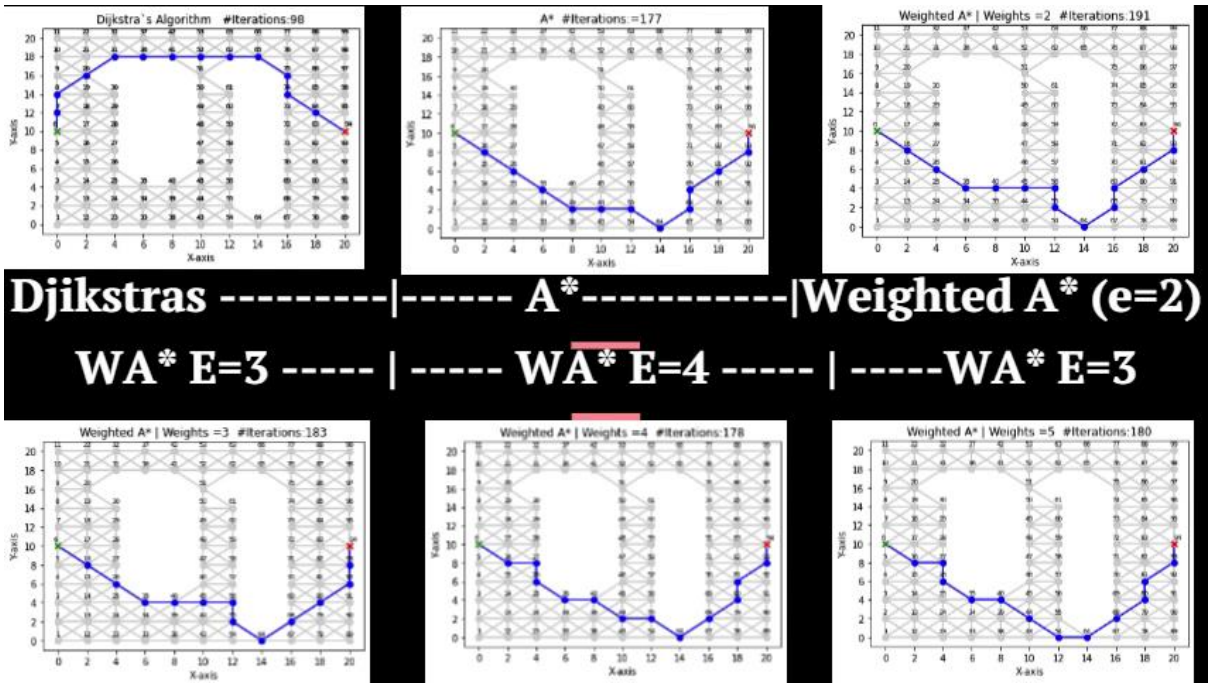
Assignment 2

Implementation Report for Shortest Path Finding Program

Results:



Algorithm	Dijkstaras	A*	WA e=2	WA e=3	WA e=4	WA e=5
Final Cost	30.1421	30.6274	31.7990	31.7990	31.7990	31.7990
Iteration	98	177	191	183	178	180

Files

- **input.txt**: Contains details about the graph (number of vertices, starting and target vertices).
- **coords.txt**: Holds the coordinates of graph vertices.
- **FormattedInput.txt**: Contains organized input data.
- **output.txt**: The output file where results are stored.

1. Input Processing

- Reads **input.txt** to get important details like the number of vertices, starting point, and target point.

2. Coordinate Handling

- Takes coordinates from **coords.txt** and stores them for later use in plotting.

3. Graph Initialization

- Sets up the graph structure and fills it with edges from **FormattedInput.txt**.

4. Dijkstra's Algorithm

- The program employs this algorithm to find the shortest path from the starting point to all other points.

5. Weighted A* Algorithm

- Offers an alternative algorithm that can be influenced by different weightings.

6. Heuristic Dictionary

- Calculates heuristic distances for the Weighted A* algorithm.

7. Plotting and Visualization

- Uses **matplotlib** to create visual representations of the graph and algorithm steps.

8. Output File Generation

- Adds results to **output.txt**, including the path and distances.

Running the Program

- Make sure **input.txt**, **FormattedInput.txt**, **coords.txt**, and **output.txt** are available.
- Run the program to see the algorithms in action.
- The output will be saved in **output.txt**.

Usage Examples

- This program is great for learning about graphs and algorithms. You can experiment with different setups to see how the algorithms behave.

Conclusion

This Python program provides an easy-to-follow demonstration of two methods for finding the shortest path in a graph. The combination of clear visuals and detailed output makes it a valuable learning tool.

Dijkstra's Algorithm (dijkstra)

Function Signature

def dijkstra(self, start):

Description

This function implements Dijkstra's algorithm to find the shortest path from a given starting vertex to all other vertices in the graph.

Parameters

- **self**: Refers to the current instance of the **Graph** class.
- **start**: The starting vertex for the algorithm.

Returns

- **dist**: A dictionary containing the shortest distances from the starting vertex to all other vertices.
- **parent**: A dictionary containing the parent vertices that lead to the shortest path.

Shortest Path with Distances (shortest_path_with_distances)

Function Signature

def shortest_path_with_distances(self, start, end, parent):

Description

This function calculates the shortest path and distances from the starting vertex to the target vertex using the parent vertices obtained from Dijkstra's algorithm.

Parameters

- **self**: Refers to the current instance of the **Graph** class.
- **start**: The starting vertex.
- **end**: The target vertex.
- **parent**: A dictionary containing the parent vertices obtained from Dijkstra's algorithm.

Returns

- **path**: A list representing the shortest path from the starting vertex to the target vertex.
- **distances_between**: A dictionary containing distances between vertices in the shortest path.

Weighted A* Algorithm (weighted_a_star)

Function Signature

def weighted_a_star(self, start, weight=1):

Description

This function implements the weighted A* algorithm to find the shortest path from a given starting vertex to all other vertices in the graph. It allows for the influence of different weights on the search process.

Parameters

- **self**: Refers to the current instance of the **Graph** class.
- **start**: The starting vertex for the algorithm.
- **weight**: A multiplier influencing the heuristic function (default is 1).

Returns

- **dist**: A dictionary containing the shortest distances from the starting vertex to all other vertices.
- **parent**: A dictionary containing the parent vertices that lead to the shortest path.