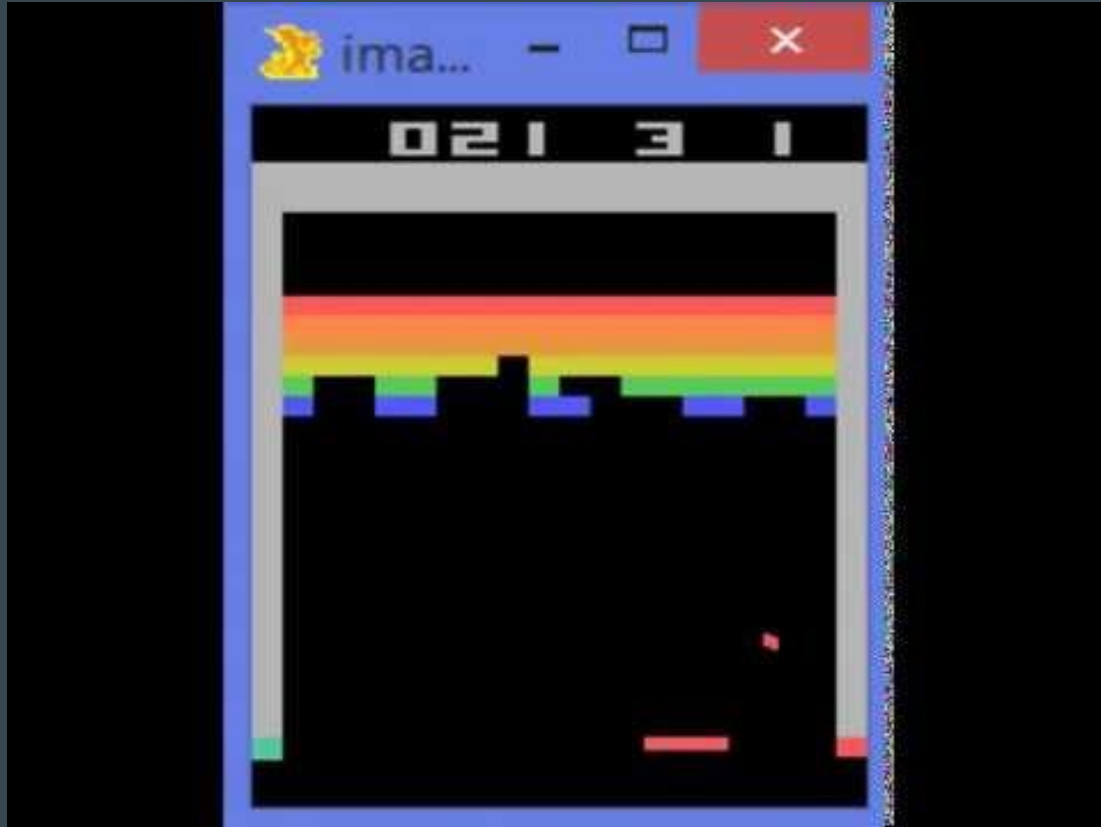


Deep Learning for Video Games

...

Kevin Du

Breakout



<https://www.youtube.com/watch?v=V1eYniJ0Rnk>

Introduction

- *“Machine learning is the science of getting computers to act without being explicitly programmed.”*
- Fundamentally different from traditional game AI, which:
 - Is explicitly programmed
 - Only works for the game it's programmed for
 - Does not learn from mistakes
 - Can be exploited easily

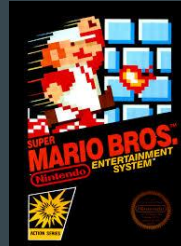
Companies of Interest

- DeepMind
 - Acquired by Google in 2014 for \$500 million
 - AlphaGo AI beat world Go champion 4-1 in March 2016
 - **Deep Q Network AI** plays various simple video games at or above human-level
- Nvidia
 - Makes graphics cards with necessary computing power to perform deep learning
 - Very supportive of deep learning and AI research



