Intelligent Traffic Control via Multi-Agent Reinforcement Learning

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MathSys Project Proposal

Idea and Motivation

Traffic control is one of the most challenging problems for modern Artificial Intelligence. In its most basic scenario, it involves individuals travelling in a road network from different origins and to different destinations, with a number of control mechanisms, e.g., traffic lights, often deployed at junctions, trying to optimise the flow. Optimisation will typically be geared towards the achievement of desirable systemic properties such as minimal total travel time, having drivers adhere to speed limits, prioritising certain groups of pedestrians and so on.

Currently, traffic network analysis is studied within the realm of game theory via congestion games, i.e., games of perfect information where participants can select among available resources (the possible routes that are available to them), with the cost of each resource depending on its overall usage (the road congestion).

However, game-theoretic models abstract away from important features of real-world traffic networks, such as even the presence of control mechanisms, not to mention their capacity to communicate with one another and adapt to individuals' behaviour. Moreover, due to the complexity of real-world traffic networks, optimal equilibrium configurations can rarely be found but, if anything, only approximated.

Recently, Multi-Agent Reinforcement Learning has emerged as a powerful framework to study interdependent agents learning each others' behaviour and initial studies have shown promise in its application to traffic control.

This project aim at investigating how to design intelligent traffic control mechanisms that react to intelligent (and self-interested) drivers using Multi-Agent Reinforcement Learning methods.

The analysis will be carried out looking at the mathematical and computational properties of the game equilibria, but also using state of the art traffic simulators such as SUMO.

Key Research Areas

Artificial Intelligence, Algorithmic Game Theory, Transportation Research.

Key References

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