celtra

Reinforcement Learning

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IADS Big Data and Analytics Summer School
2019-08-05

The Field

Artificial Intelligence > Machine Learning

(A special case of) supervised learning

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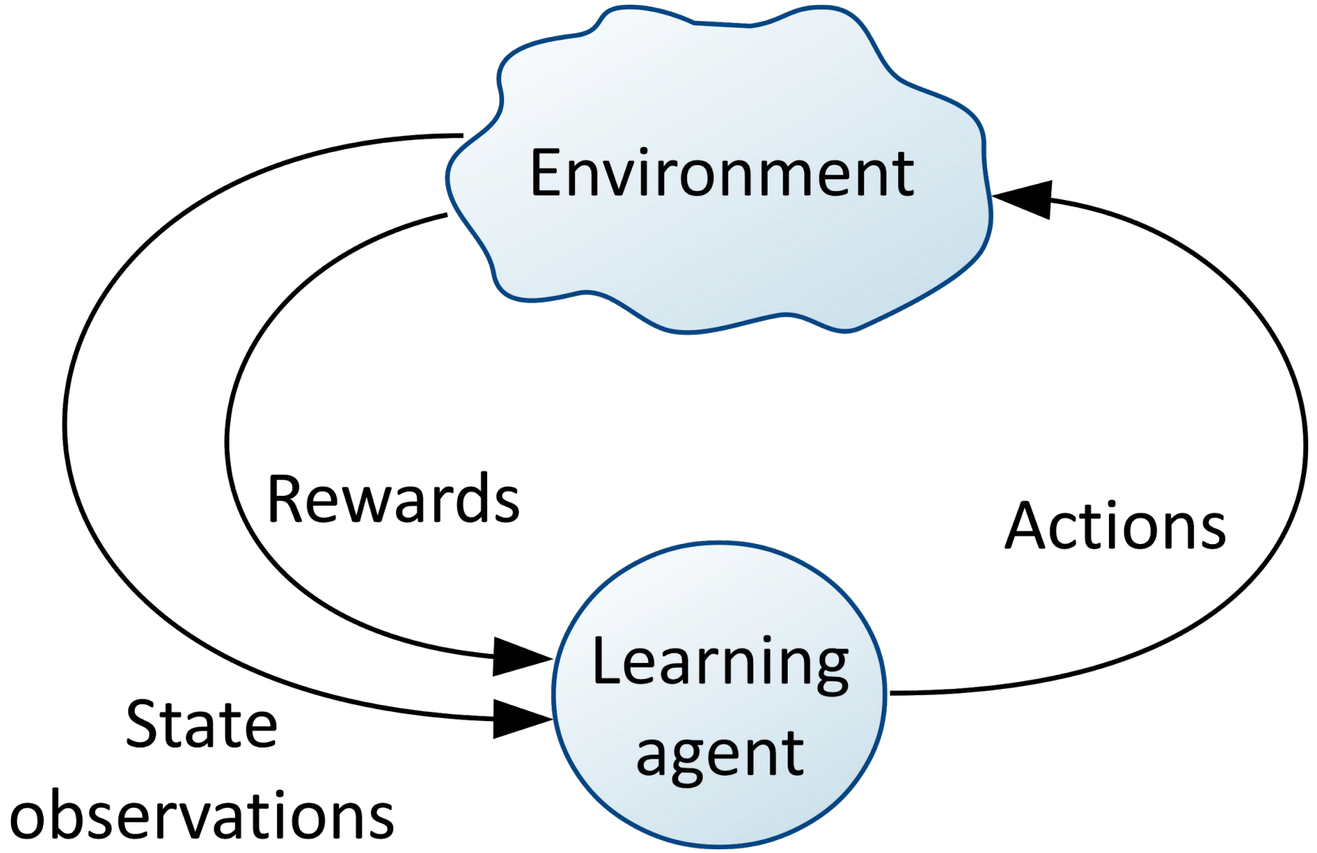
But also has elements of unsupervised learning

