DAT405 Introduction to Data Science and AI

2020-2021, Reading Period 1

Assignment 5: Reinforcement learning and classification

There will be an overall grade for this assignment. To get a pass grade (grade 3), you need to pass items 1-3. To receive higher grades, finish items 4 and 5 as well.

In this assignment you will use the Jupyter notebook to edit the submitted ipynb-file.
The entire assignment, including all code, solutions and plots should be submitted through the notebook file. No separate files shall be submitted. For a complete tutorial on how to use Jupyter notebook see, for instance
https://www.datacamp.com/community/tutorials/tutorial-jupyter-notebook

For specific instructions on how to type and edit the notebook, using Markdown, see for instance:
https://www.datacamp.com/community/tutorials/markdown-in-jupyter-notebook

The details and specific assignment questions are included in the submitted ipynb-file.

Overview

This assignment is about sequential decision making under uncertainty. 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.

What to submit

- **The entire assignment should be submitted through the notebook. No separate file will be accepted.**
- In the notebook:
  - State your names and how many hours each person spent on the assignment.
  - The solutions and answers to the theoretical and practical problems, including LaTeX math-mode equations, plots and tables etc.
  - All plots/results should be visible such that the notebook does not have to be run. But the code in the notebook should reproduce the plots/results if we choose to do so.

- Before submitting, make sure that your code can run on another computer. That all plots can show on another computer including all your writing. It is good to check if your code can run here: https://colab.research.google.com.

Deadline: Oct 5, 2020 at 23:59.

Self-check

Is all the required information included? Have you answered all questions to the best of your ability? Anything else you can easily check? (details, terminology, arguments, clearly stated answers etc.?) Does your notebook run and can reproduce the results, plots and tables?

Do not submit an incomplete assignment! We are available to help you, and you can receive a short extension if you contact us.

Grading

Grading will be based on a qualitative assessment of each assignment. It is important to:

- Present clear arguments
- Present the results in a pedagogical way.
    - Should it be table/plot? What kind of plot? Is everything clear and easy to understand?
- Show understanding of the topics
- Give correct solutions.
- Make sure that the code is well commented.
    - Important parts of the code should be included in the running text and the full code uploaded to Canvas.