

DAT405 Introduction to Data Science and AI

2022-2023, 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 question 3 (q_learning_frozen_lake.ipynb).

Grading

Question 1 – 1p, question 2a – 2.5p, question 2b – 0.5p, question 3 – 1.5p, question 4a – 1p, question 4b – 1p, question 5a – 1.5p, question 5b – 1p.

What to submit

- Please, submit everything as one PDF with all your python code included. Use LaTeX template.
- State the names of the people submitting the work.
- On the first page of the report state how many hours each person spent working on the assignment.
- The solutions and answers to the theoretical and practical problems, including LaTeX math-mode equations, plots and tables etc

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.

Deadline Dec. 6 2022 at 23:59