Reinforcement Learning

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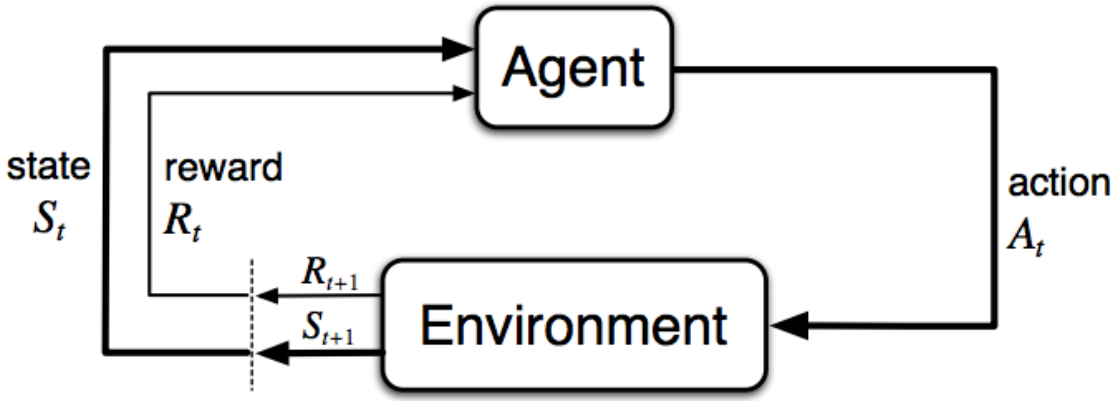
Overview

Reinforcement Learning

- **Framing of the problem of learning from interaction to achieve a goal.**
- **Agent**: learner and decision maker
- **Environment**: what the learner interacts with (everything outside the agent)
- Agent selects actions and the environment responds to those actions and presents new situations

Reinforcement Learning



- At each time step t, the agent receives the environment **state** $S_t \in \mathcal{S}$, and the agent then selects an **action** $A_t \in \mathcal{A}(S_t)$
  - $\mathcal{S}$ is the set of possible states
  - $\mathcal{A}(S_t)$ is set of actions available in state S_t
- One time step later, the agent receives a **reward**, $R_{t+1} \in \mathcal{R} \subset \mathbb{R}$, and ends up in a new state S_{t+1}

Reinforcement Learning

- At each time step, the agent implements a mapping π_t from states to probabilities of selecting each possible action, where π_t is called a **policy**
  - $\pi_t(a|s)$ = probability that $A_t = a$ if $S_t = s$

Reinforcement Learning Objective

The agent's goal is to maximize the total amount of reward it receives over the long run by changing its policy as a result of its experience

Reinforcement Learning

- Let the sequence of rewards after time step t is $R_{t+1}, R_{t+2}, R_{t+3}, \ldots$, then we want to maximize the return G_t
- The agent chooses A_t to maximize the discounted return:

$$G_t = \sum_{k=0}^{\infty} \gamma^k R_{t+k+1} \tag{1}$$

  where γ is the discount rate and $0 \geq \gamma \leq 1$
- The closer γ is to 1, the more the agent accounts for future rewards

Markov Decision Processes

Multiple Columns

Heading

1. Statement
2. Explanation
3. Example

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Table

Treatments	Response 1	Response 2
Treatment 1	0.0003262	0.562
Treatment 2	0.0015681	0.910
Treatment 3	0.0009271	0.296

Table: Table caption

Theorem

Theorem (Mass–energy equivalence)

$E = mc^2$

Verbatim

Example (Theorem Slide Code)

```
\begin{frame}
\frametitle{Theorem}
\begin{theorem}[Mass--energy equivalence]
$E = mc^2$
\end{theorem}
\end{frame}
```

Figure

Uncomment the code on this slide to include your own image from the same directory as the template .TeX file.

Citation

An example of the `\cite` command to cite within the presentation:

This statement requires citation [Smith, 2012].

References

John Smith (2012)

Title of the publication

Journal Name 12(3), 45 – 678.