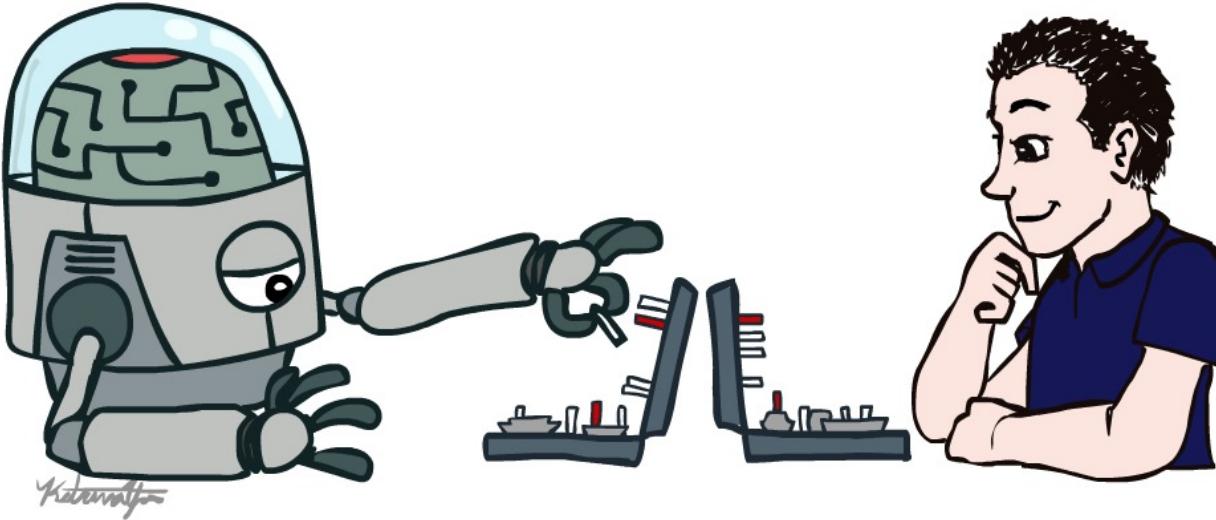


CMPT 310: Artificial Intelligence

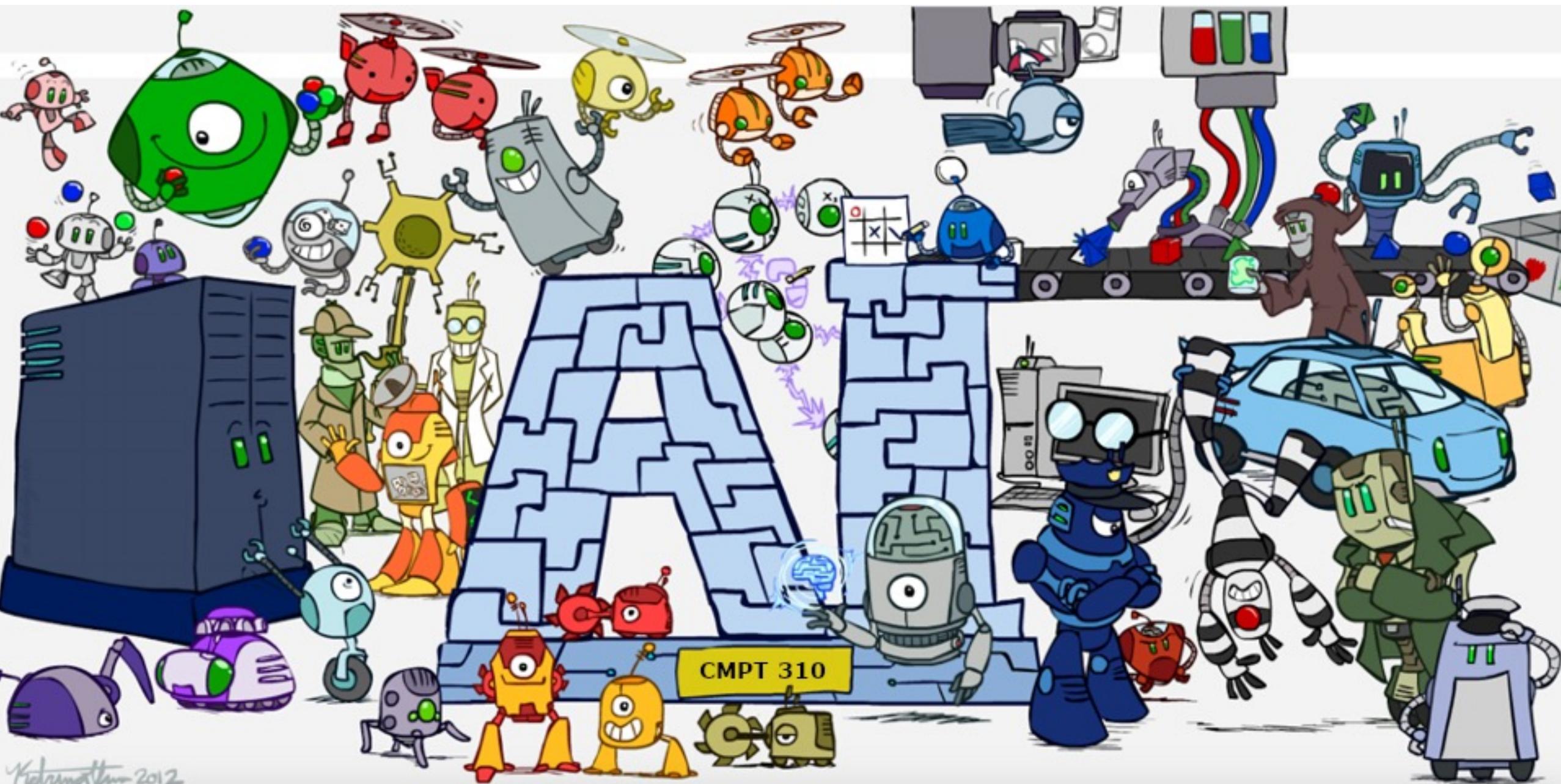
Introduction



Instructor: Steven Bergner

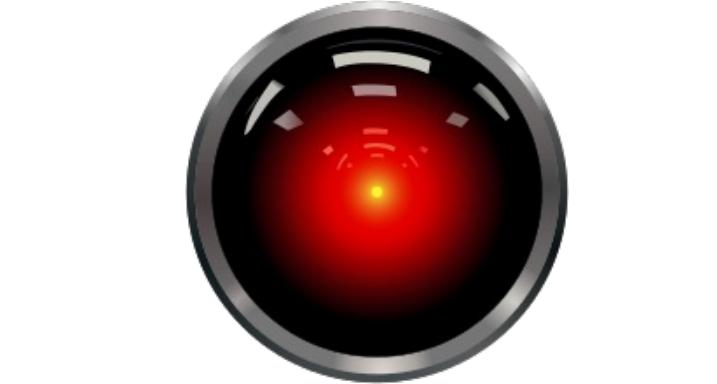
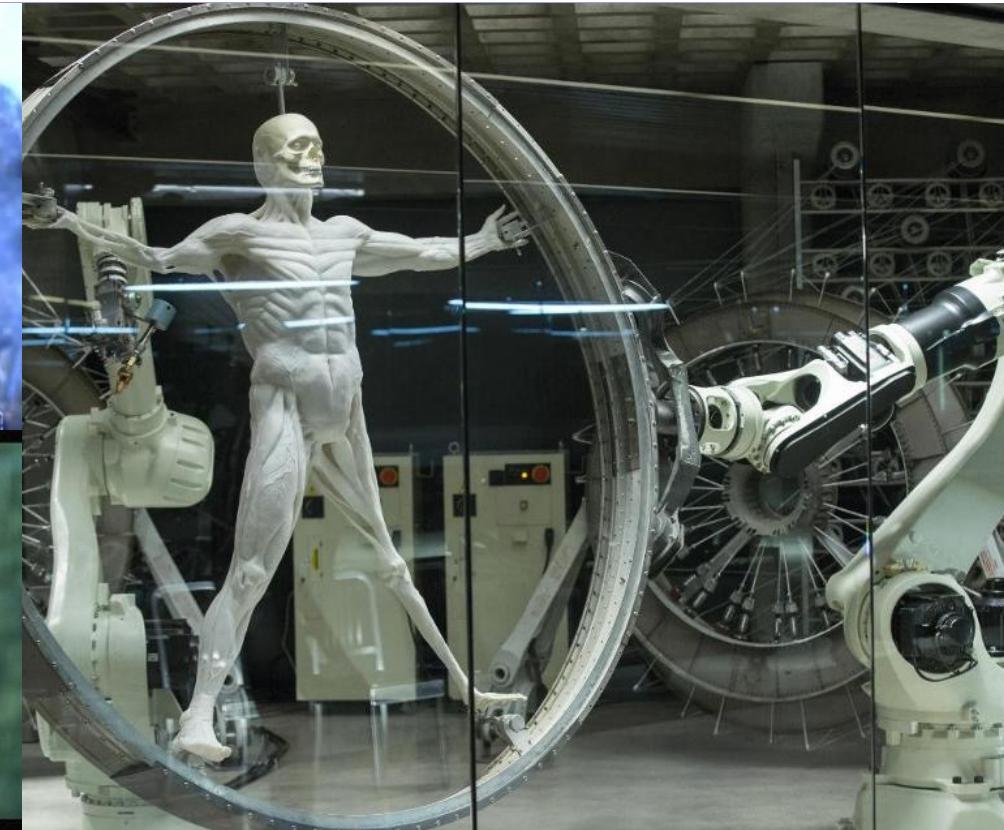
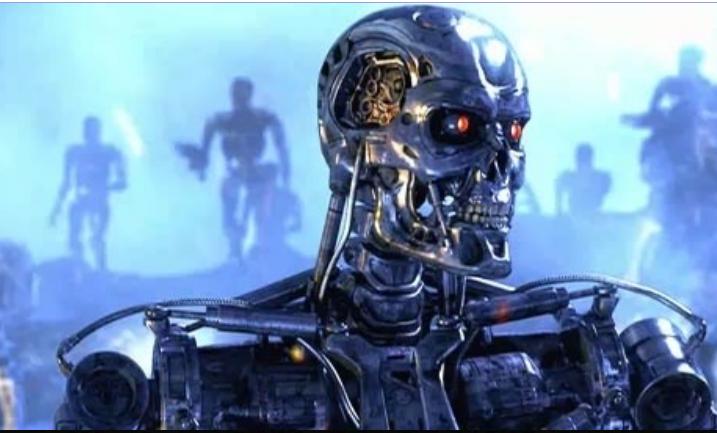
Simon Fraser University

(slides adapted from UC Berkeley CS188 slides)



Kidzumattam 2012

AI









What is artificial intelligence?



Artificial intelligence (AI) refers to the simulation of human intelligence in machines that are programmed to think and learn like humans. It is a broad field of computer science that focuses on creating intelligent machines capable of performing tasks that typically require human intelligence, such as visual perception, speech recognition, decision-making, problem-solving, and language translation.