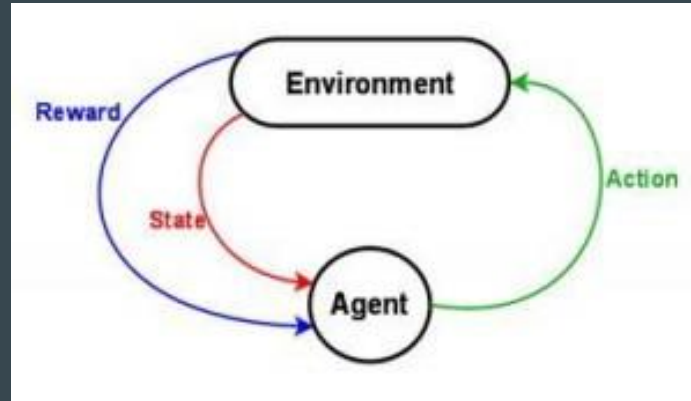
Reinforcement Learning

Agent reacts to environment to maximize reward



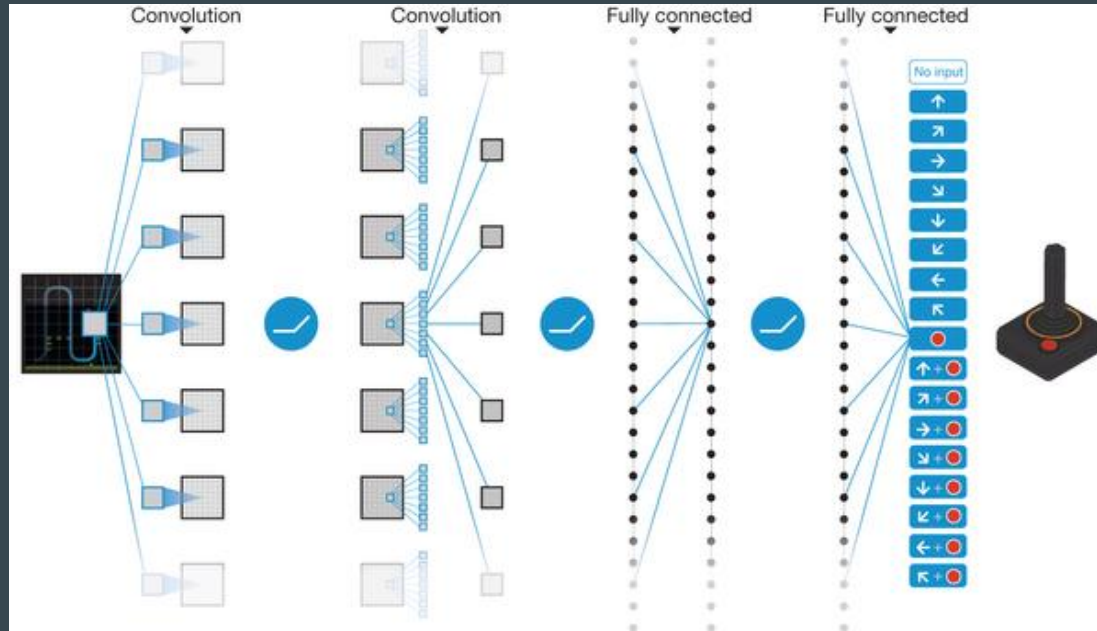
Quality function

$$Q(s_t, a_t) = \max R_{t+1}$$



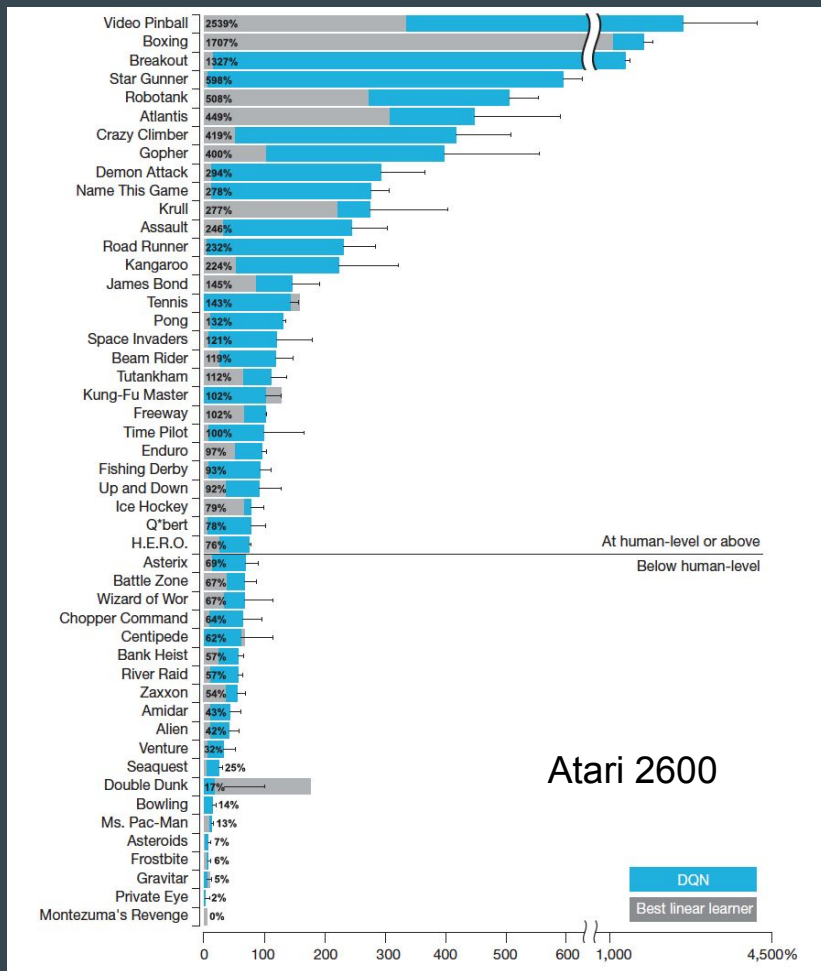
Convolutional Neural Network

- AI does not have access to game's internal code
- Relies on computer vision of pixels - Convolutional Neural Networks



Performance Evaluation

- DQN performs worse on games that require long-term strategy, or if there is a time delay between action and reward
- Limited to lower-resolution games otherwise neural network would take too long to train



Applications

- No real demand in video game industry
- Good for PR, explaining tough concepts in friendly manner
- Deep learning applications:
 - Self-driving cars
 - Targeted advertising
