Efficient Computation of Multi-Modal Public Transit Traffic Assignments using ULTRA

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Motivation

Traffic planners need good predictions of the utilization of public transit vehicles

Challenges

- Not all passengers behave the same
- Some passengers walk long distances
- Previous algorithms do not support long walking
- ULTRA enables fast queries, but only one-to-one
- Estimate passenger behavior
- Cycles in perceived arrival time optimal paths

Decision Models

- Our algorithm implements a sequential choice model
- Random utility depends on perceived arrival time (PAT)
- Choice is a function: PAT \( \rightarrow \) probability
- We support various choice functions

Algorithm

Preprocessing:

- ULTRA: Core-CH and shortcuts
- Bucket-CH: CH and buckets

Assignment:

- For each origin \( o \):
  - Let \( N(o) \) be a list of stops, sorted by distance from \( o \)
- For each destination \( d \):
  - Compute perceived arrival times from all stops to \( d \)
  - For each origin \( o \) with demand for \( d \):
    - Generate a group \( g \) of passengers for the demand
    - Use \( N(o) \) to decide where \( g \) walks first
    - Decide which passengers use \( c \)
- Remove unwanted cycles from journeys

Running time:

- Grouping of passengers reduces running time
- Faster, despite solving a problem more complex problem

Literature