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K. N. Toosi University of Technology

Faculty of mechanical engineering

Artificial Intelligence

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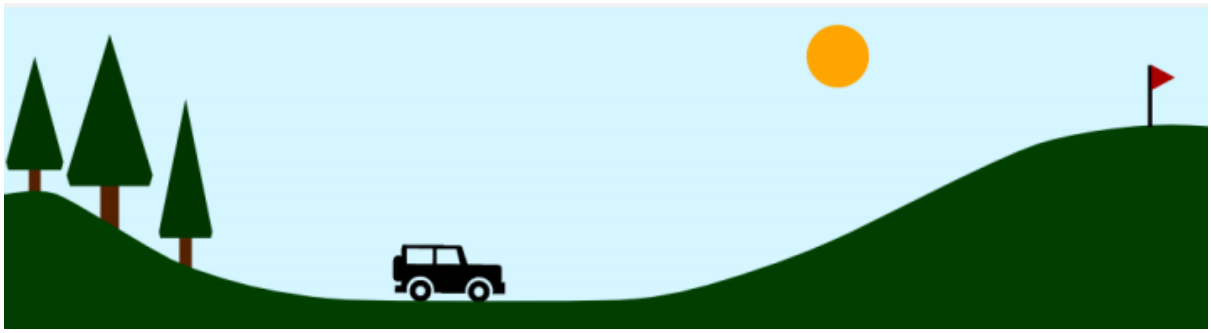
RL Project

Due date: 00/04/10

Mountain Car

The mountain car is a classic reinforcement learning problem. This problem was first described by Andrew Moore in his PhD thesis and is defined as follows: a mountain car is moving on a two-hills landscape. The engine of the car does not have enough power to cross a steep climb. The driver has to find a way to reach the top of the hill.



The state space is defined by the position x obtained through the function $\sin(3x)$ in the domain $[-1.2, +0.5]$ (m) and the velocity defined in the interval $[-1.5, +1.5]$ ($\frac{\text{m}}{\text{s}}$).

There are three possible actions [-2.0, 0.0, +2.0] which are the values of the force applied to the car (left, no-op, right). The reward obtained is positive 1.0 only if the car reaches the goal. A negative cost of living of -0.01 is applied at every time step. The mass of the car is 0.2 kg, the gravity is $g = 9.81 \frac{m}{s^2}$, the friction is defined by $k = 0.3\ N$, and the time step is $\Delta t = 0.1\ s$. Given all these parameters the position and velocity of the car at are updated using the following equations:

$$x_{t+1} = x_t + \dot{x}_{t+1} \Delta t$$

$$\dot{x}_{t+1} = \dot{x}_t + \left(g\ m\ cos(3x_t) + \frac{a_t}{m} - k\dot{x}_t \right) \Delta t$$

The environment of mountain car has been attached.

First Step

Implement two appropriate Q-Learning and SARSA based controller and compare them to each other.

Note: consider the noise of environment is zero.

Second Step

In this step, you are going to study the effect of environment noise. Implement 20 percent and 30 percent noise in the environment and explain the result.

Third Step

From homework 4, you have learned many parameters affect policy. Change any of them that you guess they can make any improvements.

Good Luck.