Price-aware Real-time Ride-sharing at Scale- An Auction-based Approach

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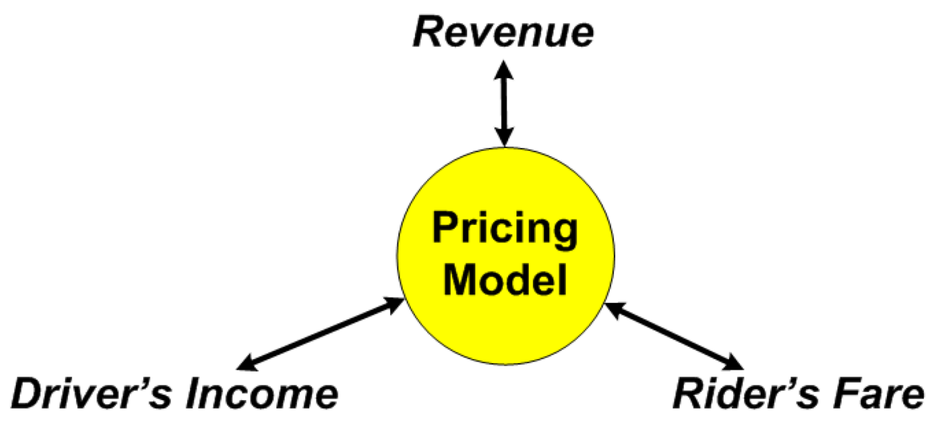
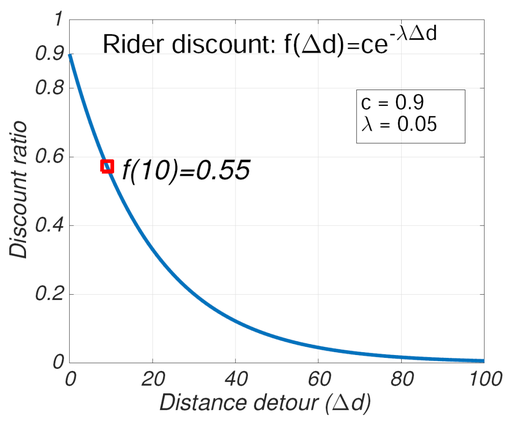
Introduction

- **Traditional Ride-sharing focused on only matching people with similar routes.**
- **Increasing popularity of commercial Ride-sharing requires focus on pricing.**

