**Unified Route Choice Framework and Empirical Study in Urban Traffic Control Environment**

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**Motivation**
- Route choice system (RCS) and traffic control system (TCS) - Two major approaches to mitigating urban congestion
- Little attempt has been made to understand their performance and difference in real-world urban traffic control environment

**Our Work**
- Realize a unified framework for route choice models
- Implement existing route choice models and hybrid models
- Evaluate route choice models on real-world traffic control systems, under microscopic traffic simulation environment
- Study their subtle difference in approaching an equilibrium, and performing under fixed-time and adaptive traffic control

**Problem Definition**
- Day-to-day commuting problem in an urban road network
  - All commuters choose a route, based on existing experience
  - The routes (as traffic flows) are then executed in the context of TCS
- The routes of RCS become new experience for TCS
- Objective: to reach an (system optimal) equilibrium
  - Focus on studying difference in route choice strategies
  - Evaluate the role of the optimization capability of TCS as well

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**Route Choice Framework**

- **Goal**: Specification/analysis of (pure and) hybrid route choice models
  - Provide a way to investigate properties of RC components and identify subtle differences between them
  - Accumulate and build more effective and stable RC models
  - Assumes a simple ISP and a set of agents
    - Focus on realistic, decentralized user behavior

**Agent: Probabilistic Sequential Decision Making Process**

- Decision rules are configured (using sequential execution) to define specific route choice models
  - Basic form: sequence of \(<\text{Decision Rule}(i), \text{Prob}(\text{agent}/i)\) > pairs
  - If Decision Rule(i) is not activated or returns can't decide, then execute Decision Rule(i+1)

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**Simulation Setup**

- Real-world road network with grid-like character

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**Results**

- Reach an Equilibrium (No disturbance)
  - The adaptive RCS reduced average travel time by 21.7%, and the adaptive TCS produced a further reduction 13.4%
- Fixed-Time vs. Adaptive Traffic Control
  - Adaptive TCS: Real-time adaptation leads to flexible capacity control and reducing the risk of congestion
  - Fixed-time TCS: The loss of effectiveness as dynamic flow changes might be seen as modeling an aging problem that is observed in the real world

**Observations on Decision Components**
- R4 (best response) can help for reaching to near optimal, R3 (inertia) can help for maintaining stable in congested cases
- LRU and AIBN variants make better decisions by updating choice probabilities rather than directly based on the cost array

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