The Reinforcement Learning Setting



The Reinforcement Learning Setting

Agent

Behaviour > Actions

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Environment

States

Rewards > define the goal of the agent

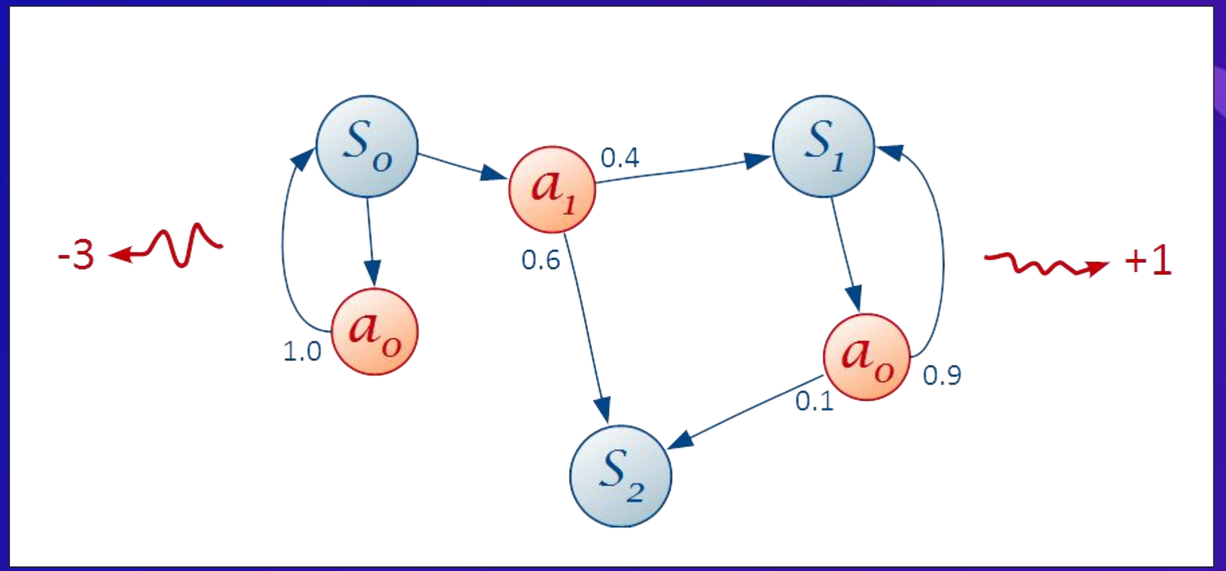
Markov Decision Processes

States

Actions

Rewards

Transition probabilities



Markov Decision Processes

Trajectory (concept of time)

(Expected) return

Discount rate

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Continuing vs. episodic tasks

Terminal states

Non-stationary MDPs

Partially-observable MDPs

What to Learn From?

Experience = Samples of interaction with environment

- Real (learning)
- Simulated (planning)

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Exploration-exploitation trade-off

Uncertainty

How to Store Knowledge?

State-value function

Action-value function

Behaviour policy

Model (of the environment)

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Representations

- Tabular vs. approximate
- Fixed vs. adaptive

Updating Knowledge = Learning

Goal: learn optimal policy (and optimal value function)

Generalized policy iteration

- Policy evaluation
- Policy improvement

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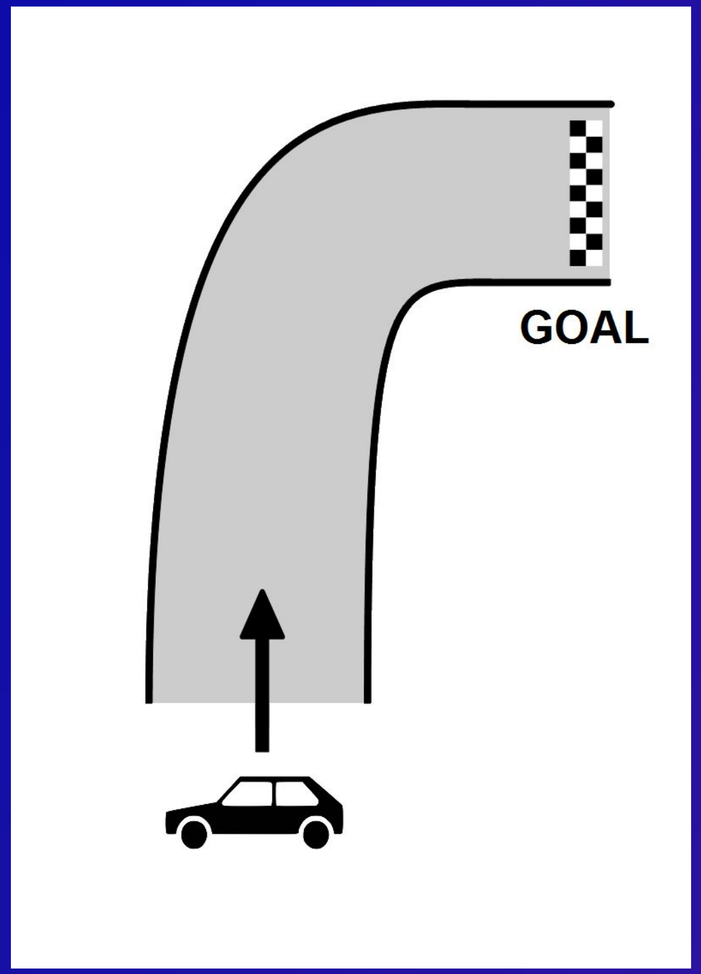
Algorithms

- Model-based
- Model-free

Race Track Example



Algorithms

Dynamic programming

Monte Carlo

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Temporal-difference learning

- Bootstrapping
- Eligibility traces

Algorithms

Dynamic programming: policy iteration, value iteration

Monte Carlo

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Temporal-difference learning: TD(λ), Sarsa, Q-learning, Deep Q-learning

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Algorithms

Dynamic programming: policy iteration, value iteration

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Policy gradient and Actor-Critic: REINFORCE

Applications

Games: AlphaGo

Scheduling tasks: optimization of memory control

Modelling bird movement

Web services / optimization

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Reading Material

Quick and practical state-of-the-art:

Thomas Simonini, Deep Reinforcement Learning course with Tensorflow

Most comprehensive and best foundations:

Richard S. Sutton and Andrew G. Barto, Reinforcement Learning, An introduction, second edition

Outstanding applications:

Silver et al., AlphaGo, AlphaGo Zero, AlphaZero

Recap

Agent, actions, environnement, state, rewards

Representation of knowledge

Explore and collect experience

Update knowledge = learn

Improve behaviour

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