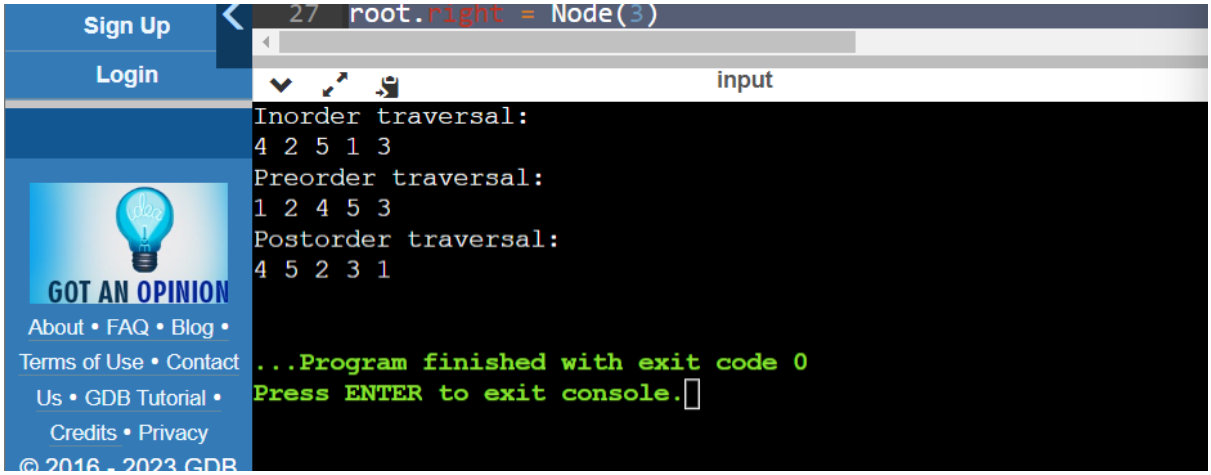
Day-17 : Binary Tree - 1

Problem Statement: Given a Binary Tree. Find and print

1. the inorder traversal of Binary Tree.
2. the preorder traversal of Binary Tree
3. the postorder traversal of Binary Tree

```
class Node:
    def __init__(self, value):
        self.value = value
        self.left = None
        self.right = None

def inorder_traversal(node):
    if node:
        inorder_traversal(node.left)
        print(node.value, end=" ")
        inorder_traversal(node.right)

def preorder_traversal(node):
    if node:
        print(node.value, end=" ")
        preorder_traversal(node.left)
        preorder_traversal(node.right)

def postorder_traversal(node):
    if node:
        postorder_traversal(node.left)
```

```
    postorder_traversal(node.right)
    print(node.value, end=" ")

root = Node(1)
root.left = Node(2)
root.right = Node(3)
root.left.left = Node(4)
root.left.right = Node(5)

print("Inorder traversal:")
inorder_traversal(root)
print()

print("Preorder traversal:")
preorder_traversal(root)
print()

print("Postorder traversal:")
postorder_traversal(root)
print()
```



