

## Abstract:

With the development of modern cities, traffic congestion has become a significant problem, leading to substantial time and economic wastage and increased carbon emissions. One potential solution lies in optimizing traffic signal patterns. This study seeks to employ reinforcement learning and agent-based models (ABM) to find an optimal traffic signal pattern to alleviate congestion in London. Traffic lights will serve as agents, perceiving the flow of cars in all four directions at intersections in real-time, and use reinforcement learning to gain experiences to assist in the decision of signal switching. We propose the following research question: 'What is the optimal traffic signal strategy when an intersection faces various types of traffic flow?' To answer this question, this paper review relevant literature, establish an agent-based model for simulating the scene of an intersection, define and train a reinforcement learning model to find the optimal traffic signal pattern, and quantitatively compare this pattern with pre-defined ones. We then will try to apply this method to the London traffic network and evaluate the results. As conclusion, the model produces a decision table that contains the expected rewards for decision actions under any momentary environments of traffic flow in all four directions. Using this decision table, we can effectively reduce traffic congestion, contributing positively to the United Nations' Sustainable Development Goals.

## Keywords:

traffic congestion, reinforcement learning, agent-based model, traffic signal congestion,

## Workflow:

