Assignment 9

Applied Machine Learning

Please refer to the Reinforcement Learning Jupyter notebook in course materials.

Answer questions 1-3 below considering any Nim game reinforcement learning model.

1. [10 pts] Describe the environment in the Nim learning model.

2. [10 pts] Describe the agent(s) in the Nim learning model (Hint, not just the Q-learner). Is Guru an agent?

3. [10 pts] Describe the reward and penalty in the Nim learning model.

4. [10 pts] How many possible states there could be in the Nim game with a maximum of 10 items per pile and 3 piles total? (This problem requires a number for its answer, not merely a closed-form expression.)

5. [10 pts] How many possible unique actions are there for player 1 to take as their first action in a Nim game with 10 items per pile and 3 piles total? (This problem also requires a number for its answer, not merely a closed-form expression.)

6. [10 pts] Do you think a Q-learner can beat the Guru player? Why or why not? Be thorough.

7. [40 pts] Find a way to improve the provided Nim game learning model. (Hint: How about penalizing the losses? Hint: It is indeed possible to find a better solution, which improves the way Q-learning updates its Q-table). You must **code** a solution and **also demonstrate** the improvement by reporting its performance against players (Random, Guru).

   Do not put the Guru player's operating code inside the learning module, as this would defeat the purpose of reinforcement learning. However, you may train your improved Q-learner by having it playing against a Guru; using those games as experience is legitimate reinforcement learning.