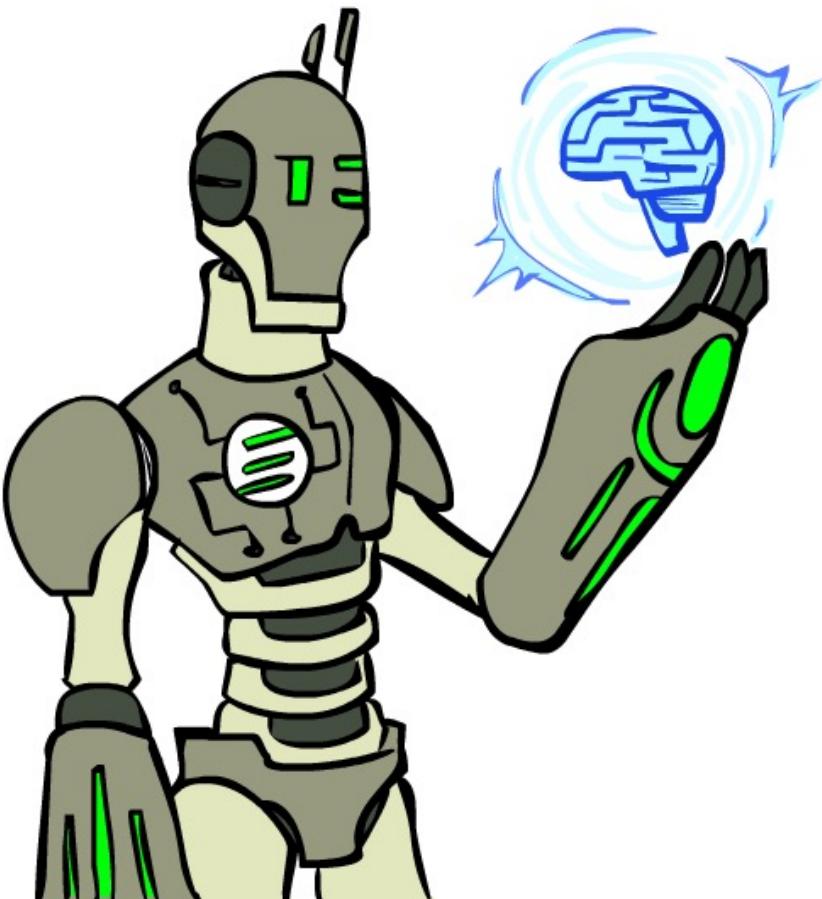


AI encompasses various subfields and techniques, including machine learning, natural language processing, computer vision, expert systems, and robotics. These approaches enable AI systems to acquire knowledge, process information, reason, and make predictions or decisions based on the available data.

Machine learning, a key component of AI, involves training algorithms to recognize patterns in large amounts of data and make predictions or take actions without being explicitly programmed. This ability to learn from experience and adapt to new situations is what sets AI apart from traditional software systems.

Today

- What is artificial intelligence?
- Where did it come from/What can AI do?
 - What should we and shouldn't we worry about?
- Course Logistics
- Utilities and Rationality



What is AI?

The science of making machines that:

Rational Decisions

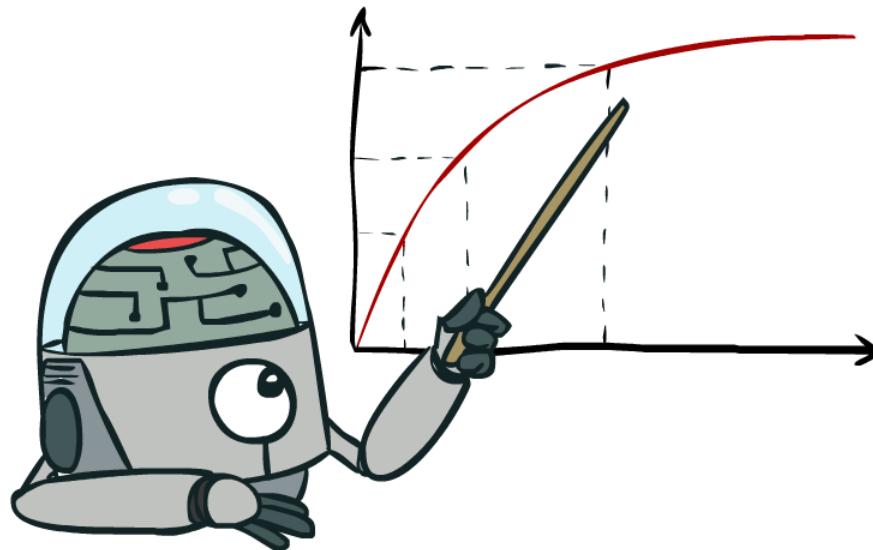
We'll use the term **rational** in a very specific, technical way:

- Rational: maximally achieving pre-defined goals
- Rationality only concerns what decisions are made
(not the thought process behind them)
- Goals are expressed in terms of the **utility** of outcomes
- Being rational means **maximizing your expected utility**

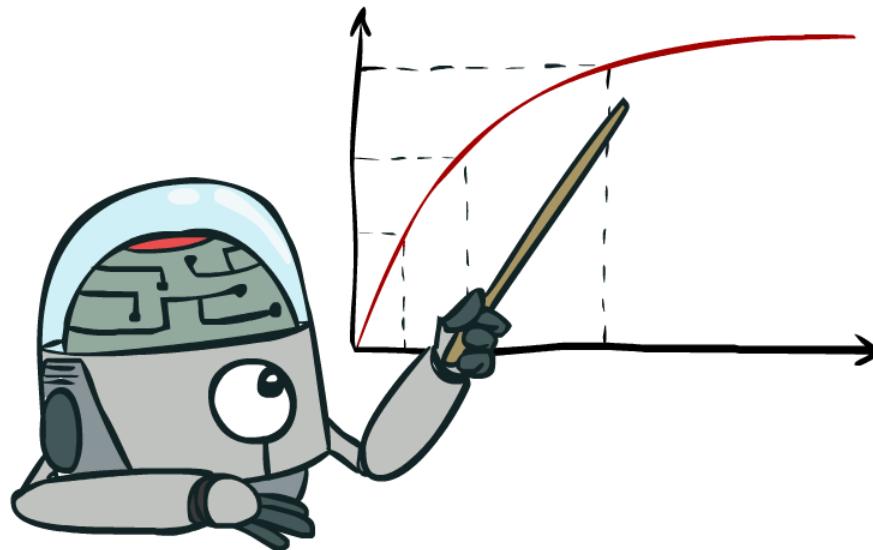
A better title for this course would be:

