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On the use of reinforcement learning to play Atari games

Idea and application:

Atari games are widely known and have been played by millions of people globally. We want to implement a reinforcement learning algorithm to solve some of these games such as Breakout, Space Invaders and Pacman. These games were solved several years ago and even more complex games such as *Chess* or *Go* have been solved **[4]**, however we think it will be a good first hands-on experience of reinforcement learning.

Based on the research we made, we will use Q-learning and inverse reinforcement learning to produce an artificial intelligence capable of winning at a selected Atari game. A last step would be to widen our algorithm so that it can generalize quickly to other Atari games.

Planned work:

- First, we will use the Open AI Gym library from python **[2]** to get the environments working. Implementing a program capable of playing (randomly) the games will be our first step.
- Second, we will set up some useful functions to do reinforcement learning: building a storage function to collect the data of observations, taken actions, earned rewards...
- Third, we will start by implementing a very easy Q-Learning algorithm to find the optimal policy to play each game, and see what performances we can reach on them.
- Fourth, we will complexify the architecture of the agent with methods such as asynchronous actor critic agents **[3]** to reach even better performances.
- Finally, if we have enough time, we will try to build a general artificial intelligence **[1]**, capable of playing not only one game, but the three of them (breakout, space invaders and pacman).

Sources:

1. https://towardsdatascience.com/atari-reinforcement-learning-in-depth-part-1-ddqn-ceaa762a546f
2. https://gym.openai.com/envs/#atari
3. https://medium.com/emergent-future/simple-reinforcement-learning-with-tensorflow-part-8-asynchronous-actor-critic-agents-a3c-c88f72a5e9f2
4. https://arxiv.org/pdf/1712.01815.pdf