# Berkeley CS285 Notes

## Contents

# 1 Deep Reinforcement Learning, Decision Making, and Control

## 1.1 What is reinforcement learning, and why should we care?

How do we build intelligent machines?

Intelligent machines must be able to adapt

Deep learning helps us handle unstructured environments

Reinforcement learning provides a formalism for behavior

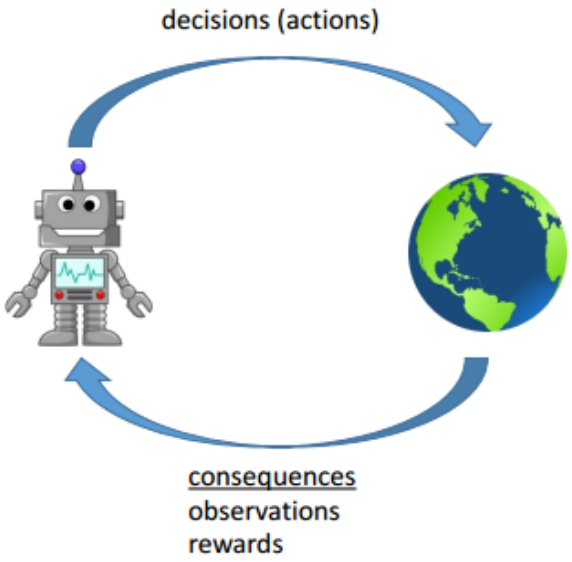


图 1: a formalism for behavior

What is deep RL, and why should we care?

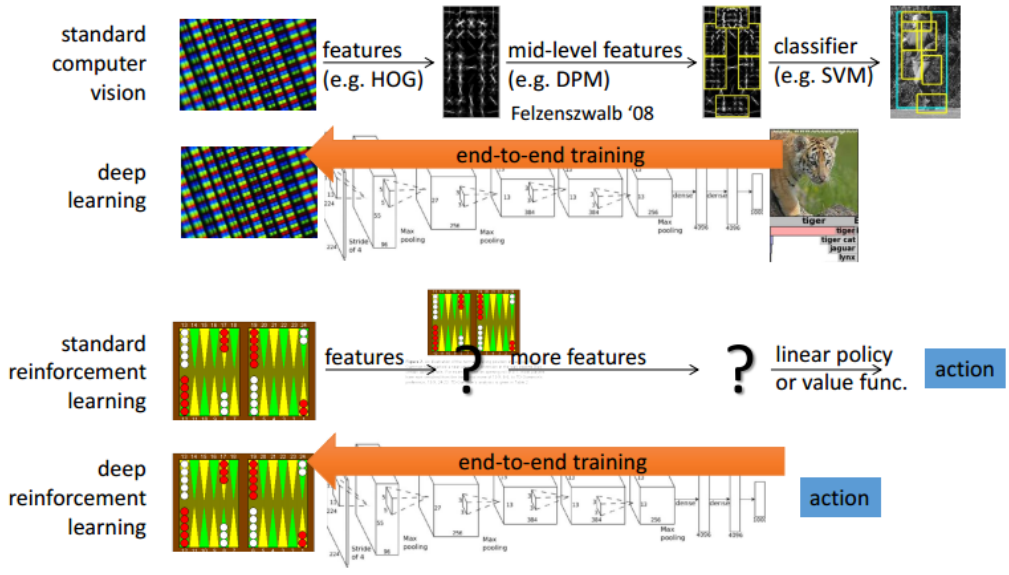


图 2: end to end loop

## 1.2 What does end-to-end learning mean for sequential decision making?

perception (tiger) -> action (run away).

sensorimotor loop.

