Capacity and Crowdedness in Public Transport
A Complex Systems Approach

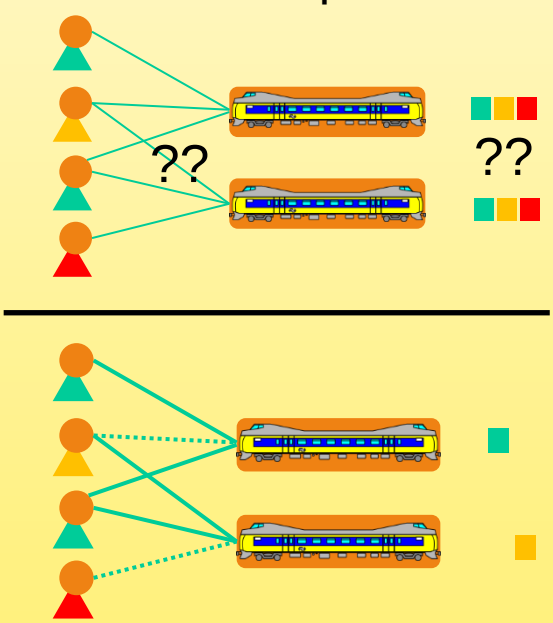
Problem

- Many models in transportation research assume either a fixed demand or a fixed capacity of the infrastructure
- In public transport, some people may try to avoid crowded trains (if possible), while the operator can change the rolling stock allocation daily
- This interaction is important for both the satisfaction of the passengers and the costs of the operator

Methodology

- Use minority games (like the El Farol Bar Problem) to study this interaction in a simplified setting
- Use optimization techniques (Integer Linear Programming) to calculate social optimally (but possibly unfair) bounds
- Simulate how a game with predictive agents using full information and random agents based on the LP-relaxation choose their journeys and compare this to the social optimum

Example



Model for Social Optimum

- Passengers P, Services: T, Utilizations: U
- x_{tp} passenger p takes service t
- y_{ct} utilization of service t is limited to u_c

Maximize $\sum_{t\in T}\sum_{p\in P} x_{tp}$, Subject to:

$$\sum_{t\in T} x_{tp} \le 1 \qquad \forall\, p \in P$$

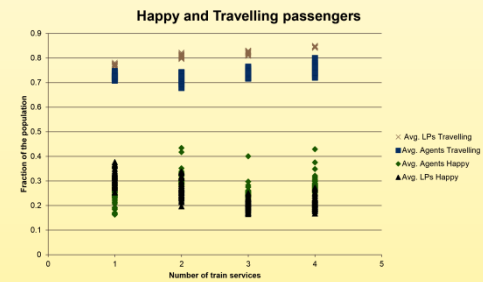
$$\sum_{c\in U} y_{ct} = 1 \qquad \forall\, t \in T$$

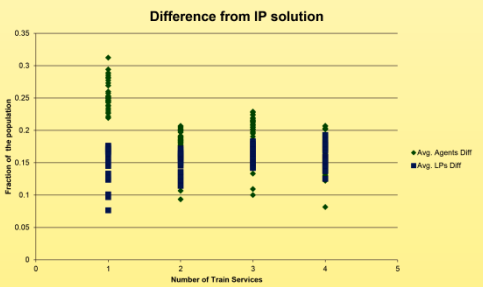
$$\sum_{p\in P} x_{tp} \le \sum_{c\in U} u_c y_{ct} \qquad \forall\, t \in T$$

$x_{tp} + y_{ct} \le 1$ if tolerance of p is incompatible with utilization u_c

$x_{tp}, y_{ct} \in \{0,1\}\ \forall\, p \in P, t \in T, c \in U$

Some Experiments





Future Work

- Study the impact of information on the predictive agents
- Evaluate what type of information the operator should provide to passengers
- Extend to more general utility models
- Extend to a full network level simulation

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