Waymo Fleet Profitability Optimizer

Aksel Kretsinger-Walters Alena Chan Andrey Aksyutkin Blake Sisson *

Problem Statement

One of the most promising and revolutionary applications of reinforcement learning is in the domain of autonomous robots, specifically self-driving cars. There are many challenges in this domain: intellectual, ethical, technical, and more. For our project, we've decided to narrow our focus to the specific problem of optimizing the profitability of a fleet of self-driving cars.

Monitoring, maintaining, and optimizing a large fleet of self driving cars is a complex problem, and one can quickly think of many dimensions that the problem takes on. Predicting demand, scheduling maintenance, recharging vehicles, setting competitive prices, maximizing coverage, minimizing wait times, and more are all separately non-trivial problems. Jointly optimizing across all of these dimensions and adapting to distribution shifts is an even more challenging problem, and the interactive nature of the problem makes it a natural fit for reinforcement learning and agentic approaches.

We plan to simulate a fleet of self-driving cars as a Markov Decision Process (MDP), and develop reinforcement learning algorithms to optimize the fleet's operations and profitability.

Interest and Relevance

This is an area of active research and development, with many companies investing heavily in self-driving technology. For this technology to reach the market, it is absolutely critical to resolve the safety and reliability challenges that currently exist; however, the economic viability must also be solved for self-driving to reach its full potential.

For the purposes of this course, we think that the interactive nature of the state with its ecosystem, the high dimensionality of the state and action spaces, the data and research publicly available and the possibility of performing far better than a heuristic algorithm make the project a good fit for our semester project.

References

[1] U.S. Census Bureau. "LEHD Origin-Destination Employment Statistics (LODES)." https://lehd.ces.census.gov/data/

[2] Sutton, R. S., & Barto, A. G. "Reinforcement Learning: An Introduction." MIT Press, 2018.

[3] Waymo. "Waymo Open Dataset." https://waymo.com/open/

*Collaborator(s): Aksel Kretsinger-Walters (adk2164), Alena Chan (ac5477), Andrey Aksyutkin (aa5499), Blake Sisson (mbs2246)

[4] Xiao, I. "Reinforcement Learning Project: CitiBike." https://github.com/ianxxiao/reinforcement_learning_project/blob/master/Reports/Presentation_RL_citiBike_20180514.pdf

[5] Li, J., Li, X., & Wang, F. "Reinforcement Learning for Ridesharing: An Extended Survey." arXiv preprint arXiv:2102.11896, 2021.