# Paper Review
# Deep Reinforcement Learning: A Brief Survey

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## 1 Paper Summary

This survey paper starts from introducing some foundational reinforcement learning techniques comparing model-based v.s. model-free methods as well as value based v.s. policy search based methods. It also discussed some hybrid setups such as actor-critic where both value functions and actor policy are involved. Building on top of those foundational background, the survey summarizes some of early work that focuses on deploying deep neural network to those traditional RL methods. The most famous ones include DQN which approximate quality function in Q-learning with DNN, deep policy gradient, and deep DPG which builds off of the actor-critic method. Finally, this survey highlights some of the current ongoing research directions including but not limited to model learning with deep NN, hierarchical RL, and inverse RL.

## 2 What I Learned

1. The idea of inverse reinforcement learning is quite interesting that it seems like this could be the future for imitation learning. Instead of training some policy to mimic behaviors, inverse RL actually learns the objective function that is capable of long horizon prediction.

2. Model-based RL has not yet utilized deep learning technologies very well due to the low data efficiency in deep learning algorithms.

## 3 Opinions

### 3.1 Up Votes

- This survey really nicely sets up the background of RL as well as Markov Decision Processes before jumping into the more recent methods involving deep learning techniques.

- This survey also covers some details on recent progressions on DQN based methods, such as experience replay and target network. It is quite informative for people with few RL experiences.

### 3.2 Down Votes

Since this is a survey paper, I don't really have too much negative opinion about the paper. One slight concern of mine is that the mathematical equations in this survey could sometimes be out of the blue. For example, equation 7 is put their without explanation. However, given this is a survey paper, the equation becomes clear when I looked at the cited paper that this survey is directing towards.

## 4 Evaluations

The goal of this paper is to put together a brief survey on the recent development on deep reinforcement learning. I belief that this is a perfectly valid goal because of the general development in RL has branched off in multiple directions (e.g. value / policy based, model based / model free, etc.), and so such a survey could really help the readers obtain a bigger picture on the overall development in the reinforcement learning literature. This is novel in a way that few people have put together such comprehensive overview on RL up to that time.

The quality of this survey is overall pretty good. Since it is not a research paper, there is not really any assumptions made by the survey. The quality is mostly evaluated on how comprehensive this survey covers about the topics in deep reinforcement learning. The provided foundational review on reinforcement learning is pretty solid as it covers most of the well deployed methods ranging from a variety of different approaches. The later discussions on deep reinforcement learning, however, tend to gloss over quite some detail implementations over those covered methods. This is understandable from a page limit perspective, as it cannot include all the details for all the paper that this survey is reviewing for.

## 5 Questions

1. How does Q learning relates with Temporal Difference Learning?

2. How does gradient free policy search explores the parameter space? Or what heuristics are most often used?