# RL: Deep

## The Big Picture

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# RL with Function Approximation

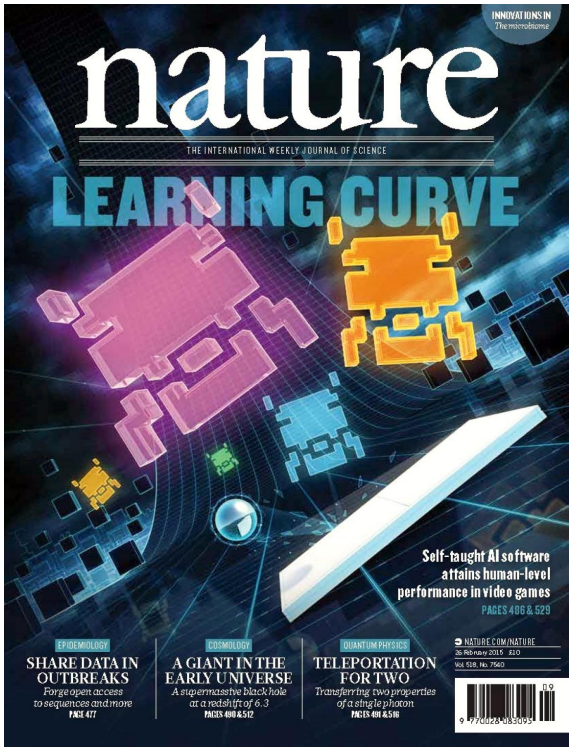
- Linear value function approximators (VFA) assume value function is a weighted combination of a set of features, where each feature a function of the state
  - Linear VFA often work well given the right set of features
  - But can require carefully hand designing that feature set
    - ⋆ Same argument as in traditional ML vs. deep ML
- An alternative is to use a much richer function approximation class that is able to directly go from states without requiring an explicit specification of features
  - E.g., the state is simply an image (or a sequence of images)
- Local representations including Kernel based approaches have some appealing properties (including convergence results under certain cases) but can't typically scale well to enormous spaces and datasets

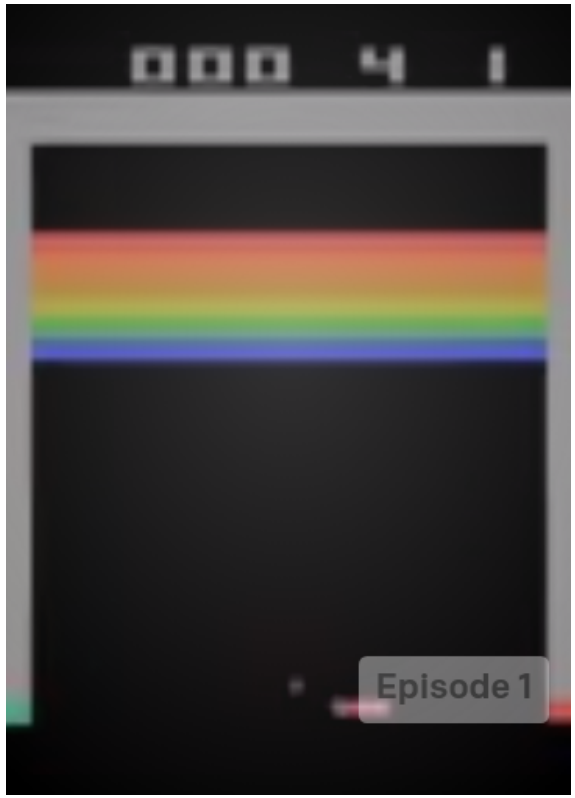
⇝ RL with deep neural networks is often state of the art these days!

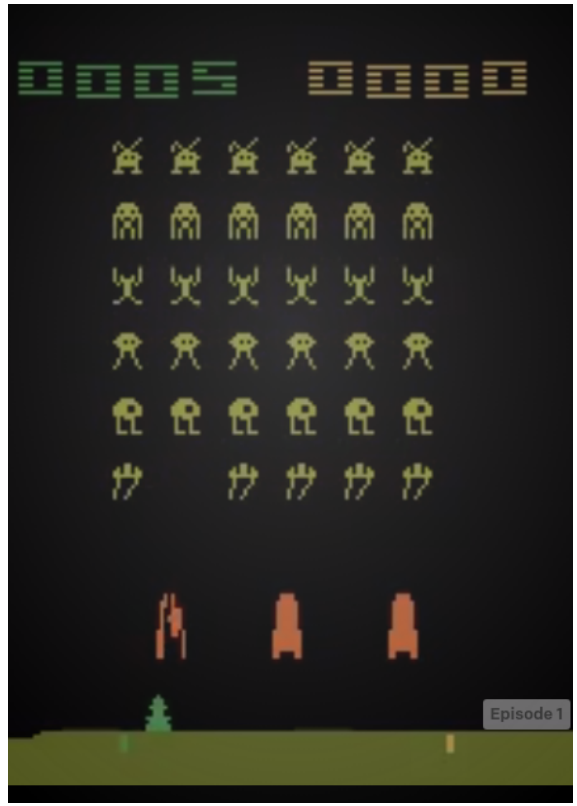
# The Benefit of Deep Neural Network Approximators

- Uses distributed representations instead of local representations
- Universal function approximator
- Can potentially need exponentially less nodes/parameters (compared to a shallow net) to represent the same function
- Can learn the parameters using stochastic gradient descent

# Learning from Images




See `https://gym.openai.com/envs/#atari`

# Deep Reinforcement Learning

- Use deep neural networks to represent
  - Value, Q function
  - Policy
  - (Model of the environment)
- Optimize loss function by stochastic gradient descent (SGD)