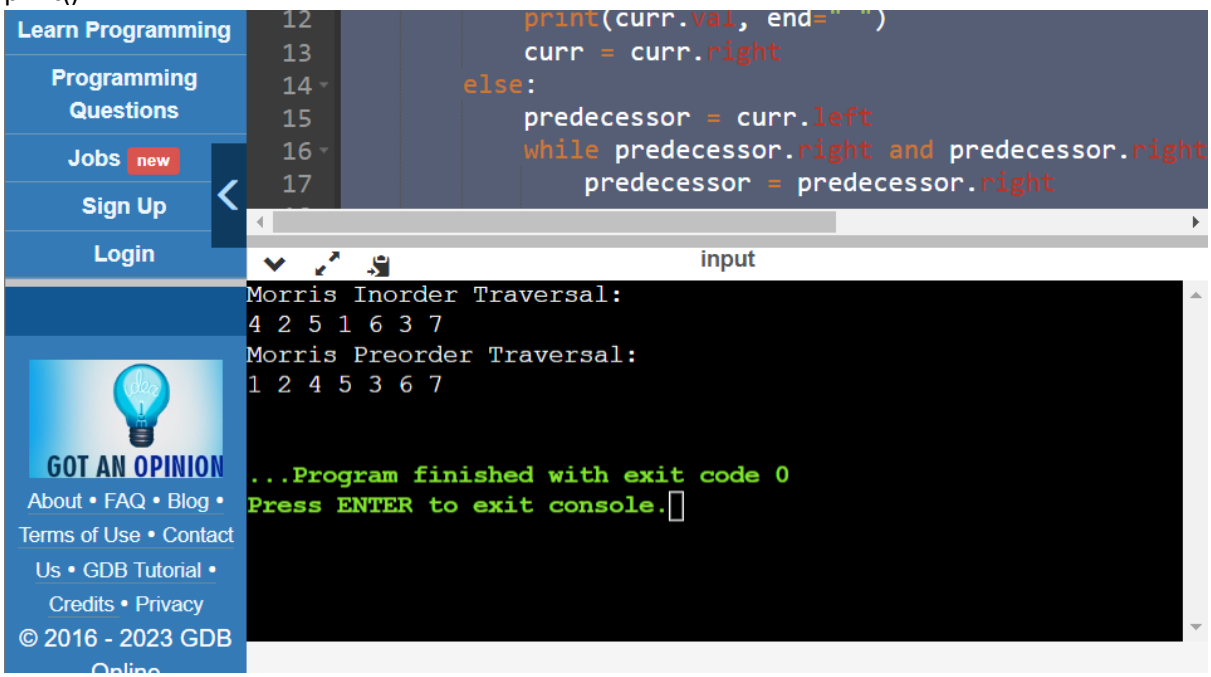
Problem Statement: Write a program for

1. Morris Inorder Traversal of a Binary Tree.
2. Morris Preorder Traversal of a Binary Tree.

```
class TreeNode:
    def __init__(self, val):
        self.val = val
        self.left = None
        self.right = None



def morris_inorder(root):
    curr = root
    while curr:
        if not curr.left:
            print(curr.val, end=" ")
            curr = curr.right
        else:
            predecessor = curr.left
            while predecessor.right and predecessor.right != curr:
                predecessor = predecessor.right
```

```
            if not predecessor.right:
                predecessor.right = curr
                curr = curr.left
            else:
                predecessor.right = None
                print(curr.val, end=" ")
                curr = curr.right



def morris_preorder(root):
    curr = root
    while curr:
        if not curr.left:
            print(curr.val, end=" ")
            curr = curr.right
        else:
            predecessor = curr.left
            while predecessor.right and predecessor.right != curr:
                predecessor = predecessor.right

            if not predecessor.right:
                predecessor.right = curr
                print(curr.val, end=" ")
                curr = curr.left
            else:
                predecessor.right = None
                curr = curr.right

root = TreeNode(1)
root.left = TreeNode(2)
root.right = TreeNode(3)
```

```
root.left.left = TreeNode(4)

root.left.right = TreeNode(5)

root.right.left = TreeNode(6)

root.right.right = TreeNode(7)


print("Morris Inorder Traversal:")

morris_inorder(root)

print()


print("Morris Preorder Traversal:")

morris_preorder(root)

print()
```