Computational Rationality

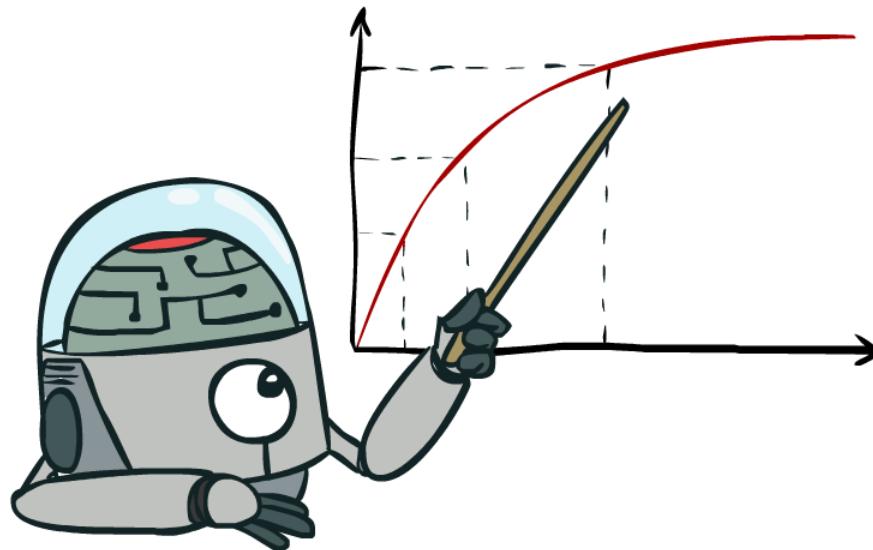
Maximize Your Expected Utility



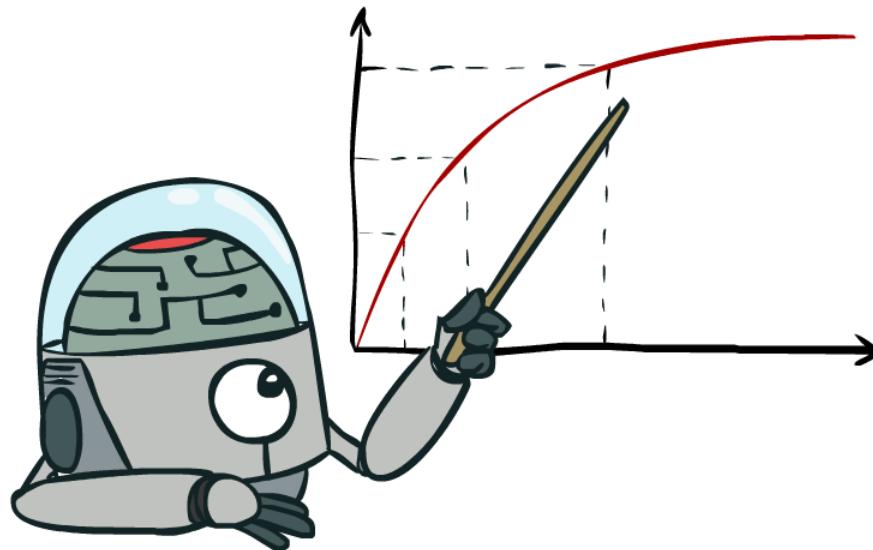
Maximize Your Expected Utility



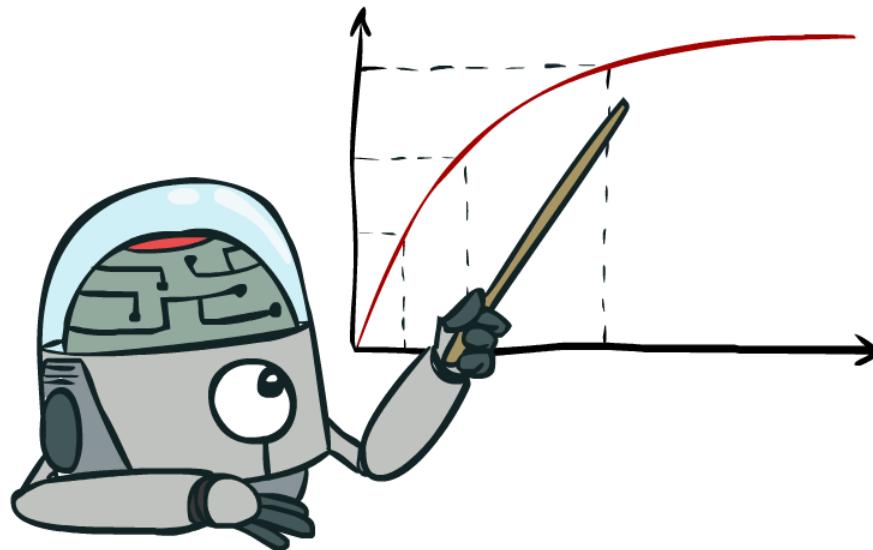
Maximize Your Expected Utility



Maximize Your Expected Utility



Maximize Your Expected Utility



What About the Brain?

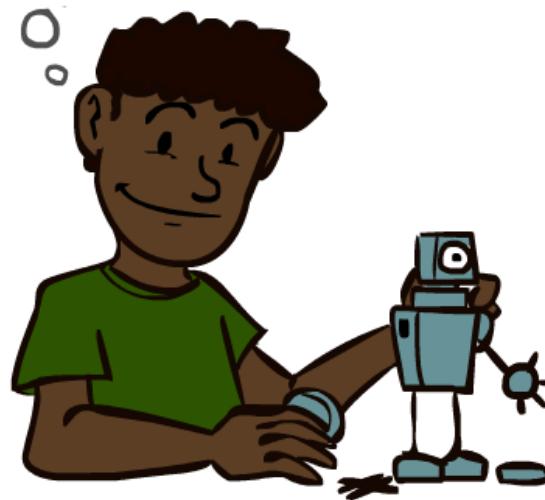
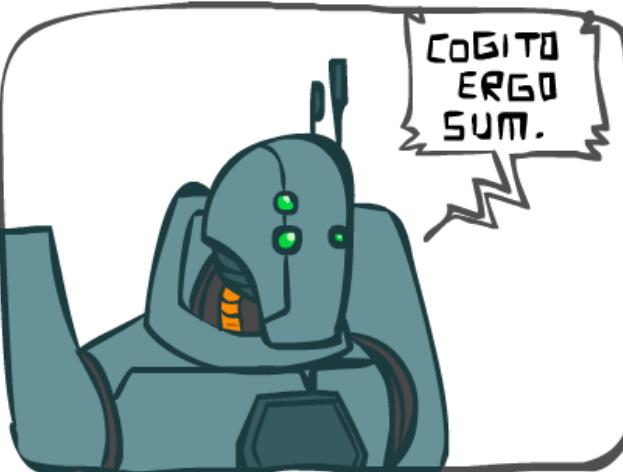
- Brains (human minds) are very good at making rational decisions, but not perfect
- Brains aren't as modular as software, so hard to reverse engineer!
- "Brains are to intelligence as wings are to flight"
- Lessons learned from the brain: memory and simulation are key to decision making

