DCIT - CIMO and Louage REPORT

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Introduction

This report aims to explain how three algorithms studied in course work and their importance in the mobility of users. These algorithms are Dynamic Carpooling, CIMO (Ordered Multimodal Route Planner), and Louage.

Dynamic Carpooling Intra-Modal with Transshipment

The Dynamic Carpooling Intra-Modal with Transshipment (DCIT) algorithm is a solution designed to facilitate efficient drive sharing among drivers and passengers traveling along similar routes. This algorithm aims to reduce traffic congestion, to optimize transportation resources, and to provide flexibility to users. Here is how it works, step by step.

- ❖ Normalized Time Windows

The first step is the normalization of the time windows provided by drivers and passengers. It converts time windows into a standardized format to facilitate accurate matching and to enable effective comparison and compatibility assessment between users.

- ❖ Itinerary Division

Then, to simplify the matching process, the algorithm divides the trip into two components: a single itinerary and a return itinerary. This separation ensures that matching is based on the specific needs and preferences of drivers and passengers for both the outbound and return journeys.

- ❖ Verification of Return Itinerary

The existence of a return itinerary is a critical aspect of DCIT. Ensuring that drivers can retrieve their vehicles at the end of the journey is essential. Verification of a return itinerary is conducted to secure the convenience and commitment of participating drivers.

- ❖ Matching Process

Once the previous steps are completed, the algorithm proceeds to match drivers and passengers. This matching process takes into account several factors:

- ➢ Location: matching users traveling along on similar routes.
- ➢ Destination: ensuring passengers share the same or near destinations.
- ➢ Time Windows: aligning users with compatible travel schedules.
- ➢ Vehicle Capacity: the capacity of each vehicle is considered to optimize ride sharing.
- ➢ Constraints and Preferences: user-specific constraints and preferences, such as smoking, music, pet, etc.

- Flexibility and Adaptability

The algorithm is designed to adapt to various scenarios and user requirements. Its flexibility allows it to address different transportation needs and adapt to diverse user profiles, it contributes to the effectiveness in handling a wide range of carpooling scenarios.

- Testing and Evaluation

Testing and evaluation ensures effectiveness in reducing traffic congestion and improving transportation efficiency. Real-world testing and simulations demonstrate the algorithm's capacity to optimize routes, reducing the number of vehicles on the road, and enhancing its efficiency.

Louage

The Louage transportation system in Tunisia is a challenge of matching transportation offers and demands using an innovative incremental greedy pairing algorithm. So it is a multi-constraint and multi-objective optimization challenge, solved by employing the incremental greedy pairing algorithm that incrementally builds a solution by making locally optimal choices at each step. Here are the different aspects of Louage in details:

- Incremental Greedy Pairing Algorithm

Through an iterative process, the algorithm creates pairs of offers and demands, based on their compatibility and predefined optimization criteria, it adapts to new offers and demands without the need for a full re-computation, making it efficient and responsive to real-time changes. This robust management system that collects, processes, and executes offers and demands is what provides optimized transportation matches.

- Evaluation

The Louage performance is evaluated thanks to the number of requests processed, the quality of matches generated by the system, and the computational efficiency of the incremental greedy pairing algorithm.

By leveraging advanced algorithms and digital technologies, Louage allows an optimization which contributes in the improvement of the quality of life for tunisians by reducing their travel times, maximizing vehicle occupancy, and enhancing the revenue for transportation providers.

CIMO

CIMO is an algorithm designed to compute multimodal itineraries, considering real-time transportation demands, it is constituted of two crucial phases: pre-processing and query, each one with its objectives.

- Pre-processing Phase:

During this phase a tree is built using several transportation modes, representing buses, trains, metros, and more as a network of nodes and edges, with nodes denoting stops or stations and edges depicting the connections between them. Furthermore, CIMO allows a dynamic nature of transportation demand by creating a "time-dependent" graph, factoring in variables like time of day and day of the week.

- Query Phase:

The query phase is what allows CIMO to do real-time itinerary calculation. It accomplishes this thanks to:

    - Cost Function: a dynamic programming function that evaluates the optimal itinerary based on two factors: minimizing the number of correspondences and minimizing the global transport time.

    - Heuristic Search: The algorithm explores the transportation network by initiating at the origin of the query (the root) and advances using breadth-first search (BFS), examining all potential paths through the network.

    - Termination Conditions: The algorithm terminates when it reaches the destination specified in the query or when it has examined all feasible paths through the network.

- Efficiency and Real-Time Processing:

CIMO is particularly efficient in its real-time itinerary calculations, by taking into account the time-dependency of transportation demand and by optimizing using a cost function that simultaneously considers correspondences and transport time, in short it minimizes travel challenges and optimizes multimodal travel for users.

Conclusion

In conclusion, the Dynamic Carpooling Intra-Modal with Transshipment algorithm, the Louage transportation system in Tunisia with the incremental greedy pairing algorithm, and CIMO are all transportation optimization solutions, each of them bring unique benefits and features to the transportation sector.

The Dynamic Carpooling algorithm is an adaptable approach reducing traffic congestion and improving transportation efficiency, confirmed by its real-world testing.

The Louage transportation system in Tunisia, employing the incremental greedy pairing algorithm, enhances transportation service matching with its multi-constraint, multi-objective optimization. Its implementation was successful according to the statistics presented, digital technology can transform transportation services in Tunisia.

CIMO is a versatile algorithm that enhances the calculation of multimodal itineraries. Its robust pre-processing phase and efficient query phase, along with its adaptability to real-time factors, position is helpful in multimodal transportation.

In summary, while DCIT, CIMO, and Louage have all transportation-related objectives, they differ in terms of functionalities, indeed DCIT targets carpooling, CIMO specializes in real-time multimodal itinerary calculations, and Louage concentrates on optimizing the allocation of transportation services. Each algorithm is implemented in order to address specific transportation challenges and goals.

So these solutions represent advancements in transportation optimization, with the potential to answer to various challenges and improve the overall transportation experience of users.