INFO8003-1 Optimal decision making for complex problems

Part 1 – Problem initialization

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Abstract

In this second assignement, the car on the hill problem is considered. This report only considers the initial steps of implementing a solution to make the car reach the top of the hill.

Section 2

Three classes were implemented :

- The game class containing all the information of a given game, as the number of steps, the trajectory taken, and methods to launch a game.
- The agent class containing the decision agent, taking actions based on a policy and a domain's dynamics
- The domain class containing the dynamics of the environnement in which the car evolves.

The Euler integration method of the state variable s and p is given by the following pseudo code:

Algorithm 1 Euler integration

```
it = 0.001 {integration time }
ts = 0.1 {time step}
N = ts/it
while i<N do
  s = s + it * ds/dt
  p = p + it * dp/dt
end while
```

The car starts at an initial state (p, s) with $s = 0$ and p drawn uniformly in the $[-0.1, 0.1]$ interval. The chosen policy is to always accelerate, in other word the agent always selection the action $u = 4$. The car is never able to reach a final state in this configuration. It tries to climb the hill but is unable to do so as it has not the sufficient acceleration and momentum to overcome the gravity.

Section 3

Several games are played each starting from the stat (p, s) with $s = 0$ and $p = \mathbb{U}[-0.1, 0.1]$. The expected return value of this state is estimated by using the Monte Carlo method. In other words, the mean of the cumulative rewards of thoses games is taken as expected return value for the initial state (for the "always accelerate" policy, it is equal to 0, without surprise).

Section 4

The code in section4.py runs a game, then uses the trajectory produced to create the corresponding images thanks to the provided code and builds the image as it goes. The library imageio is being used, and a gif is stored in the local file from which we execute the script.