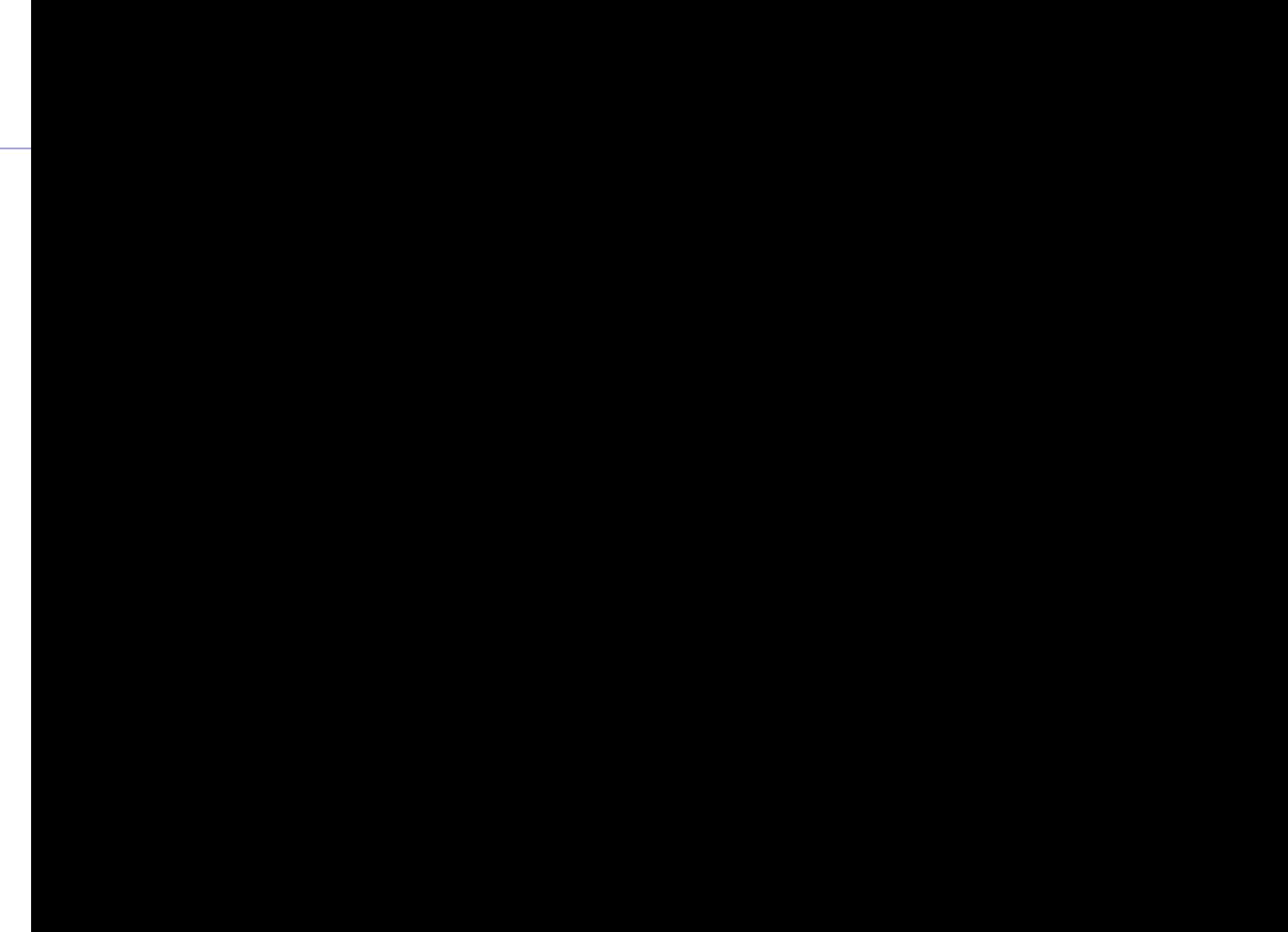


Course Topics

- Part 1: Making Decisions
 - Fast search / planning
 - Constraint satisfaction (e.g. scheduling)
 - Adversarial and uncertain search (e.g. routing, navigation)
- Part 2: Intelligence from Data
 - Probabilistic inference with Bayes' nets (e.g. robot localization)
 - Decision theory
 - Supervised machine learning (e.g. spam detection)
- Throughout: Applications
 - Natural language, vision, robotics, games, etc.

