UNIVERSITY OF WESTMINSTER

INFORMATICS INSTITUTE OF TECHNOLOGY

University of Westminster

Algorithms, Theory, Design and Implementation
5SENG003W

Course Work Report

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a) Choice of Data Structure and Algorithm

For our map navigation system, we chose to implement Dijkstra's algorithm for finding the shortest path between two points on a map represented as a grid. Dijkstra's algorithm is well-suited for this task because:

- It guarantees finding the shortest path in weighted graphs with non-negative edge weights, which fits our scenario.
- It's efficient for finding the shortest path from a single source vertex to all other vertices in a graph, which aligns with our requirement to find the shortest path from a starting point to a destination on the map.

We represented the map as a graph data structure, where each cell in the grid corresponds to a node in the graph, and edges between adjacent nodes represent possible movements (up, down, left, right) on the map. This graph representation allows for efficient traversal and pathfinding.

b) Algorithm Run on Benchmark Example

Here's an example run of our algorithm on a small benchmark map:

Map: **maze10_1.txt**

.0...00...

.0F0.....

..0..0....

.0.0.....0

....

....

....0.0.0.

.0.0.....

0.......0

S.0.....00

> Start Position: (1, 10)
> Finish Position: (3, 2)

Output:
Enter file name: maze10_1.txt

File Name: maze10_1.txt

Shortest Path for this file:

1. Start at (1,10)
2. Move right to (2,10)
3. Move up to (2,9)
4. Move right to (9,9)
5. Move up to (9,8)
6. Move left to (5,8)
7. Move down to (5,10)
8. Move right to (8,10)
9. Move up to (8,1)
10. Move right to (10,1)
11. Move down to (10,3)
12. Move left to (7,3)
13. Move up to (7,2)
14. Move left to (5,2)
15. Move up to (5,1)
16. Move left to (3,1)
17. Move down to (3,2)
18. Done

c) Performance Analysis

The doubling Hypothesis is the way of observing the running time of a program by running it while doubling the size of the input. The data and the table drawn to the written code using the doubling hypothesis are as follows.

Input	Average(ms)	Trail 1(ms)	Trail 2(ms)	Trail 3(ms)	Trail 4(ms)	Trail 5(ms)	Difference(ms) (rounded)
puzzle_40	18	18	18	19	18	17	0
puzzle_80	41.83	43	42	42	40	42	24
puzzle_160	87.8	85	85	91	91	87	46
puzzle_320	188.4	197	197	189	178	181	100
puzzle_640	419	424	418	413	421	419	230
puzzle_1280	1265	1291	1303	1245	1243	1243	846
puzzle_2560	3925.2	5601	3319	3472	3778	3456	2660

According to the table, it is similar to a quadratic order-of-growth complexity. So, the complexity of the table can be considered as $O(n^2)$.