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Praxis der Forschung
Themenbeschreibung
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Fast Multicriteria Multimodal Journey Planning Using ULTRA

Background.   ULTRA (UnLimited TRAnsfers) is a preprocessing technique that allows any journey planning algorithm for public transit networks to support unrestricted use of a non-schedule-based secondary transfer mode (e.g., walking, cycling). It works by precomputing *shortcuts* which represent transfers between two public transit vehicles. Currently, ULTRA supports finding Pareto-optimal journeys for two criteria: arrival time and the number of used public transit trips. An extension for transfer time as a third criterion is in development. However, in multimodal journey planning it is often desirable to consider even more criteria, such as waiting time, reliability or travel fare. The goal of this project is to adapt ULTRA for additional criteria.

Possible Directions.   The first step is to adapt the shortcut computation step to handle more criteria. This can be done in either of two ways:

- Adding a straightforward criterion (e.g., waiting time) to the three-criteria variant.

- Adding a more complicated criterion (e.g., travel fare) to the original two-criteria variant.

From here, there are several possible areas of further investigation:

- Developing an efficient query algorithm for the chosen set of criteria.

- Adapting methods for reducing the size of the Pareto set, which tends to grow exponentially with the number of criteria.

- Investigating methods for reducing the number of shortcuts produced by ULTRA. For a high number of criteria and faster transfer modes (e.g., taxis), the current approach is expected to produce too many shortcuts to support efficient queries.

Requirements.

- Programming experience in C++

- Familiarity with modern route planning algorithms