Energy consumption for Travel Optimisation

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Problem Statement

What are we trying to optimize?

- The pathfinding algorithm for electric vehicle (EV) travel, incorporating energy consumption statistics, congestion fees, and real-time traffic data.

Applications

- In contrast to conventional navigation software, we want to offer accurate insights on energy-efficient travel while accounting for urban constraints.
- Calculate concrete figures to represent energy consumption over routes.

Success Metrics & Limitations

How we gauge success:

- Comparison to baseline models
- Accuracy of energy-efficient routing
- Performance vs. Google Maps & proprietary software

Key limitations:

- Real-time data access issues
- Computational efficiency challenges
- Trade-off between speed & energy efficiency
- Problem breadth

Data Requirements & Challenges

Key Data Sources

- IEEE dataset
- Traffic Congestion Dataset
- EV consumption dataset

Challenges

- Resolving very large datasets into small workable instances.
- Dataset Synchronization between different cities.

Technical Approach

Mathematical Formulation:

Algorithm choices:

- **Baseline**: Dijkstra's Algorithm
- **Enhancements**: A*, ML-based models, Loss Optimisation from basic consumption formulation
- **Deep Learning**: Graph Neural Networks (GNNs) via PyTorch

Current Progress

What’s done so far:

- Initial pathfinding with Dijkstra’s Algorithm
- Basic energy modeling

Preliminary results:

- Correct path calculation in small NYC road sections
- A* with simple heuristics also delivers viable results

Performance Metrics & Findings

Key performance indicators:

- Execution time efficiency
- Accuracy of EV energy estimation
- Portability to regular fuel usage estimations

Limitations observed:

- Lack of real-time updates
- Need for improved energy consumption modeling
- No available data to incorporate differences between various EV models

Next Steps & Improvements

Short-term goals:

- Incorporate real-time congestion data
- Enhance energy consumption modeling
- Implement A* pathfinding with better heuristics
- More complete mathematical formulation of the problem statement

Long-term goals:

- Implement machine learning-based dynamic routing
- Scale model for larger road networks

Areas to explore

- **Machine Learning & RL:** Adaptive route prediction
- **Urban Constraints:** Road closures, pedestrian zones
- **Optimized Algorithms:** Localizing existing pathfinding methods
- **Alternative Data:** Satellite imagery for traffic prediction