Problem Statement: Given a Binary Tree, find the

1. Right view
2. Left view
3. Top view
4. Bottom view

```
class Node:

    def __init__(self, data):
```

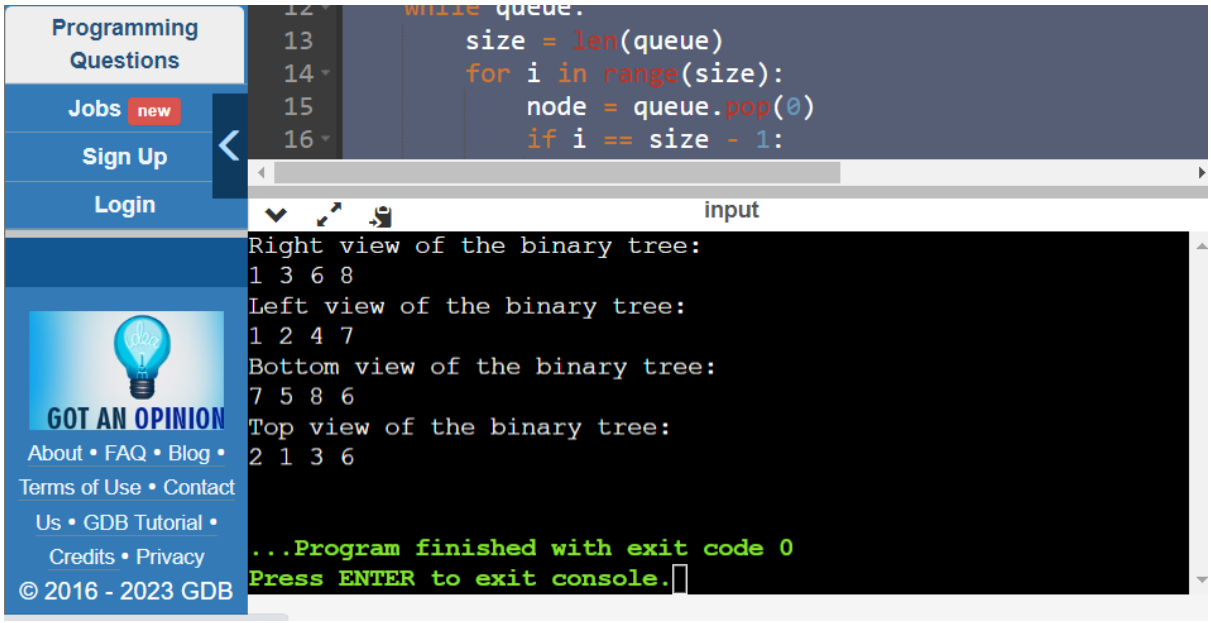
```
        self.data = data
        self.left = None
        self.right = None

def printRightView(root):
    if root is None:
        return

    queue = [root]
    while queue:
        size = len(queue)
        for i in range(size):
            node = queue.pop(0)
            if i == size - 1:
                print(node.data, end=" ")
            if node.left:
                queue.append(node.left)
            if node.right:
                queue.append(node.right)
    print()

def printLeftView(root):
    if root is None:
        return

    queue = [root]
    while queue:
        size = len(queue)
        for i in range(size):
            node = queue.pop(0)
            if i == 0:
```

```
            print(node.data, end=" ")
        if node.left:
            queue.append(node.left)
        if node.right:
            queue.append(node.right)
    print()

def printBottomView(root):
    if root is None:
        return

    queue = [(root, 0)]
    bottom_view = {}
    while queue:
        node, hd = queue.pop(0)
        bottom_view[hd] = node.data
        if node.left:
            queue.append((node.left, hd - 1))
        if node.right:
            queue.append((node.right, hd + 1))

    for hd in sorted(bottom_view.keys()):
        print(bottom_view[hd], end=" ")
    print()

def printTopView(root):
    if root is None:
        return

    queue = [(root, 0)]
    top_view = {}
```

```
    while queue:
        node, hd = queue.pop(0)
        if hd not in top_view:
            top_view[hd] = node.data
        if node.left:
            queue.append((node.left, hd - 1))
        if node.right:
            queue.append((node.right, hd + 1))

    for hd in sorted(top_view.keys()):
        print(top_view[hd], end=" ")
    print()

root = Node(1)
root.left = Node(2)
root.right = Node(3)
root.left.right = Node(4)
root.right.left = Node(5)
root.right.right = Node(6)
root.right.left.left = Node(7)
root.right.left.right = Node(8)

print("Right view of the binary tree:")
printRightView(root)

print("Left view of the binary tree:")
printLeftView(root)

print("Bottom view of the binary tree:")
printBottomView(root)
```

print("Top view of the binary tree:")

printTopView(root)



Problem Statement: Vertical Order Traversal Of A Binary Tree. Write a program for Vertical Order Traversal order of a Binary Tree.

```
from collections import defaultdict

class TreeNode:

    def __init__(self, key):

        self.key = key

        self.left = None

        self.right = None


def vertical_order_traversal(root):

    if not root:

        return []
```

