Road Trip Path Optimizer

Angela, Chanthavary, Jaee

01

Background

Road Trip

1. Purpose: Have fun!
2. Want minimum time spent on the road.
3. Make sure to visit fun places on the way.

Path Optimization for a Road Trip

1. Where do we start and end the road trip?
2. What are available paths between them?
3. What traffic related data should we use?
4. What are the factors that affect time spend on the road?

Path Optimization for a Road Trip

1. Where do we start and end the road trip?
2. What are available paths between them?
3. What traffic related data should we use?
4. What are the factors that affect time spend on the road?

1. Can be any real cities.
2. Can be any real streets in between.
3. Live traffic related data updated frequently.
4. Length of the roads, speed limit of the roads, traffic at the moment, car accidents, traffic lights, weather, etc.

Road Trip as an Undirected Graph

1. Roads such as highways are not one-way street. These can be the **edges**.

2. We have clear stations that we want to stop the car during the trip, such as cities, mountains, national parks, etc. These can be the **vertices**.

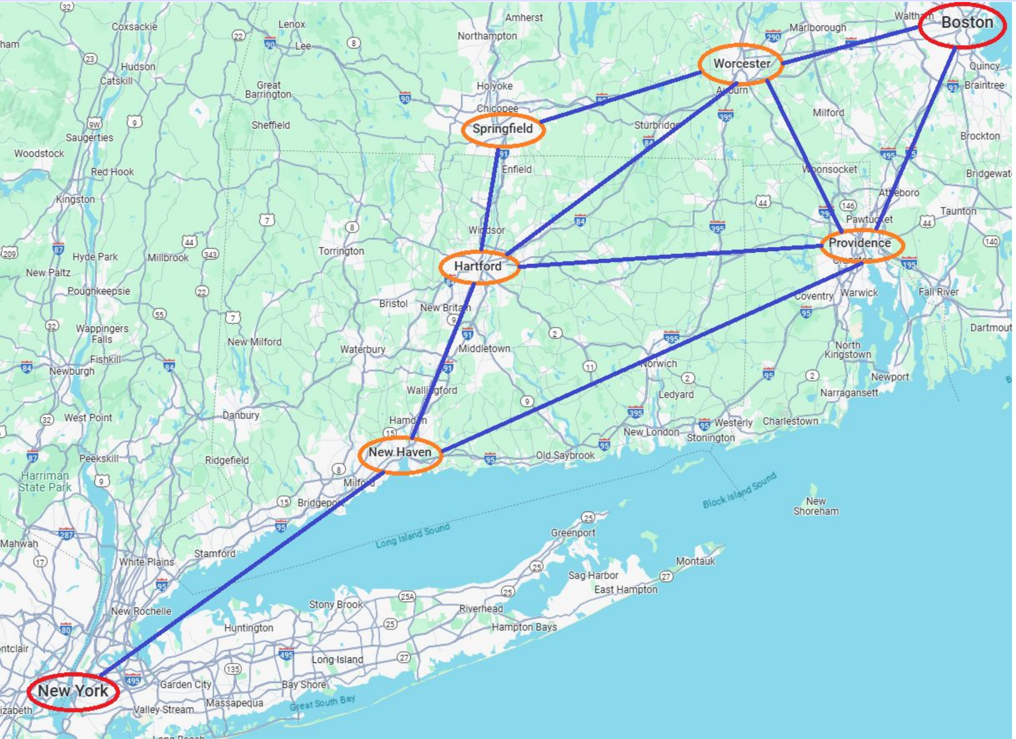
3. **Weight** of the edges can represent the time it takes to travel through the roads (Time = Distance/Speed limit).

4. There are factor that slows down the road, due to traffic, bad weather, car accident, whether the road has a traffic light, etc. This can be applied as **multiplication factors** to the weight of the edges.
   ex) If it is snowing, we multiply 2.0 on the weight of the edge.

