COMP5212 Machine Learning 2018 Fall programming project proposal

Building a self-driving game bot with Reinforcement Learning

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October 15, 2018

Abstract

In this project proposal, we intend to build a smart self-driving agent using reinforcement learning algorithms. Due to the limitation of real-world hardware and data, we tend to use a game simulator provided by OpenAI to generate training data. We introduce the elements of Q-learning, a reinforcement learning technique which does not require a model of the environment.

1 Description of the application and its practical significance

Self-driving car has been a hot topic in recent years. Several industry giants, like Google and Tesla Motor, have devotes significant efforts to developing self-driving cars. Letting computers to drive can not only release human beings from fatigue, but also reduce the frequency of traffic accidents. However, designing a robust self-driving system is non-trivial as the real-world traffic conditions are diversed. Due to the limitation of hardware and computing resources, we intend to find a solution to self-driving in a simulated game environment.

2 Formulation of the machine learning problems involved in the application

For human drivers, the driving behavior can be formulated in a loop from an environment sensing input to action output. Our eyes and ears are the sensors to interpret the current environment, including the road view from wind screen (e.g. weather, traffic lights, walking people), view from side mirror (e.g. neighboring cars, following cars), car horns, and so on. Then our brain takes
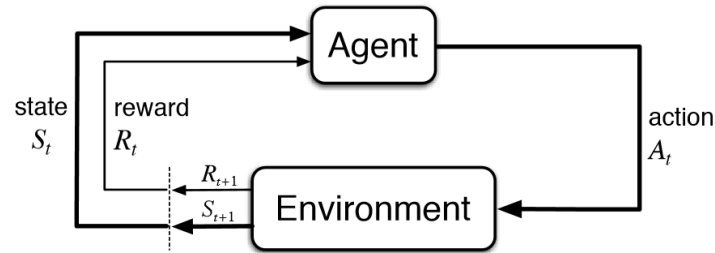
Figure 1: Reinforcement Learning Illustration

all these input signals to decide what action to take. The actions include turning the steering wheel, lighting turn signals, accelerating, braking, and so on. Once the actions are executed, the environment input changes, and again drivers will decide and take a new round of actions accordingly. This loop continues until the car arrives at the destination.

The environment-action loop in the driving experience resembles the basics of reinforcement learning, an area of machine learning concerned with taking actions in an environment in order to maximize some notion of cumulative reward. Unlike supervised learning, reinforcement learning does not require correct input/output pairs. Instead, reinforcement learning often requires a reward function in terms of different actions under the environment. For driving, the final reward can be no traffic accident and arrive at the destination safely.

3 Data set (and preprocessing, if needed)

TODO

4 Machine learning methods

TODO

5 Design of experiments and performance evaluation

TODO