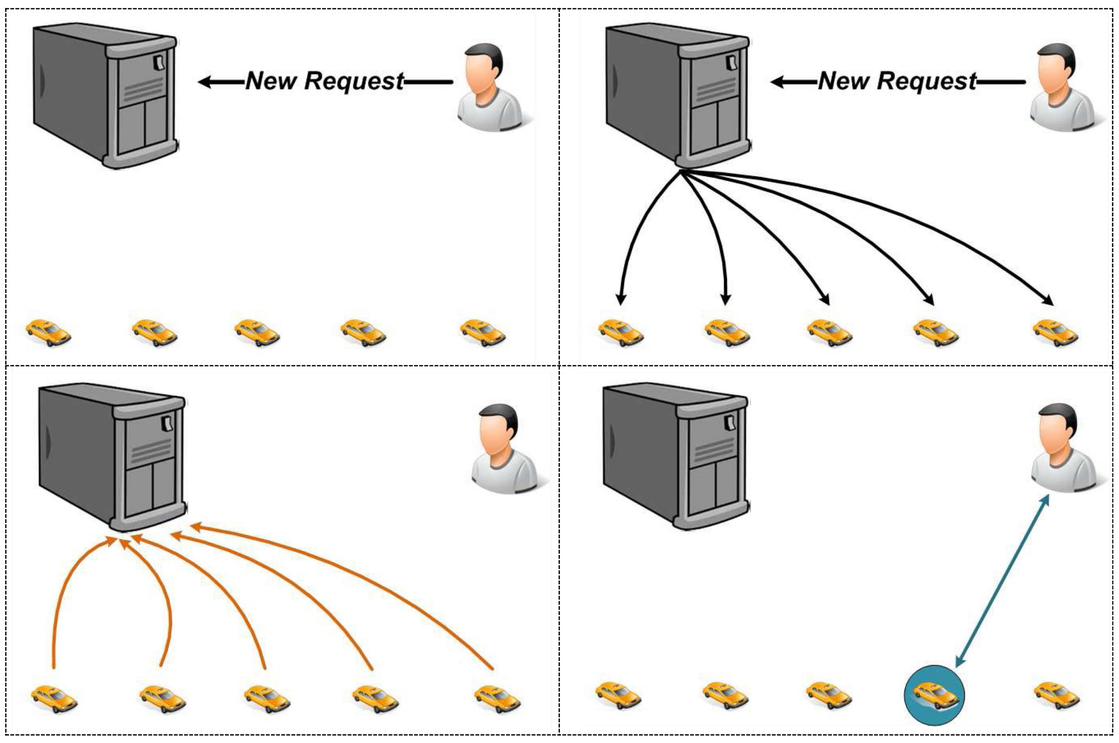
Pricing Model



- **In a *Fair* system:**
  - + The rider should receive a *discount* proportional to the detour incurred to his trip.
  - + The driver's compensation should increase proportional to the distance of his trip.

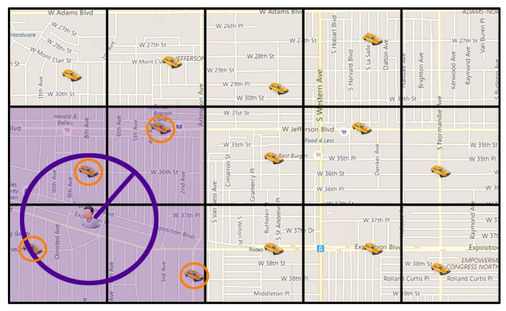


Framework

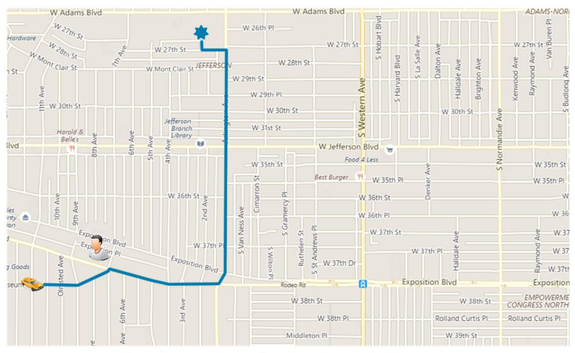


Simple Scenario

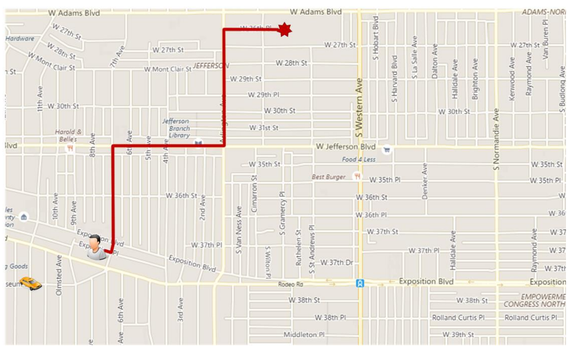
1. **Server identifies potential drivers**



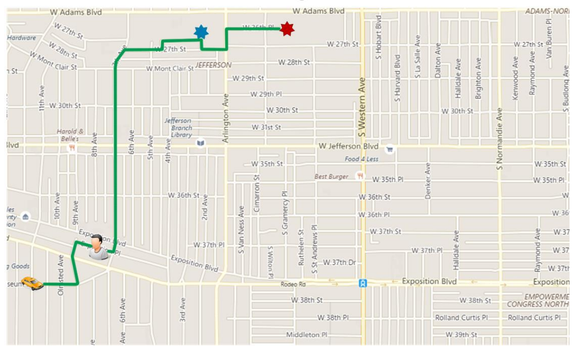
2. **Each potential driver computes its bid locally**



