# CMP2020M Advanced Machine Learning – Workshop Week 1

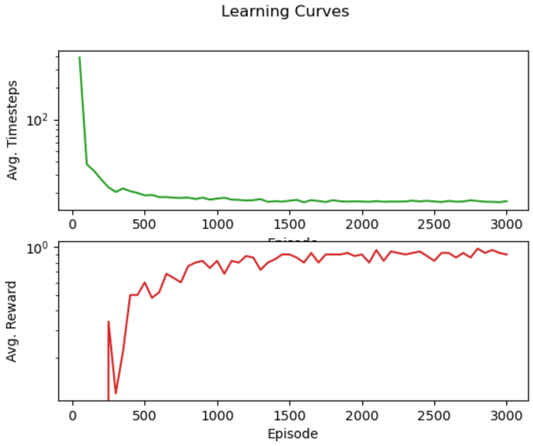
**Summary**: In this workshop you will start training Reinforcement Learning (RL) agents, first using tabular RL and then using deep RL. To do that we will use the Python programs available from our module in Blackboard, see the workshop materials under week 1 (please download them). Please tell your answers to your lecturer or demonstrator (and compare your answers with your peers).

## Task 1: **Grid World**

In this task you will train a tabular RL agent in a grid world. Train it from the command line as:

- Python QLearning-GridWorld.py

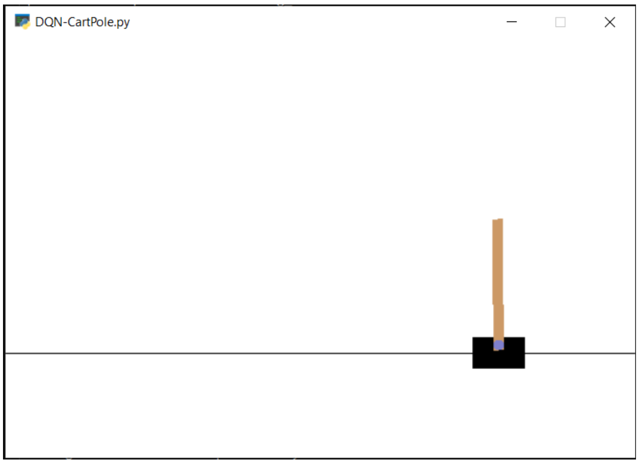
It generates a couple of learning curves such as the following. *How would you extend this program to output the learnt sequence of actions starting from the initial state s=[0,0]?*



## Task 2: **Cart Pole**

In this task you will train two RL agents to learn to balance a cart pole. To do that, open two terminals and execute one of the following commands in each of the terminals:

- python QLearning-CartPole.py
- python DQN-CartPole.py



Observe the amount of training episodes for each of them. In addition, observe the how the epsilon value decreases over time and how its relationship to the overall reward. We should expect the cumulative discounter reward to increase as epsilon decreases. At the end of training, the programs show a visualisation of a cart pole such as the one on the right-hand side. *What agent learnt a better policy/behaviour Q-Learning or DQN (note that the longer an episode takes to finish the better)?*

Task 3: **Breakout Game**

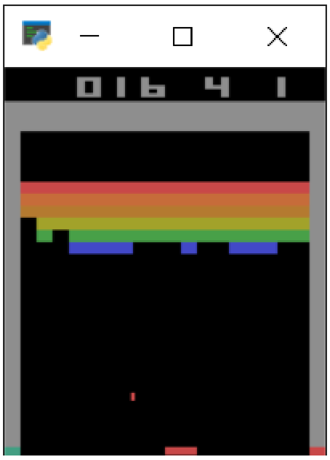
In this task you will train a deep RL agent to play the game of Breakout from images.  To enable that, open a terminal as administrator and install the software pre-requisites as follows:

- git clone https://github.com/openai/baselines.git
- cd baselines
- pip install -e .
- # Download http://www.atarimania.com/roms/Roms.rar
- # Extract Roms.rar
- # Extract ROMS.zip
- pip install atari_py
- #  or
- conda install -c conda-forge atari_py
- python -m atari_py.import_roms Roms\ROMS

Once you have done the above, train your agent from the command line as follows:

- python DQN-Breakout.py

Given that this agent learns from image-based states (as the one in the figure on the right), it will take longer to train than the previous agents (about 1 hour or less, depending on your hardware). You can leave your agent training to see how far it goes in the remaining time of the workshop.



Whilst your agent is training, download the example output in the file LogFile-BreakoutAgent-train100Ksteps.txt.  Write a program that plots the running reward against frame count, and the epsilon value against frame count. You could use the program in task 1 as an example. As homework you could try other hyperparameters such as the following to see if you can train a better agent:

```
epsilon_greedy_frames=200000
update_target_network=5000
```