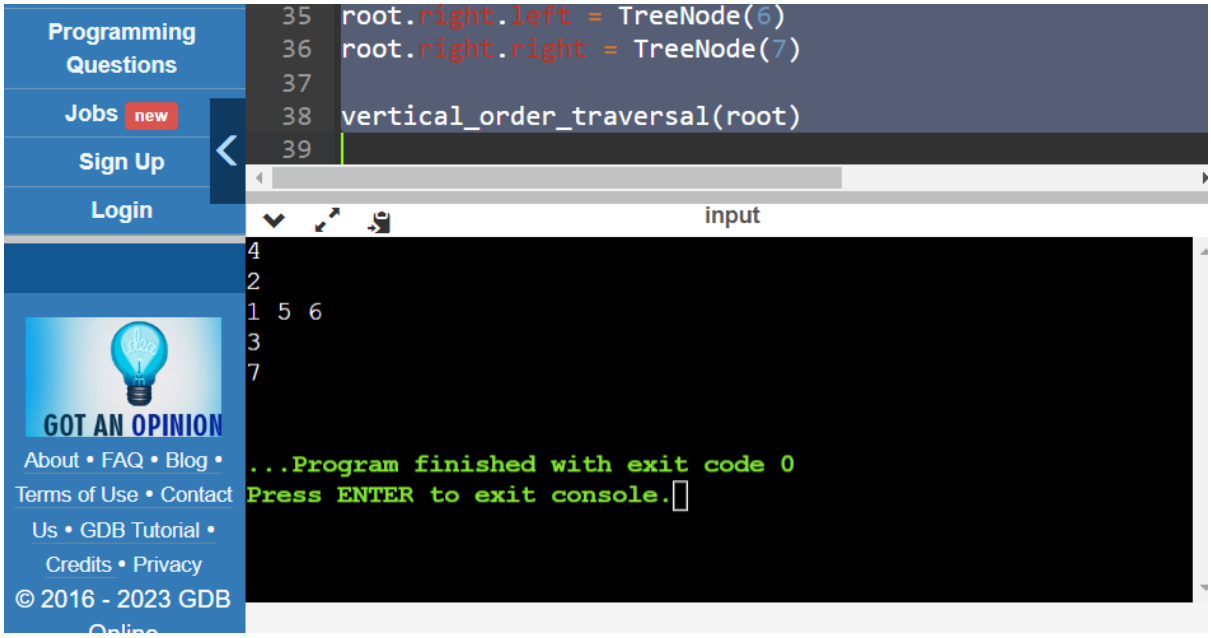
```
    vertical_levels = defaultdict(list)

    queue = [(root, 0)]

    while queue:
        node, level = queue.pop(0)
        vertical_levels[level].append(node.key)

        if node.left:
            queue.append((node.left, level - 1))
        if node.right:
            queue.append((node.right, level + 1))

    sorted_levels = sorted(vertical_levels.keys())

    for level in sorted_levels:
        print(*vertical_levels[level])

root = TreeNode(1)
root.left = TreeNode(2)
root.right = TreeNode(3)
root.left.left = TreeNode(4)
```

root.left.right = TreeNode(5)

root.right.left = TreeNode(6)

root.right.right = TreeNode(7)

vertical_order_traversal(root)