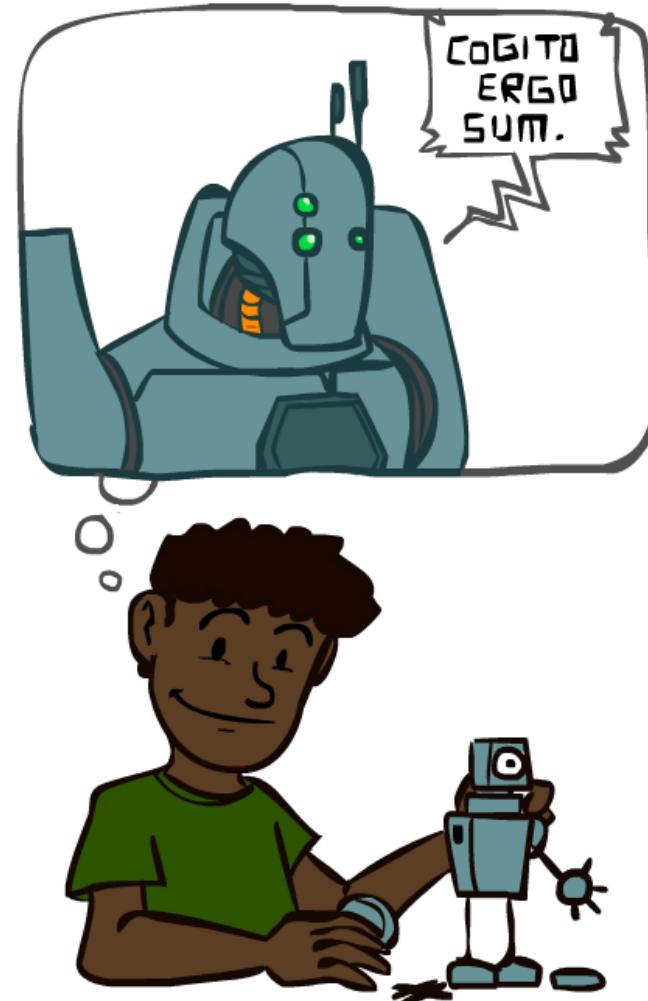
A (Short) History of AI





A (Short) History of AI

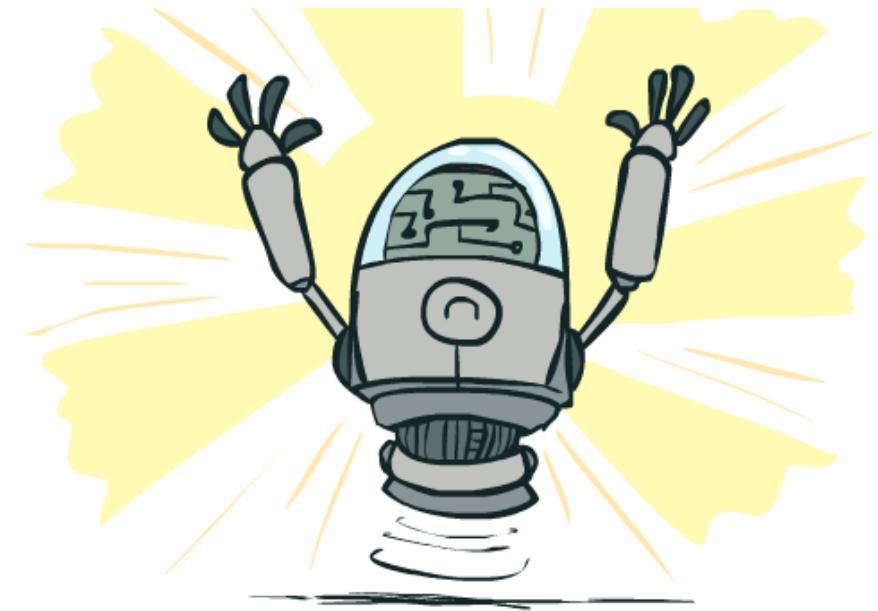
- 1940-1950: Early days
 - 1943: McCulloch & Pitts: Boolean circuit model of brain
 - 1950: Turing's "Computing Machinery and Intelligence"
- 1950—70: Excitement: Look, Ma, no hands!
 - 1950s: Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's Geometry Engine
 - 1956: Dartmouth meeting: "Artificial Intelligence" adopted
 - 1965: Robinson's complete algorithm for logical reasoning
- 1970—90: Knowledge-based approaches
 - 1969—79: Early development of knowledge-based systems
 - 1980—88: Expert systems industry booms
 - 1988—93: Expert systems industry busts: "AI Winter"
- 1990—: Statistical approaches
 - Resurgence of probability, focus on uncertainty
 - General increase in technical depth
 - Agents and learning systems... "AI Spring"?
- 2000—: Where are we now?



What Can AI Do?

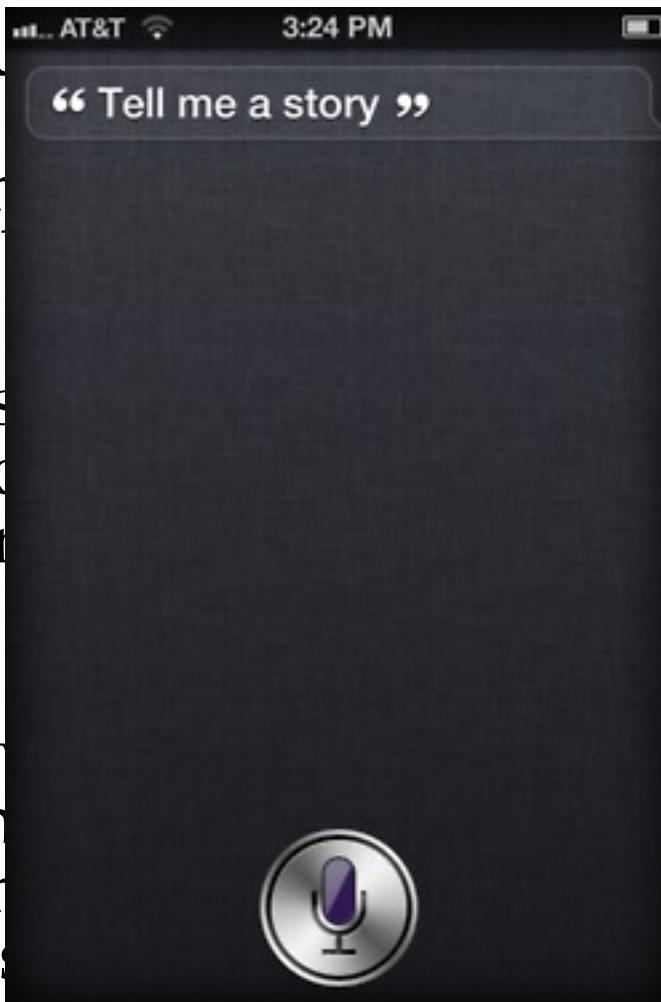
Quiz: Which of the following can be done at present?

- Play a decent game of Jeopardy?
- Win against any human at chess?
- Win against the best humans at Go?
- Play a decent game of tennis?
- Grab a particular cup and put it on a shelf?
- Unload any dishwasher in any home?
- Drive safely along the highway?
- Drive safely along Hastings Street?
- Buy a week's worth of groceries on the web?
- Buy a week's worth of groceries at Nesters Market?
- Discover and prove a new mathematical theorem?
- Perform a surgical operation?
- Unload a know dishwasher in collaboration with a person?
- Translate spoken Chinese into spoken English in real time?
- Write an intentionally funny story?



Unintentionally Funny Stories

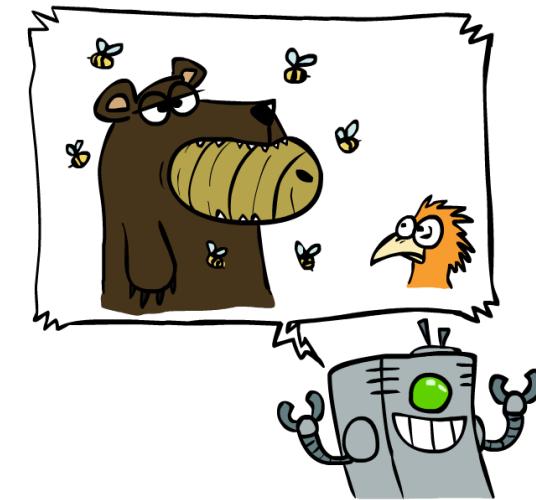
- One day Joe Bear was hungry. Irving Bird where some there was a beehive in the tree. He ate the honey.
- Henry Squirrel was thirsty. He went to the river bank where his good friend the crow was sitting. Henry slipped and fell into the water. The End.
- Once upon a time there was a crow. The crow was sitting in his tree. He noticed that he was hungry. He swallowed the cheese.



friend
ld him
ed to

to the
s sitting.
rowned.

and a vain crow. One day he had a piece of cheese in his mouth. He became very hungry, so he flew over to the crow. The End.



