Lab Exercise

SE4050 – Deep Learning **2024**

Lab: Reinforcement Learning

Question 1: Markov Decision Process and Q-Learning

Objective: Students are expected to gain coding experience in two approaches to Reinforcement Learning, namely the Markov Decision Process and Q-Learning. They should utilize this knowledge to develop Deep Q-Learning models on their own.

Tasks

1. Upload the attached Markov_Decision_Process (PolicyIteration) notebook and the GridWorld (QLearning) notebook to Google colab.
2. Understand the two codes.
3. Complete the incomplete parts in each notebook (these parts are mentioned by '#type your code here').
4. Run the notebooks.
5. In the GridWorld notebook, increase the grid size to a large value to see how the execution time and the time to converge changes.
6. Add screenshots of the completed parts of two notebooks (in step 3) in a word file.

Question 2: Model-Based vs Model-Free Reinforcement Learning

Objective: Deepen the understanding of the difference between Model-Based and Model-Free Reinforcement Learning.

Tasks:

1. In the Markov Decision Process (MDP) notebook, **modify** the code to compare the execution time and convergence between a Model-Based approach (e.g., Policy Iteration or Value Iteration) and a Model-Free approach (e.g., Q-Learning).
2. **Explain** the difference between Model-Based and Model-Free algorithms briefly.
3. **Add screenshots** of the results for both approaches in a Word file.

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Question 3: Introduction to Deep Q-Learning (DQN)

Objective: Transition from traditional Q-Learning to Deep Q-Learning, building on the foundational knowledge gained in the previous tasks.

Tasks:

1. Extend your implementation from Question 1 to develop a Deep Q-Learning (DQN) model. Use a neural network to approximate the Q-values instead of using a lookup table.
2. Implement an epsilon-greedy strategy for action selection in the DQN, testing different epsilon values (e.g., 0.1, 0.5, 0.9) to analyze the balance between exploration and exploitation.
3. Compare the convergence and performance of the DQN model at different epsilon values and plot the results.
4. Add screenshots, the plots, and a brief discussion of your observations to the Word document.

Submission: -Download the final modified notebooks. Add these notebooks and the word file to a new zip file. Upload this zip file to the submission link. The file name should be your registration number.