Playing Games with Vision-based Deep Reinforcement Learning

Anirudh Vemula
avemula1@andrew.cmu.edu
16-720

Debidatta Dwibedi
debidatd@andrew.cmu.edu
10-701

Project Idea

Recently, Google Deepmind showcased how deep learning can be used in conjunction with existing reinforcement learning(RL) techniques to play Atari games[1]. Deep learning has been successful in extracting useful features from images, text and audio. Instead of using handcrafted features, they use a Convolutional Neural Network(CNN) to extract visual features to learn good value functions in a reinforcement learning setting. In contrast to the supervised learning setting in which samples are drawn independently from a stationary distribution, in RL the input data is usually highly correlated an not stationary. To tackle the above problem an experience replay mechanism[2] is used. We want to explore these recent developments in RL by implementing a system that learns to play Atari games using Deep Q Learning.

The video of the game being played from the emulator will serve as input. Our system would emit an action to the emulator which would perform the requested action modifying the current state of the game and occasionally emit a reward(which can be positive or negative). Our reinforcement learning system would expect to learn a policy to successfully play the game.

Dataset

We will use the Arcade Learning Environment(ALE)[4] to play one of the 2600 Atari games. The system allows us to interact with it by actually playing the game and provides access to the video(210 $\times$ 160 RGB video at 60Hz) of the game being played which will serve as visual input for the system.

Software

We will use Caffe as the deep learning framework which will provide us with off-the-shelf implementations of CNNs and LSTMs.

Teammates and work division

Anirudh Vemula and Debidatta Dwibedi will be working on this project. Debidatta Dwibedi is registered in 10701 course and Anirudh Vemula is registered in 16720 course and this will serve as the course project in each member's respective courses.

Goals of the project

We expect to implement the baseline version that uses a CNN in a reinforcement learning setting to play Atari games(like Breakout and Pong). One improvement that researchers have looked into is adding an Long Short Term Memory(LSTM) module to encode sequential visual information[3]. After that, we will look into why this approach fails for some games(like Asterix and Bank Heist) and attempt to improve the system's performance.

References

[1] Mnih, V., Kavukcuoglu, K., Silver, D., Graves, Alex, A., Ioannis, W., Daan, Riedmiller, M. (2013) Playing atari with deep reinforcement learning. arXiv preprint arXiv:1312.5602

[2] Long-Ji Lin.(1993) Reinforcement learning for robots using neural networks. Technical report, DTIC Document.

[3] Oh, J., Guo, X., Lee, H., Lewis, R. L., Singh, S. (2015). Action-conditional video prediction using deep networks in atari games. In Advances in Neural Information Processing Systems (pp. 2845-2853).

[4] M. G. Bellemare, Y. Naddaf, J. Veness and M. Bowling.(2013) The Arcade Learning Environment: An Evaluation Platform for General Agents. In Journal of Artificial Intelligence Research 47, pp. 253-279.