 - Medical diagnosis
 - Energy efficiency



DeepMind AI
Reduces Google Data
Centre Cooling Bill by
40%

20 July 2016

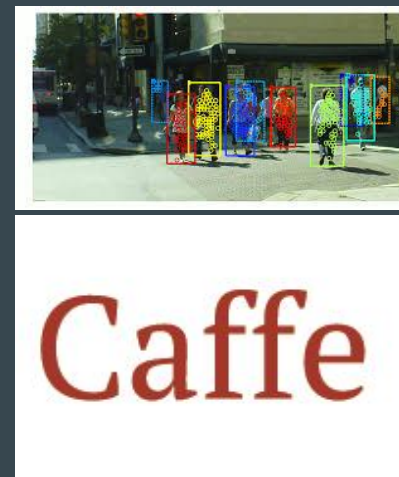
Deep Learning Frameworks



High-level wrapper



Keras



Plus many more!

References

- <https://www.nervanasys.com/demystifying-deep-reinforcement-learning/>
- <https://deepmind.com/research/dqn/>
- <http://karpathy.github.io/2016/05/31/rl/>
- <https://research.googleblog.com/2015/02/from-pixels-to-actions-human-level.html>
- Mnih, Volodymyr, et al. "Playing atari with deep reinforcement learning." arXiv preprint arXiv:1312.5602 (2013).

Deep Learning



What society thinks I do



What my friends think I do



What other computer scientists think I do



What mathematicians think I do



What I think I do

```
from theano import *
```

What I actually do