Homework #3: Markov Decision Process & Reinforcement Learning

MESIIN476024 - AI algorithms

Due: Sunday, December 22, 2024, at 11:59 p.m.

Instructions

Read all the instructions below carefully before starting the assignment and making your submission.

- The homework **may be completed individually or in pairs**. Be sure to include the names and lab group of both students in your submission.
- **Notebooks submitted with only code, without any explanations, discussions and analysis of results, will not be evaluated.**
- **This assignment is not intended to assess your Python programming skills. Instead, it is designed to evaluate your understanding of the concepts covered in class, your ability to apply these concepts to solve complex problems, and your analytical and critical thinking skills in addressing these challenges.**
- Up to 1 bonus points will be awarded for submissions that demonstrate deep reflection, innovation, and notable commitment in the final deliverable.
- If specific instructions or details are not explicitly provided, you are free to make reasonable assumptions as long as they are justified and consistent with the context.
- **Submission Requirements:**
  - Your submission should be a **zip file** containing a PDF summarizing your written answers to Exercise 1, a notebook file (.ipynb) containing the Python code for Exercise 2, along with any additional scripts or files you consider relevant. Name the zip file according to this format: HW3_YourLabGroup_YourName (e.g., HW3_DIA3_PierreFEUILLE).
  - **Due date: December 22, 2024.** Late submissions will incur a penalty of -2 points per day after the due date.
  - Upload your assignments to the designated submission space on DeVinci Learning by the deadline. (Navigate to Homework → Homework#3 → Deposit Homework 3 → DIA_).
- Cite all external sources used. This assignment is your individual responsibility, and plagiarism will not be tolerated. Software will be used to check for similarities in both writing and code. If you have used ChatGPT or any generative AI, please specify on which aspects it was used.

Topics: Points

- **Exercise 1**: 6 Points
- **Exercise 2**: 14 Points

Exercise 1: MDP Examples [6 Points]

Devise three distinct example tasks that fit into the Markov Decision Process (MDP) framework. For each example:

1. Clearly identify the **states**, **actions**, and **rewards**.
2. Ensure that the examples are as diverse as possible, exploring different contexts.
3. In at least one example, stretch the limits of the MDP framework to showcase its flexibility and abstract nature.

Guidelines:

- Think creatively about the tasks while maintaining the MDP structure.
- The examples can range from practical real-world problems to abstract theoretical scenarios.

Exercise 2: Completing Lab 5 Session Exercises [14 Points]

Complete all questions and tasks from **Lab Session 5: MDP & RL**. Ensure that your responses demonstrate clear reasoning and implementation for each task.

Instructions

1. Review the questions and exercises provided in the Lab 5 notebook thoroughly.
2. For each exercise, ensure that you **discuss your results**. This includes:
    - Analyzing the outcome of your implementation.
    - Highlighting key observations.
    - Explaining how the results relate to the underlying concepts covered in the lab.

Deliverables

Submit a single **Jupyter Notebook** that includes:

- Completed answers to all Lab 5 questions.
- All Python code implementations.
- Well-structured discussions and analyses, clearly labeled for each exercise using Markdown cells.

Evaluation Criteria

Your submission will be assessed based on:

- **Completeness:** All exercises and questions are addressed.
- **Clarity and Accuracy:** Explanations are detailed, accurate, and concise.
- **Depth of Analysis:** Results are critically analyzed, and observations are insightful.
- **Presentation:** Notebook is well-organized, with proper formatting and labels.