National College of Ireland

Metropolitan City Transportation Analysis & Optimal Route Suggestions

Configuration Manual
MSc Artificial Intelligence

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Project Submission Sheet
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1 About

The main objective of this software is to conduct a thorough analysis of the transportation system of Dublin and provide optimal route suggestions between two bus stops.

1.1 Description

This project is designed to get the data from TFI for Dublin Bus, visualize that on the map and perform in-depth analysis, and perfrom graph optimization algorithms.

- Get data from TFI about all Dublin bus routes.
- Visualize geographical data using latitude and longitude on a map.
- Distribute and visualize data across Dublin City Council using polygon.
- Convert realtime transportation system to graph optimization problem.
- Analyze bidirectional graphs using A* and Dijkstra's algorithms.
- Evaluating algorithm performance in terms of time complexity and nodes explored.

2 Getting Started

This section guides you through the necessary steps to set up the project, including installing dependencies and running the program.

2.1 Dependencies

Before you begin, ensure you have the following dependencies installed:

- **Operating System:** Windows 10
- **Python:** Included with Anaconda installation
- **Anaconda:** For managing environments and dependencies
- **Required Libraries:** Pandas, Folium, Shapely, Geopandas, NetworkX, Matplotlib, etc.

2.2 Installing

2.2.1 Anaconda Installation on Windows 10

- Download Anaconda:
  - Visit the Anaconda distribution page and download the installer for Windows.
- Install Anaconda:
  - Run the downloaded installer.
  - Follow the on-screen instructions.

2.2.2 Install Required Libraries:

- Install the required libraries using the following command:
  - pip install <library-name>

2.3 Executing program

To run the program please place the provided codebase in C>Users >AdminUser>DublinBus folder then open Jupyter Notebook and retrieve DublinBus, change the file path according to your settings in each file and follow these steps:

2.3.1 Fetch Data

- Run the script from Inbound_Routes.ipynb & Outbound_Routes.ipynb it will fetch all the data from TFI and store it in the form of CSV in InboundRoutes & OutboundRoutes folders for all bus routes.

2.3.2 Data Preprocessing

- Run script in Data_Preprocessing.ipynb it will merge all the routes into a single file and fetch all the unique bus stops. Then it will filter all the bus stops in the custom area, assign the socio-economic rating to each bus stop in the custom area and store all bus stops in CSV format named FinalStops.
- Run Script in the Stops_Distribution.ipynb it will store all the bus stops in the city council and outside of the city council in CSV format. This will also map bus stops according to 5 sub-part of the city council and save bus stops as CSV files.
- Run the script in City_Councils_Maps.ipynb it will map all bus stops in the city council, outside of the city council, and sub-parts of city council.

2.3.3 Data Analysis

- Run the script in Analysis.ipynb to visualize the heatmap and cluster of bus stops on the map using Folium.

2.3.4 Graph Validation

- Run the script in Create_Graph.ipynb that will generate all the possible bus route connections and save them in a CSV file named Graph.csv in the custom area. The CSV contains a straight line distance between bus stops, the socio-economic rating of bus stops, edge weights and other details.
- Run the script in Graph_Validation.ipynb to validate the graph.

2.3.5 Graph Algorithms & Evaluation

- Run the script in Algorithm_A_Star.ipynb to apply A* algorithm.
- Run the script in Algorithm_Dijkstra.ipynb to apply Dijkstra's algorithms.
- Run the script in Algorithms_Comparison.ipynb to analyze the results, including cost and nodes explored.

3 Authors

Contributors names and contact info.

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4 Version History

- v1.0: Initial release with basic functionalities.
- v1.1: Improved data visualization features.
- v1.2: Added A* and Dijkstra's algorithms.

5 Acknowledgments

- **Folium:** For providing powerful and easy-to-use tools to visualize geographical data on interactive maps.
- **Transport for Ireland (TFI):** For providing public transport data used in this project.