Natural Language

- Speech technologies (e.g. Siri)
 - Automatic speech recognition (ASR)
 - Text-to-speech synthesis (TTS)
 - Dialog systems
- Language processing technologies
 - Question answering
 - Machine translation

"Il est impossible aux journalistes de rentrer dans les régions tibétaines"

Bruno Philip, correspondant du "Monde" en Chine, estime que les journalistes de l'AFP qui ont été expulsés de la province tibétaine du Qinghai "n'étaient pas dans l'illégalité".

Les faits Le dalaï-lama dénonce l'"enfer" imposé au Tibet depuis sa fuite, en 1959
Vidéo Anniversaire de la rébellion tibétaine, le Chili



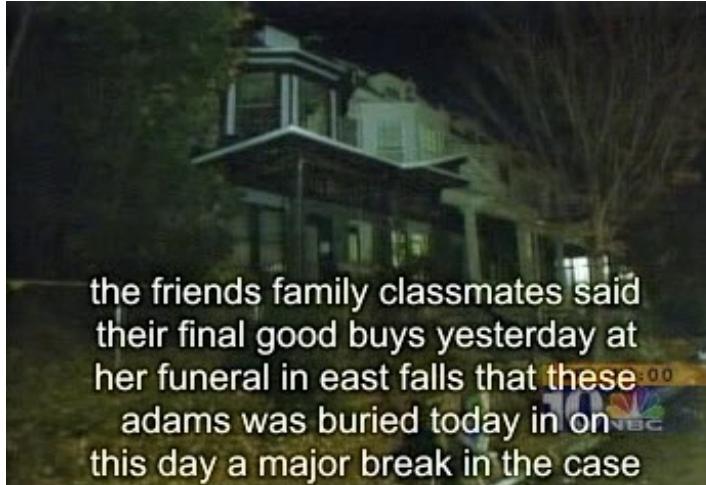
"It is impossible for journalists to enter Tibetan areas"

Philip Bruno, correspondent for "World" in China, said that journalists of the AFP who have been deported from the Tibetan province of Qinghai "were not illegal."

Facts The Dalai Lama denounces the "hell" imposed since he fled Tibet in 1959
Video Anniversary of the Tibetan rebellion: China on guard



- Web search
- Text classification, spam filtering, etc...



Computer Vision



"man in black shirt is playing guitar."



"construction worker in orange safety vest is working on road."



"two young girls are playing with lego toy."



"boy is doing backflip on wakeboard."



"girl in pink dress is jumping in air."



"black and white dog jumps over bar."

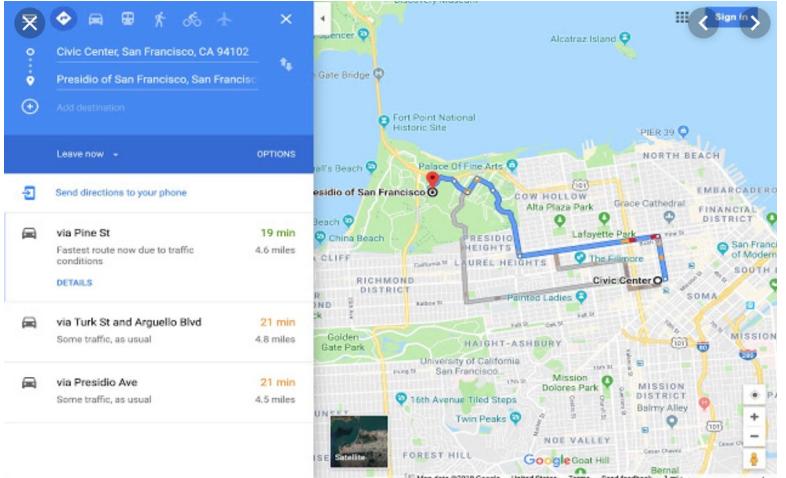


"young girl in pink shirt is swinging on swing."



"man in blue wetsuit is surfing on wave."