Driver's Original Route



Requester's Shortest Route

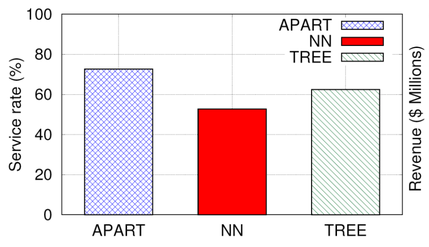


Final Route

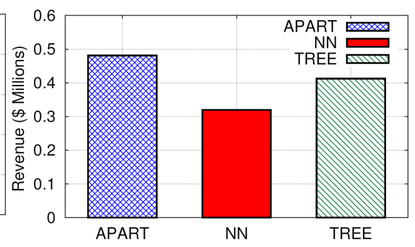
$$\Delta d_{red} = diff(green - red)$$
$$fare_{red} = f(\Delta d).FARE(red)$$
$$income_{driver} = g(green)$$
$$bid = \sum fare - income_{driver}$$

Evaluation

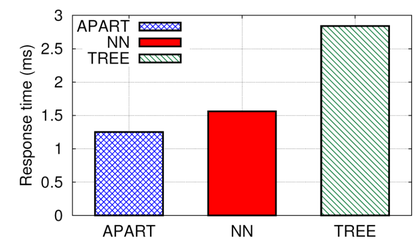
- **Dataset:** NYC Taxi Trips in May 2013 (40K drivers & 500K trips per day)
- **Algorithms:** Apart (our framework), Tree[1] (optimize shortest travelled distance) & NN (always select nearest neighbor)
- **Pricing:** $F(d) = 2 \times d$, $f_r(\Delta d) = 1 - (0.25 \times \Delta d_r^2)$ and $g_v(d) = 1.5 \times d$



Service Rate

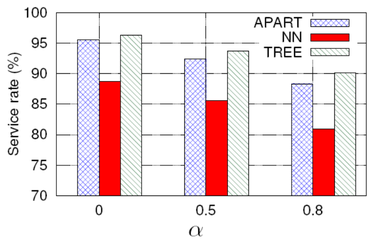


Revenue

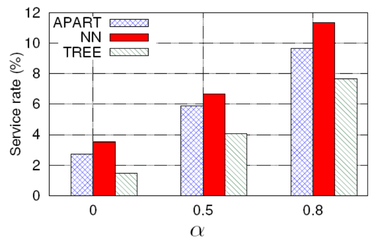


Response Time

- **Different Pricing Model [2]:** $g_v(d_1, d_2) = c.d_1 + (1+\alpha).c.d_2$



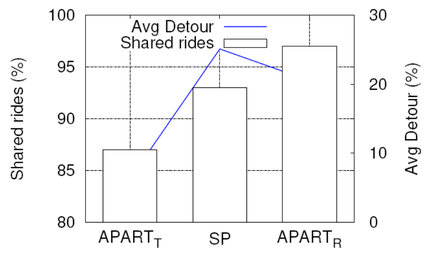
Users that Saved Money



Users that Lost Money

- **Effect of profiles:**

$$Apart_T: f_T(\Delta d_r) = \frac{1}{(\Delta d_r + 1)}$$
$$Apart: f_R(\Delta d_r) = 1 - (\frac{\Delta d_r}{\max\delta})$$



Effect of Profiles

[1] Y. Huang et. al., Large scale real-time ridesharing with service guarantee on road networks, VLDB'17
[2] S. Ma et. al. T-share: A large-scale dynamic taxi ridesharing service, ICDE'13