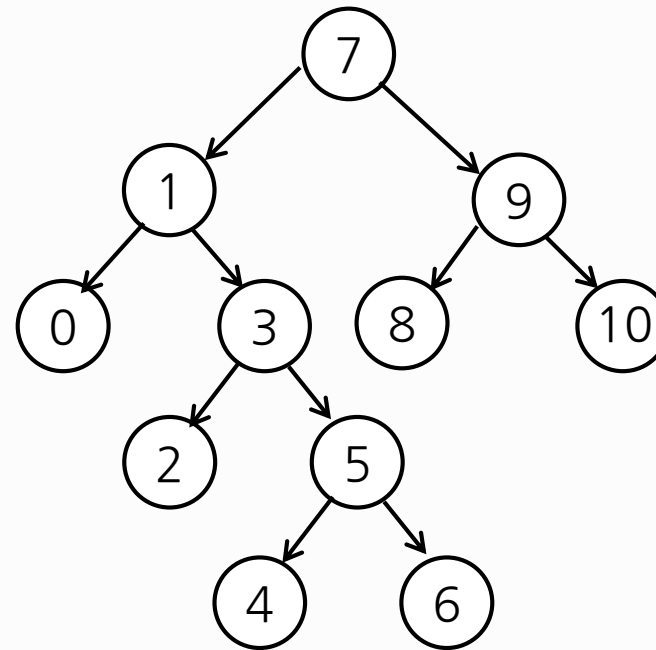
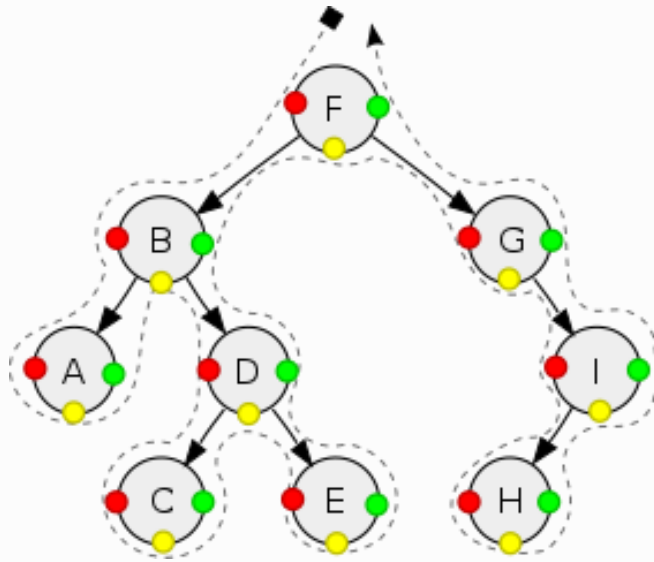
Binary tree traversals Exercise 1:

- preorder Traversal(VLR):
- inorder traversal(LVR):
- postorder traversal(LRV):



Binary tree traversals Exercise 2:

- preorder Traversal(VLR)
- inorder traversal(LVR)
- postorder traversal(LRV)



Binary tree traversals

■ Observations:

1. If you know you need to **explore the roots** before inspecting their leaves, you pick **preorder** because you will encounter roots (or parents) before their leaves.
2. If you know you need to **explore the leaves** before their parent nodes, you select **postorder** because you don't waste any time inspecting roots in search for leaves.
3. If you know that the tree has an inherent sequence in the nodes, and you want to flatten the tree back into its original sequence, then an **inorder** traversal should be used. The tree would be flattened in the same way it was created. A pre-order or post-order traversal might not unwind the tree back into the sequence which was used to create it.
4. In a binary search tree ordered such that in each node the key is greater than all keys in its left subtree and less than all keys in its right subtree, **inorder traversal** retrieves the keys in *ascending sorted order*.

학습 정리

- 1) 깊이우선탐색(DFS)에는 전위(preorder), 중위(inorder), 후위(postorder), 레벨순서(level-order) 순회가 있다
- 2) Roots를 먼저 탐색하고 싶다면 전위를, leaves를 먼저 탐색하고 싶다면 후위를 선택하는 것이 좋다
- 3) BST는 왼쪽 subtree가 오른쪽 subtree보다 값들이 항상 작기 때문에, 중위 순회를 사용하면 오름차순으로 정렬할 수 있다

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수고했습니다
곧 다음 시간에
다시 뵙겠습니다

