Optimizing Traffic Flow: Implementing Neural Networks and Deep RL Machine Learning Algorithms to Make Traffic Management More Effectual

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The purpose of this experiment is to determine if the efficiency of traffic flow can be improved by leveraging the strengths of Artificial Intelligence (AI), the best Machine Learning (ML) model for improving traffic efficiency and if the benefit of implementing AI would outweigh the cost. The investigator employed two ML models to test his hypothesis; Method 1 — Neural Networks, and Method 2 — Deep Reinforcement Learning. The investigator hypothesized that the use of ML models will significantly impact the flow of traffic, leading to more efficient travel; eradicating traffic jams, and thereby improving time and fuel efficiency. The controlled variables for both methods were - the rate at which the cars spawn in the simulation, the distribution of vehicles generated by the simulation, and the vehicle's desired path. The dependent variable for Method 1 was the number of vehicles that passed through the intersection, and for Method 2 was the average waiting time. For Method 1, the investigator developed a Neural Net with 18 input neurons, 10 output neurons, and a Tanh activation function. Method 2 incorporated a Deep RL Model with 18 inputs, 10 outputs, 2 hidden layers, and a RelU activation function. This investigation concludes that the Deep RL model was more effective, improving overall efficiency by 66%, compared to the Neural Net which improved efficiency by 27%. The knowledge gained from this research has the potential to transform traditional traffic management, making a significant difference in people's lives in terms of time saved and fuel efficiency.