Aman Kalla
RA1911003010640
Artificial Intelligence Lab.

LAB-4

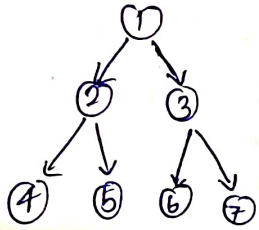
Aim:- Implement and Analysis of BFS and DFS for An application.

(i) Implementation and Analysis of BFS using Level order Traversal.

Problem Formulation:

Given a binary Tree, prints its nodes level by level. Print Nodes of any level from left to right.

Initial State



For each given directed graph, LOT order would be empty array

Final State.

LOT = [1, 2, 3, 4, 5, 6, 7, 8]

Problem Solving:

- Here, we visit every Node on a level before going to a lower level.
- Print all Nodes present in a level ~~order~~ be modifying preorder traversal on tree.

Time Complexity is $O(n^2)$ n = nodes in binary tree

Auxilliary Space Complexity $= O(h)$ $h \rightarrow$ height of tree.

<ii> Implement And Analysis of DFS Using Flood Fill Algorithm.

Problem Formulation

It is an Algorithm that determines the area connected to a given node in a multi-dimentional array.

Initial State

Y	Y	Y	G	G	G	G	G	G	G
Y	Y	Y	Y	Y	Y	G	X	X	X
G	G	G	G	G	G	G	X	X	X
W	W	W	W	W	G	G	G	G	X
W	R	R	R	R	R	G	X	X	X
W	W	W	R	R	G	G	X	X	X
W	B	W	R	R	R	R	R	R	X
W	B	B	B	B	R	R	X	X	X
W	B	B	X	B	B	B	B	X	X
W	B	B	X	X	X	X	X	X	X

Final State

Y	Y	Y	G	G	G	G	G	G	G
Y	Y	Y	Y	Y	Y	G	C	C	C
G	G	G	G	G	G	G	C	C	C
W	W	W	W	W	G	G	G	G	C
W	R	R	R	R	R	G	C	C	C
W	W	W	R	R	G	G	C	C	C
W	B	W	R	R	R	R	R	R	C
W	B	B	B	B	R	R	C	C	C
W	B	B	C	B	B	B	B	C	C
W	B	B	C	C	C	C	C	C	C

Problem Solving

- The idea is to start from the source node in the matrix, replace its color with the replacement color and recursively explore all its valid eight adjacent pixels and replace their color

Time Complexity

⇒ $O(M \times N)$

Space Complexity

⇒ $O(M \times N)$

Aman Kalla

RA1911003010640

LAB 4

BFS – Level order Traversal

Algorithm

Step 1- Start

Step 2- Make a class to store binary tree node.

Step 3- Make function to print all nodes of a given level from left to right.

Step 4- Return true if at least one node is present at the given level.

Step 5- Call function to print level order traversal and start from 1 to height h of tree.

Step 6- Run till function returns false.

Step 7- End

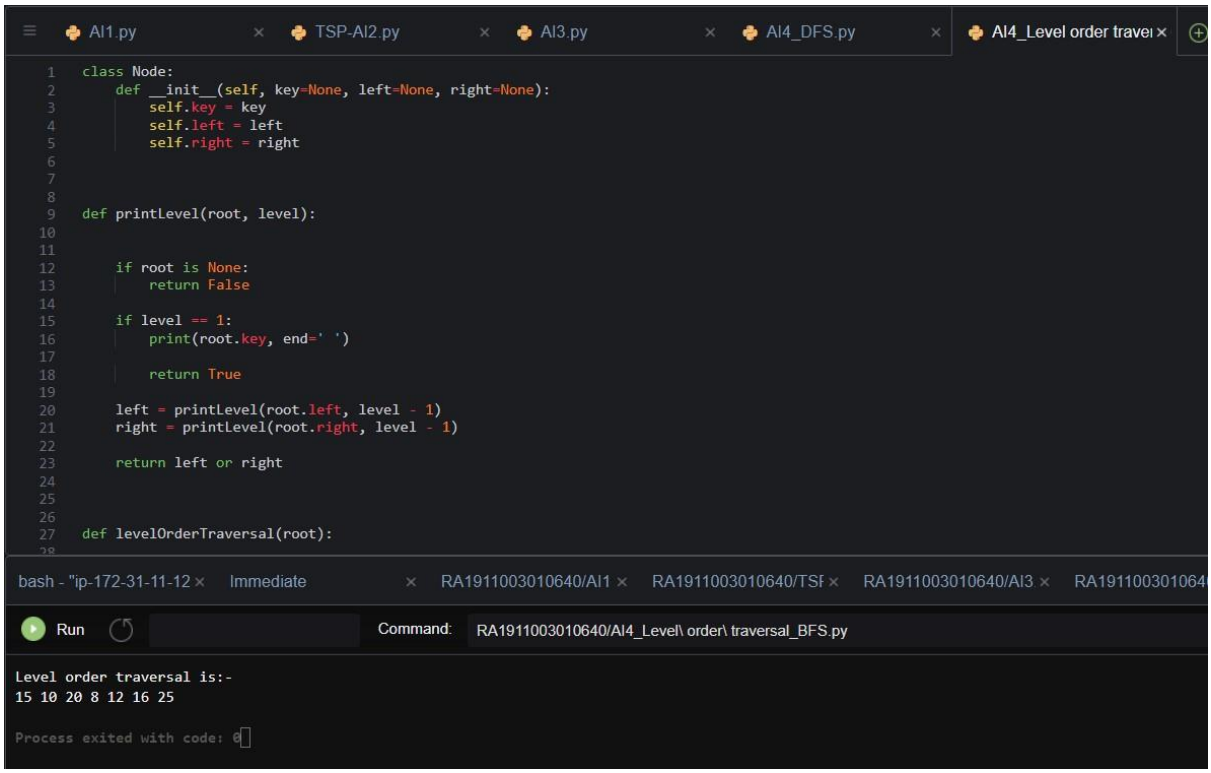
Source Code

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




def printLevel(root, level):



