DAT405 Introduction to Data Science and AI

2020-2021, Reading Period 2

Assignment 5: Reinforcement Learning

Overview

This assignment is about sequential decision making under uncertainty (Reinforcement learning). In a sequential decision process, in each state the decision maker, or agent, chooses among a set of actions, and the system (environment) jumps to a new state based on both the current state and the chosen action. At each jump the decision maker receives a reward, and the objective is to find a sequence of decisions (or an optimal policy) that maximizes the rewards.

We will use Markov decision processes (MDPs) to model the environment, and the assignment is divided into two parts:

- First, we focus on a decision process with no uncertainty, meaning that we can compute the optimal action in each state. We will use an MDP to model the environment, and then introduce one algorithm (out of many) for finding the optimal policy.
- Next, we will use Q-learning to make decisions under uncertainty. Q-learning is a reinforcement learning method that can be used to explore and learn about an unknown environment. The objective is again to determine an optimal policy for the now unknown MDP.

We have attached an example notebook illustrating the use of the OpenAI gym library used in questions 3 to 5 (q_learning_frozen_lake.ipynb).

Point distribution

To get a passing grade (5) questions 1 to 3 needs to be satisfactorily addressed. Address questions 4 and 5 to get full points (up to 10).

What to submit

In general, when submitting your reports, please make sure all results and discussions are clearly visible and readable. **That means, notebooks should be executed and all code output should be visible and readable.** In Google Colab, first go to the Runtime menu and select Factory Reset-Runtime and then go to the Runtime again and select Run all.

You have the following options to submit the assignment:

- Submit a link to a completed and fully executed Google Colab notebook (please make sure it is executable and editable for anybody with the link).
- Submit a completed and fully executed Jupyter notebook (.ipynb-file) from Colab or in Jupyter.