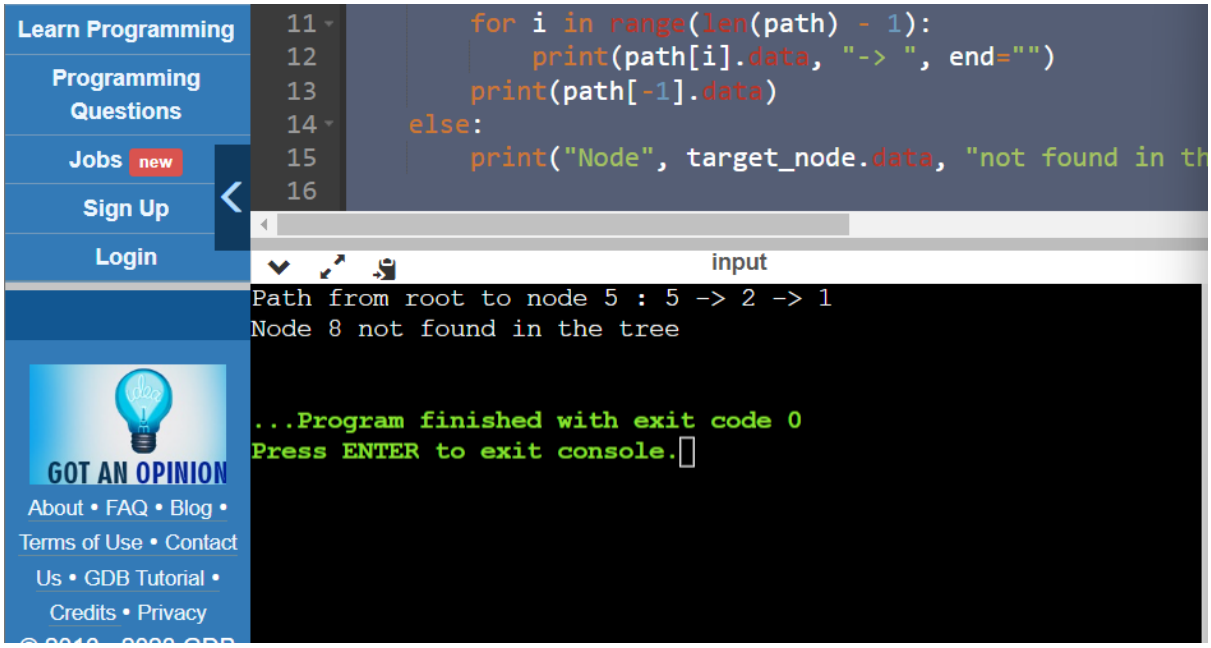


Problem Statement: Print Root to Node Path In A Binary Tree. Write a program to print path from root to a given node in a binary tree.

```
class Node:
    def __init__(self, data):
        self.data = data
        self.left = None
        self.right = None


def print_path_to_node(root, target_node):
```

```
    path = path_to_node_helper(root, target_node, [])
    if path is not None:
        print("Path from root to node", target_node.data, ": ", end="")
        for i in range(len(path) - 1):
            print(path[i].data, "-> ", end="")
        print(path[-1].data)
    else:
        print("Node", target_node.data, "not found in the tree")

def path_to_node_helper(node, target_node, path):
    if node is None:
        return None

    if node.data == target_node.data:
        path.append(node)
        return path

    left_path = path_to_node_helper(node.left, target_node, path)
    if left_path is not None:
        left_path.append(node)
        return left_path

    right_path = path_to_node_helper(node.right, target_node, path)
```

```
    if right_path is not None:
        right_path.append(node)
        return right_path
    return None

root = Node(1)
root.left = Node(2)
root.right = Node(3)
root.left.left = Node(4)
root.left.right = Node(5)
root.right.left = Node(6)
root.right.right = Node(7)

target_node = root.left.right
print_path_to_node(root, target_node)

target_node = Node(8)
print_path_to_node(root, target_node)
```



Problem Statement: Write a program to find the **Maximum Width of A Binary Tree**.

```
class Node:
    def __init__(self, data):
        self.data = data
        self.left = None
        self.right = None


def get_tree_width(root):
    if root is None:
        return 0


    max_width = 0
    queue = []
```

```
    queue.append((root, 1))

    while len(queue) > 0:
        count = len(queue)
        max_width = max(max_width, count)

        while count > 0:
            node, index = queue.pop(0)

            if node.left is not None:
                queue.append((node.left, 2 * index))
            if node.right is not None:
                queue.append((node.right, 2 * index + 1))

            count -= 1

    return max_width

root = Node(1)
root.left = Node(2)
root.right = Node(3)
root.left.left = Node(4)
root.left.right = Node(5)
```

root.right.right = Node(8)

root.right.right.left = Node(6)

root.right.right.right = Node(7)

max_width = get_tree_width(root)

print("Maximum width of the binary tree:", max_width)