Foundations of Reinforcement Learning

Alessio Rimoldi

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Chapter 1

Introduction

1.1 What is Reinforcement Learning?

Reinforcement Learning (RL) is an area of machine learning concerned with how intelligent agents ought to take actions in an environment in order to maximize some notion of cumulative reward. The agent learns to achieve a goal in an uncertain, potentially complex environment. In RL, an agent interacts with its environment, observes the state of the environment, and takes actions that affect the state. he agent also receives rewards from the environment. The agent's goal is to learn to act in a way that will maximize its expected cumulative reward over time.

1.1.1 People and Connected Fields

- Computer Science: Minsky, Barto, Sutton
- Neuroscience:
- Psychology: Holland, Klopf
- Operations Research: Bertsekas, Puterman
- Economics:
- Engineering: Bellman, Tsitsiklis

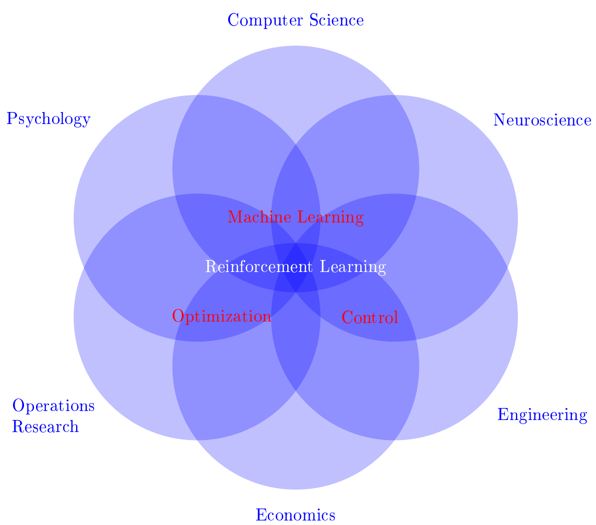

Figure 1.1: Reinforcement Learning

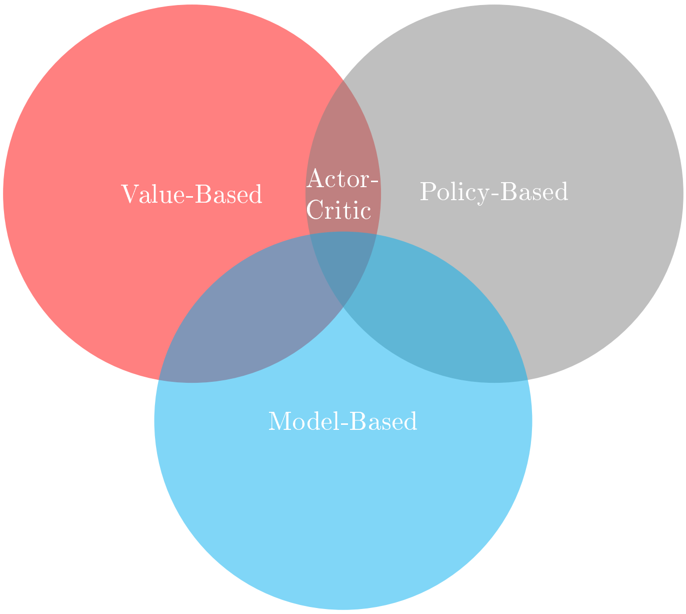

Figure 1.2: Reinforcement Learning Approaches

1.1.2 Mathematical Framework of Reinforcement Learning

The basic building blocks of the mathematical formulation of

1.1.3 Overview of Reinforcement Learning Approaches

- **Value-based**
  - Learns the optimal value function
  - Example: Monte Carlo, SARSA, Q-learning, DQN
  - Low variance, not scalable to large action spaces
- **Policy-based**
  - Learns directly the optimal policy
  - Example: Policy Gradient, NPG, TRPO, People
  - Scales to lathe and continuous action spaces, high variance
- **Model-based**
  - Learns bot the model P, r and the optimal Policy
  - Example: Dyna, UCRL2, UCB-variance
  - Computationally expensive, but better sample efficiency