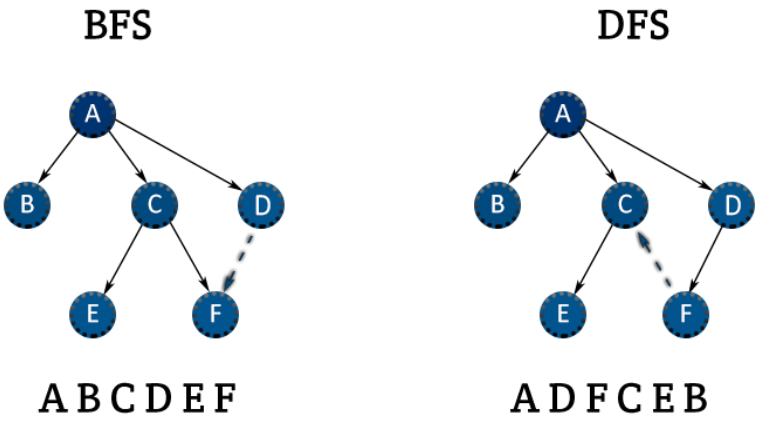
CSC 44800

01 November 2023

THE CITY COLLEGE OF NEW YORK

Depth First Search and Breadth First Search:

HW 2-1



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INTRODUCTION

Depth-First Search (DFS) and Breadth-First Search (BFS) are two techniques of traversing graphs and trees. DFS explores a graph or tree by diving as deeply as possible along a branch before backtracking, making it well-suited for tasks like finding paths and topological sorting. It is implemented using the stack data structure and recursion. Arrays/Lists can be used to implement the stack data structure. In contrast, BFS systematically explores all neighbors of a node before moving to their neighbors, making it ideal for finding the shortest path in unweighted graphs and efficiently visiting nodes level by level. BFS employs a queue to maintain a first-in-first-out order, allowing them to serve different graph exploration needs.

PROBLEM STATEMENT

Given the 2D grid in Figure 1, start at the black 1 position and reach the goal at the red 15 position. Find the path to the goal using:

1. Depth First Search (DFS)
2. Breadth First Search (BFS)

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15

Figure 1. 2D Grid

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DFS SOLUTION

In DFS we can choose our own direction to traverse the grid. The directions that we will use to traverse the 2d grid are: “right“, “down“, “up“, “left“. Steps:

1. Start at 1.
2. Go to 2. (Right)
3. Go to 3. (Right)
4. Go to 4. (Right)
5. Go to 5. (Right)
6. Go to 10. (Down)
7. Go to 15. (Down) **SOLUTION FOUND!**

BFS SOLUTION

Steps:

1. Start at 1.
2. First layer = 1
3. Search the neighbors of 1 which are 2 and 6.
4. Second layer = 6, 2
5. Search the neighbors of 2 which are 3 and 7.
6. Search the neighbors of 6 which are 11 and 7.
7. Third layer = 11, 7, 3
8. Search the neighbors of 3 which are 4 and 8.

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9. Search the neighbors of 7 which are 8 and 12.
10. Search the neighbor of 11 which is 12.
11. Fourth layer = 12, 8, 4
12. Search the neighbors of 4 which are 5 and 9.
13. Search the neighbors of 8 which are 9 and 13.
14. Search the neighbor of 12 which is 13.
15. Fifth layer = 13, 9, 5
16. Search the neighbor of 5 which is 10 because 4 is already visited.
17. Search the neighbors of 9 which are 10 and 14.
18. Search the neighbor of 13 which is 14.
19. Sixth layer = 14, 10
20. Search the neighbor of 10 which is 15. **SOLUTION FOUND!**
21. Search the neighbor of 14 which is 15.

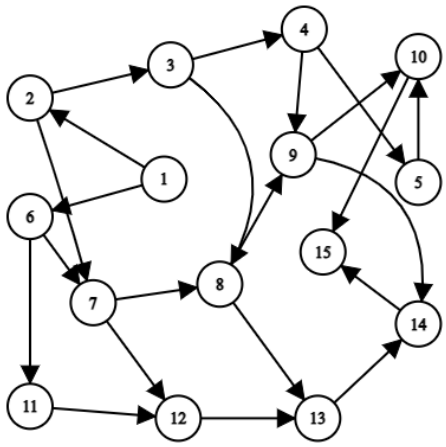

Figure 2. BFS Directed Graph Solution

CONCLUSION

It took only seven steps for DFS to reach the goal at the red 15 position however it took 21 steps for BFS to reach the goal at the red 15 position. However, we need to keep in mind that the directions that we choose to traverse the 2D grid in DFS will affect the number of steps needed to reach the goal at the red 15 position.