Road Trip from Boston to New York

1. Optimally, update live time traffic data and weather information to update the multiplication factors of the edges.
2. However, most of the data available is commercialized and required to buy them.
3. We decided to create our own sample data using Google Map.
4. Our scope is to check if the path finding algorithm works in a given real life situation, but not producing actual app.

Graph of the Sample Data



1. Simplified paths between cities.
2. Find speed limit and length of paths.
3. Give different multiplication factors, which are static in our current code. This can be easily turned into a live data if we have a good source data to update them frequently.

02

Algorithm

Overview

1. Graph-based route optimization system
2. Implement Dijkstra's Algorithm
3. Efficient Travel Planning

Graph Representation and Edge Management

1. Graph implementation using adjacency lists
2. Efficient edge addition with O(1) complexity
3. Designed for sparse graph structures

Dijkstra’s Algorithm

1. Priority Queue for node selection

2. Efficient for shortest-path calculation

3. Time complexity: $O((V+E)\log V)$

Weight Calculation

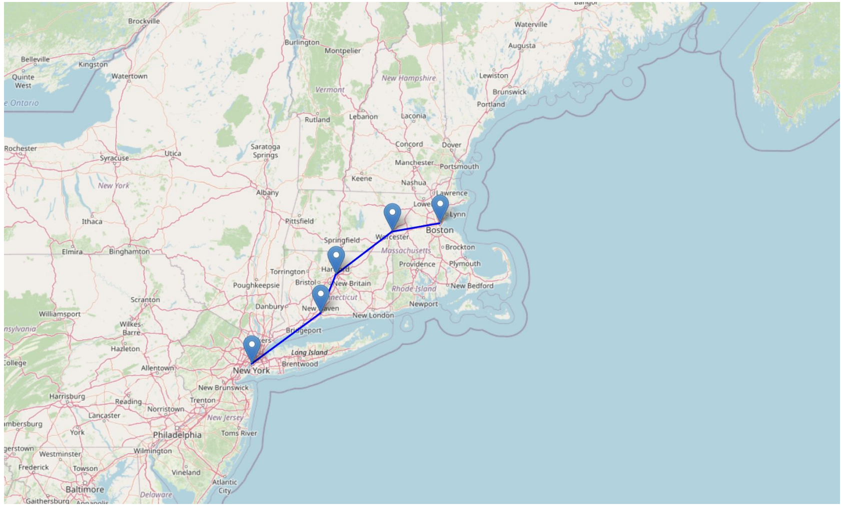
1. Consider different metrics
2. Adds penalties for traffics
3. Time complexity O(1) per edge

Graph creation

1. Predefined city routes
2. Bidirectional edges added
3. Time complexity: O(E) per edge

Visualization

1. Folium for map rendering
2. Adds city markers and route polylines



03

Conclusion

Our Path to the Finish Line

1. Brief recap of the project goal: optimizing road trip routes with user preferences using Dijkstra's algorithm.
2. Acknowledge the progress made: building a prototype to simulate real-world conditions and assess feasibility.
3. Set the tone for the conclusion: a blend of achievements and what's next.

Weaknesses & Limitations

1. **Static Data:** Relies on fixed data for distances, speed limits, traffic, and weather.
2. **Scalability:** Optimized for small graphs; may struggle with larger datasets or complex graphs.
3. **Simplistic Scenic Values:** Subjective factors like scenic beauty are challenging to quantify
4. **Real-Time Adjustments:** No capability to handle live events like accidents or road closures.

Future Research

1. **Real-Time Data Integration:** Enable dynamic updates using traffic and weather data.
2. **User-Centric Customization:** Allow users to set priorities, like scenic routes or rest stops.
3. **Multi-Objective Optimization:** Incorporate user preferences with advanced optimization methods.
4. **Algorithm Enhancement:** Explore efficient algorithms or parallel strategies for large networks.

Final Thoughts

1. Recap the foundational success of using Dijkstra's algorithm.
2. Highlight the project as a springboard for innovation.
3. Inspire future work with the potential impact on travel experiences.

Thank you