

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 is 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



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)