Mathematical Modeling for Intelligent Systems – Nadir Farhi

Project 2020-2021 - Reinforcement learning for car-following on a ring road

The objective of this project is to apply the algorithm of Q-learning to learn by numerical simulation the process of driving (car-following) on a ring road of one lane. We consider a ring (circular) road of one lane, where a given number of cars (which is a parameter here) run without passing. We use the trafic simulator to simulate the dynamics of all cars, except one, which we control under the Q-learning algorithm.

State variables :
- The speed of the controlled car, to be discretized in [0, 100 Km/h] for example.
- The relative speed (speed of the leader car of the controlled car – speed of the controlled car), to be discretized in [-100 km/h, 100 km/h] for example.
- The space-headway (the position of the leader car of the controlled car – the position of the controlled car), to be discretized in [0, the length of the road] for example.

Control variables :
- Acceleration of the controlled vehicle.

Reward :
- the speed of the controlled vehicle
- (-10) if any accident or out fo raod.

We need to learn for a given number of cars, and then change this number many times, in order to cover all the situations with respect to the car-density in the road.

- Iterate the Q-learning algorithm, and change some parameters eventually, up to convergence.
- Illustrate the Q table with color maps.
- Interpret the results.