BE a reinforcement learner
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- You, as a class, act as a learning agent
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- **Actions**: Wave, Stand, Clap
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BE a reinforcement learner

- You, as a class, act as a learning agent
- **Actions**: Wave, Stand, Clap
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- **Goal**: Find an optimal *policy*
BE a reinforcement learner

- You, as a class, act as a learning agent
- **Actions**: Wave, Stand, Clap
- **Observations**: colors, reward
- **Goal**: Find an optimal policy
  - Way of selecting actions that gets you the most reward
How did you do it?
How did you do it?

- What is your policy?
- What does the world look like?
Formalizing What Just Happened

Knowns:
Formalizing What Just Happened

Knowns:

- $\mathcal{O} = \{\text{Blue, Red, Green, Black, ...}\}$
- Rewards in $\mathbb{R}$
- $\mathcal{A} = \{\text{Wave, Clap, Stand}\}$

\[ o_0, a_0, r_0, o_1, a_1, r_1, o_2, \ldots \]
Formalizing What Just Happened

Knowns:
- $\mathcal{O} = \{\text{Blue, Red, Green, Black, \ldots}\}$
- Rewards in $\mathbb{R}$
- $\mathcal{A} = \{\text{Wave, Clap, Stand}\}$

Unknowns:
- $o_0, a_0, r_0, o_1, a_1, r_1, o_2, \ldots$
Formalizing What Just Happened

Knowns:

- $O = \{\text{Blue, Red, Green, Black, ...}\}$
- Rewards in $\mathbb{R}$
- $A = \{\text{Wave, Clap, Stand}\}$

Unknowns:

- $S = 4 \times 3$ grid
- $R: S \times A \mapsto \mathbb{R}$
- $P = S \mapsto O$
- $T: S \times A \mapsto S$
Formalizing What Just Happened

Knowns:

- $O = \{\text{Blue, Red, Green, Black, } \ldots\}$
- $\mathcal{R}$: Rewards in $\mathbb{R}$
- $A = \{\text{Wave, Clap, Stand}\}$

\[
\begin{array}{c}
o_0, a_0, r_0, o_1, a_1, r_1, o_2, \ldots
\end{array}
\]

Unknowns:

- $S = 4\times3$ grid
- $\mathcal{R}: S \times A \mapsto \mathbb{R}$
- $\mathcal{P} = S \mapsto O$
- $\mathcal{T}: S \times A \mapsto S$

$o_i = \mathcal{P}(s_i)$
Formalizing What Just Happened

Knowns:

- $O = \{\text{Blue, Red, Green, Black, . . .}\}$
- Rewards in $R$
- $A = \{\text{Wave, Clap, Stand}\}$

Unkowns:

- $S = 4 \times 3$ grid
- $R : S \times A \mapsto \mathbb{R}$
- $P = S \mapsto O$
- $T : S \times A \mapsto S$

\[
o_i = P(s_i) \quad r_i = R(s_i, a_i)
\]
Formalizing What Just Happened

Knowns:
- $O = \{\text{Blue, Red, Green, Black, \ldots}\}$
- Rewards in $\mathbb{R}$
- $A = \{\text{Wave, Clap, Stand}\}$

$$o_0, a_0, r_0, o_1, a_1, r_1, o_2, \ldots$$

Unknowns:
- $S = 4 \times 3$ grid
- $R : S \times A \mapsto \mathbb{R}$
- $P = S \mapsto O$
- $T : S \times A \mapsto S$

$$o_i = P(s_i) \quad r_i = R(s_i, a_i) \quad s_{i+1} = T(s_i, a_i)$$
This Course

- Reinforcement Learning theory (start)
This Course

- Reinforcement Learning theory (start)
- Reinforcement Learning in practice (end)
The Big Picture

- AI
The Big Picture

- AI $\rightarrow$ ML
The Big Picture

- AI → ML → RL
The Big Picture

- AI → ML → RL

- Types of Machine Learning
The Big Picture

- AI → ML → RL

- Types of Machine Learning
  
  **Supervised learning:** learn from labeled examples
The Big Picture

- AI → ML → RL

- Types of Machine Learning

  **Supervised learning:** learn from labeled examples
  **Unsupervised learning:** cluster unlabeled examples
The Big Picture

- AI $\rightarrow$ ML $\rightarrow$ RL

- Types of Machine Learning

  Supervised learning: learn from labeled examples
  Unsupervised learning: cluster unlabeled examples
  Reinforcement learning: learn from interaction
The Big Picture

- AI → ML → RL

- Types of Machine Learning

  **Supervised learning:** learn from labeled examples
  **Unsupervised learning:** cluster unlabeled examples
  **Reinforcement learning:** learn from interaction
    - Defined by the problem
The Big Picture

- AI $\longrightarrow$ ML $\longrightarrow$ RL

- Types of Machine Learning

  **Supervised learning:** learn from labeled examples
  **Unsupervised learning:** cluster unlabeled examples
  **Reinforcement learning:** learn from interaction
    - Defined by the problem
    - Many approaches possible (including evolutionary)
The Big Picture

- AI → ML → RL

Types of Machine Learning

- **Supervised learning:** learn from labeled examples
- **Unsupervised learning:** cluster unlabeled examples
- **Reinforcement learning:** learn from interaction
  - Defined by the problem
  - Many approaches possible (including evolutionary)
  - Book focuses on a particular class of approaches
Syllabus

- Available on-line
Assignments for Tuesday

- Join the mailing list!
Assignments for Tuesday

- Join the mailing list!
- Read Chapter 1
Assignments for Tuesday

- Join the mailing list!
- Read Chapter 1
- Send a question or comment by 10pm Monday