Example: robotics

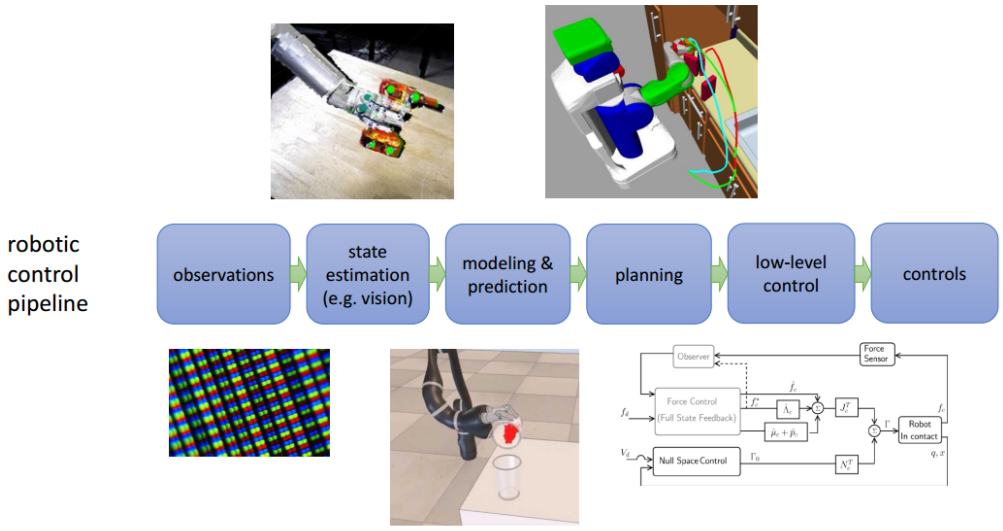


图 3: robotics

Deep models are what allow reinforcement learning algorithms to solve complex problems end to end!

The reinforcement learning problem is the AI problem!

Why should we study this now?

- Advances in deep learning
- Advances in reinforcement learning
- Advances in computational capability

## 1.3 What other problems do we need to solve to enable real-world sequential decision making?

### 1.3.1 Beyond learning from reward

- Basic reinforcement learning deals with maximizing rewards
- This is not the only problem that matters for sequential decision making!
- We will cover more advanced topics
  - Learning reward functions from example (inverse reinforcement learning)
  - Transferring knowledge between domains (transfer learning, meta-learning)
  - Learning to predict and using prediction to act

### 1.3.2 Where do rewards come from?

Game scores.
Animals as food for tiger.

### 1.3.3 Are there other forms of supervision?

- Learning from demonstrations
  - Directly copying observed behavior
  - Inferring rewards from observed behavior (inverse reinforcement learning)
- Learning from observing the world
  - Learning to predict
  - Unsupervised learning
- Learning from other tasks
  - Transfer learning
  - Meta-learning: learning to learn

## 1.4 How do we build intelligent machines?

Imagine you have to build an intelligent machine, where do you start?

### 1.4.1 Learning as the basis of intelligence

Some things we can all do (e.g. walking). Some things we can only learn (e.g. driving a car). We can learn a huge variety of things, including very difficult things. Therefore our learning mechanism(s) are likely powerful enough to do everything we associate with intelligence.

### 1.4.2 A single algorithm?

An algorithm for each "module" ?
Or a single flexible algorithm?

### 1.4.3 What must that single algorithm do?

Interpret rich sensory inputs
Choose complex actions

### 1.4.4 Why deep reinforcement learning?

Deep = can process complex sensory input... and also compute really complex functions
Reinforcement learning = can choose complex actions.

### 1.4.5 What has proven challenging so far?

Humans can learn incredibly quickly, Deep RL methods are usually slow

Humans can reuse past knowledge, Transfer learning in deep RL is an open problem

Not clear what the reward function should be

Not clear what the role of prediction should be

What is deep RL, and why should we care?

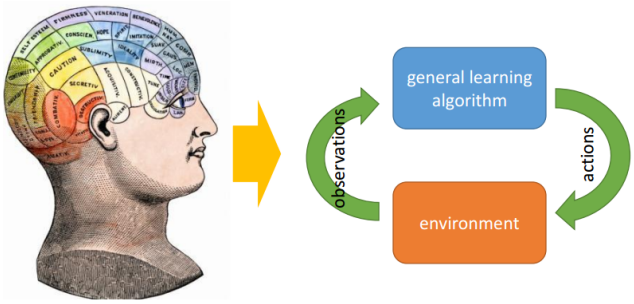


图 4: child

Instead of trying to produce a program to simulate the adult mind, why not rather try to produce one which simulates the child's? If this were then subjected to an appropriate course of education one would obtain the adult brain. –Alan Turing