    if root is None:
        return False

    if level == 1:
```

```
        print(root.key, end=' ')

        return True

    left = printLevel(root.left, level - 1)
    right = printLevel(root.right, level - 1)

    return left or right




def levelOrderTraversal(root):



    level = 1

    while printLevel(root, level):
        level = level + 1



if __name__ == '__main__':

    root = Node(15)
    root.left = Node(10)
    root.right = Node(20)
    root.left.left = Node(8)
    root.left.right = Node(12)
    root.right.left = Node(16)
    root.right.right = Node(25)

    print("Level order traversal is:- ")
```

levelOrderTraversal(root)

Output



Result

Hence level order traversal using BFS is successfully executed.

DFS - Flood Fill Algorithm

Algorithm

Step 1- Start

Step 2- Initialize roe and column array.

Step 3- Check if it is possible to go to pixel (x,y) from the current pixel. Return false if it has different color.

Step 4- Call the function, if if has same color, returns else replace that color with replacement color.

Step 5- Print colors after replacement.

Step 6- End

Source Code

```
ow = [-1, -1, -1, 0, 0, 1, 1, 1]

col = [-1, 0, 1, -1, 1, -1, 0, 1]




def isSafe(mat, x, y, target):

    return 0 <= x < len(mat) and 0 <= y < len(mat[0]) and mat[x][y] == target




def floodfill(mat, x, y, replacement):


    # base case

    if not mat or not len(mat):

        return



    target = mat[x][y]


    if target == replacement:

        return


    mat[x][y] = replacement


    for k in range(len(row)):



        if isSafe(mat, x + row[k], y + col[k], target):

            floodfill(mat, x + row[k], y + col[k], replacement)
```

```
if __name__ == '__main__':


    mat = [
            ['Y', 'Y', 'Y', 'G', 'G', 'G', 'G', 'G', 'G', 'G'],
            ['Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'G', 'X', 'X', 'X'],
            ['G', 'G', 'G', 'G', 'G', 'G', 'G', 'X', 'X', 'X'],
            ['W', 'W', 'W', 'W', 'W', 'G', 'G', 'G', 'G', 'X'],
            ['W', 'R', 'R', 'R', 'R', 'R', 'G', 'X', 'X', 'X'],
            ['W', 'W', 'W', 'R', 'R', 'G', 'G', 'X', 'X', 'X'],
            ['W', 'B', 'W', 'R', 'R', 'R', 'R', 'R', 'R', 'X'],
            ['W', 'B', 'B', 'B', 'B', 'R', 'R', 'X', 'X', 'X'],
            ['W', 'B', 'B', 'X', 'B', 'B', 'B', 'B', 'X', 'X'],
            ['W', 'B', 'B', 'X', 'X', 'X', 'X', 'X', 'X', 'X']
        ]



    x, y = (3, 9)

    replacement = 'C'



    floodfill(mat, x, y, replacement)



    for r in mat:
        print(r)
```

Output

AI1.py | TSP-AI2.py | AI3.py | AI4_DFS.py | AI4_Level order travel

```python

row = [-1, -1, -1, 0, 0, 1, 1, 1]
col = [-1, 0, 1, -1, 1, -1, 0, 1]



def isSafe(mat, x, y, target):
    return 0 <= x < len(mat) and 0 <= y < len(mat[0]) and mat[x][y] == target


# Flood fill using DFS
def floodfill(mat, x, y, replacement):

    # base case
    if not mat or not len(mat):
        return

    # get the target color
    target = mat[x][y]

    # target color is same as replacement
    if target == replacement:
        return

    # replace the current pixel color with that of replacement
    mat[x][y] = replacement

    # process all eight adjacent pixels of the current pixel and
```

bash - "ip-172-31-11-12 | Immediate | RA1911003010640/AI1 | RA1911003010640/TSP | RA1911003010640/AI3 | RA1911003010640/AI

Run Command: RA1911003010640/AI4_DFS.py

```
['Y', 'Y', 'Y', 'G', 'G', 'G', 'G', 'G', 'G', 'G']
['Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'G', 'C', 'C', 'C']
['G', 'G', 'G', 'G', 'G', 'G', 'G', 'C', 'C', 'C']
['W', 'W', 'W', 'W', 'W', 'G', 'G', 'G', 'G', 'C']
['W', 'R', 'R', 'R', 'R', 'R', 'G', 'C', 'C', 'C']
['W', 'W', 'W', 'R', 'R', 'G', 'G', 'C', 'C', 'C']
['W', 'B', 'W', 'R', 'R', 'R', 'R', 'R', 'R', 'C']
['W', 'B', 'B', 'B', 'B', 'R', 'R', 'C', 'C', 'C']
['W', 'B', 'B', 'C', 'B', 'B', 'B', 'B', 'C', 'C']
['W', 'B', 'B', 'C', 'C', 'C', 'C', 'C', 'C', 'C']
```

Result

Hence Flood Fill Algorithm using DFS is successfully executed.