Tools for Predictions & Decisions



Berkeley, CA 94709
Tuesday 2:00 PM
Mostly Sunny



Game Agents

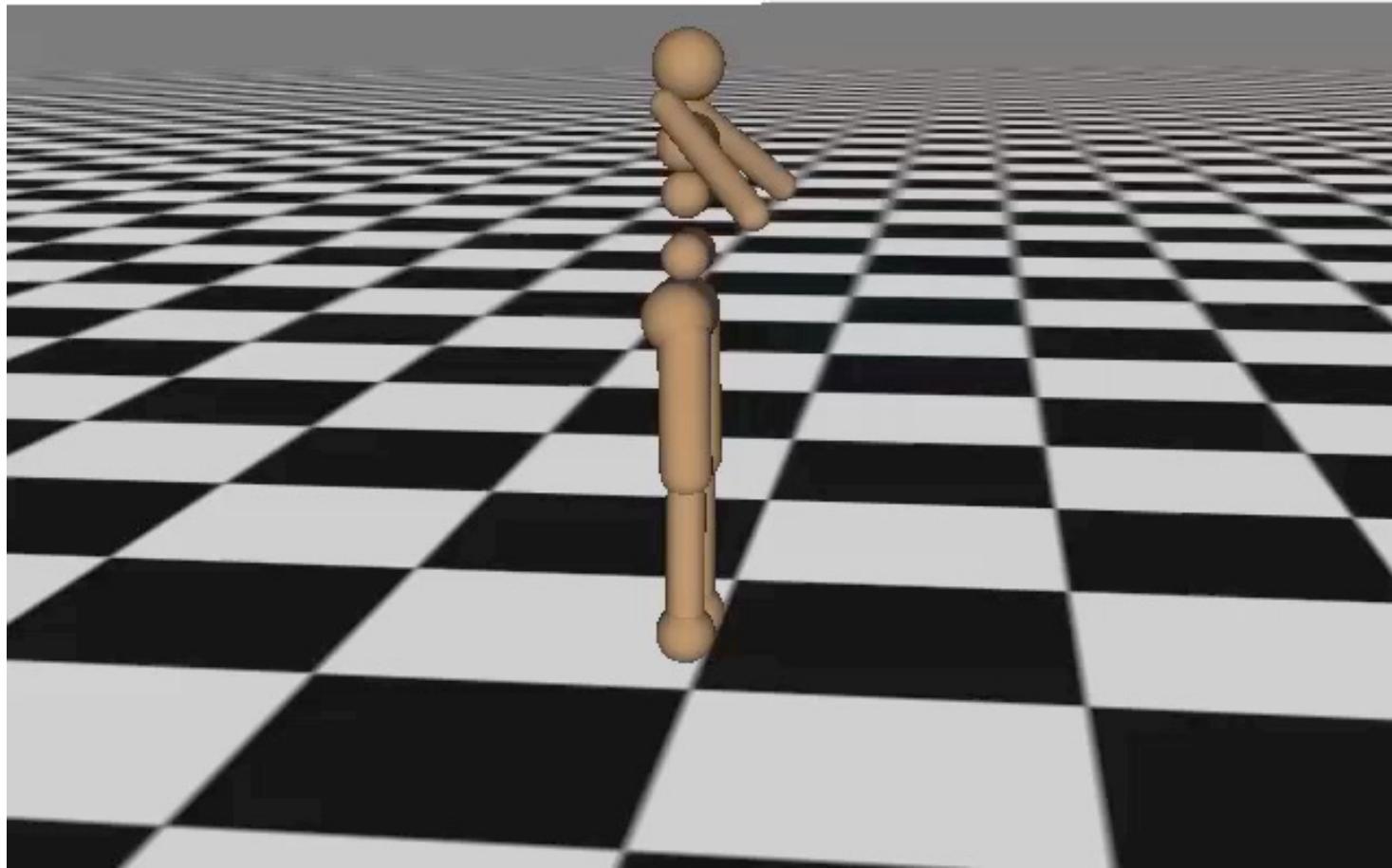
- Classic Moment: May, '97: Deep Blue vs. Kasparov
 - First match won against world champion
 - “Intelligent creative” play
 - 200 million board positions per second
 - Humans understood 99.9 of Deep Blue's moves
 - Can do about the same now with a PC cluster
- 1996: Kasparov Beats Deep Blue
“I could feel --- I could smell --- a new kind of intelligence across the table.”
- 1997: Deep Blue Beats Kasparov
“Deep Blue hasn't proven anything.”





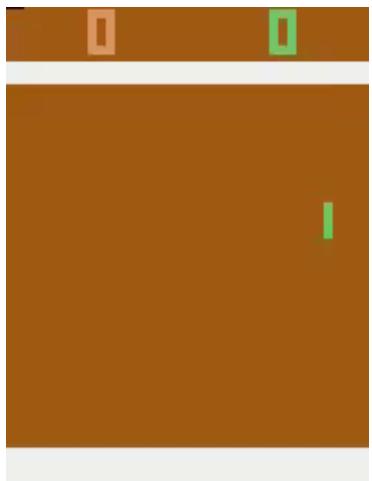
Simulated Agents

Iteration 0

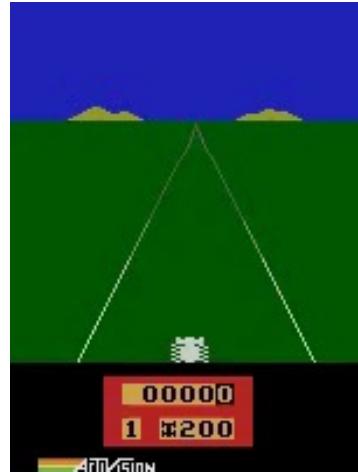


Game Agents

- Reinforcement learning



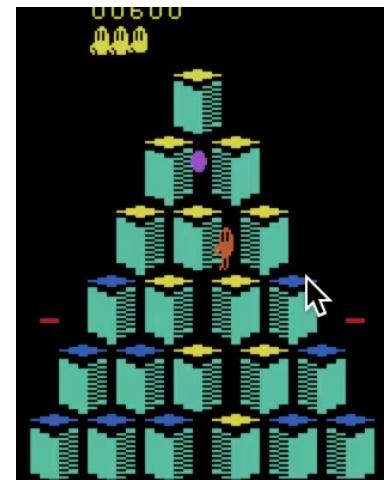
Pong



Enduro



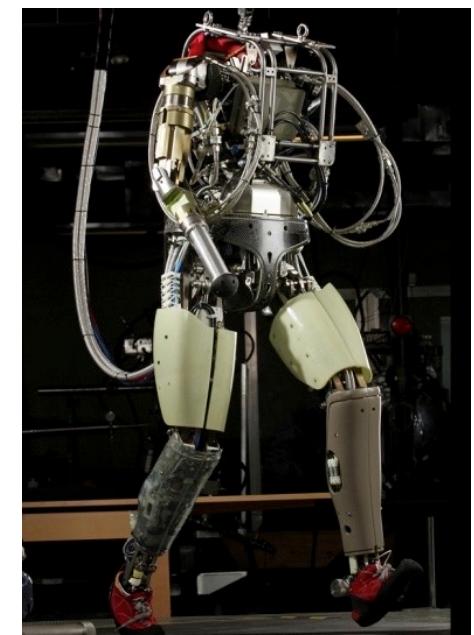
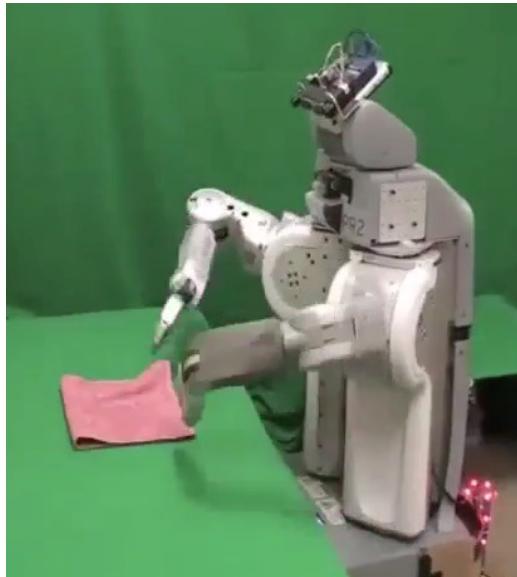
Beamrider



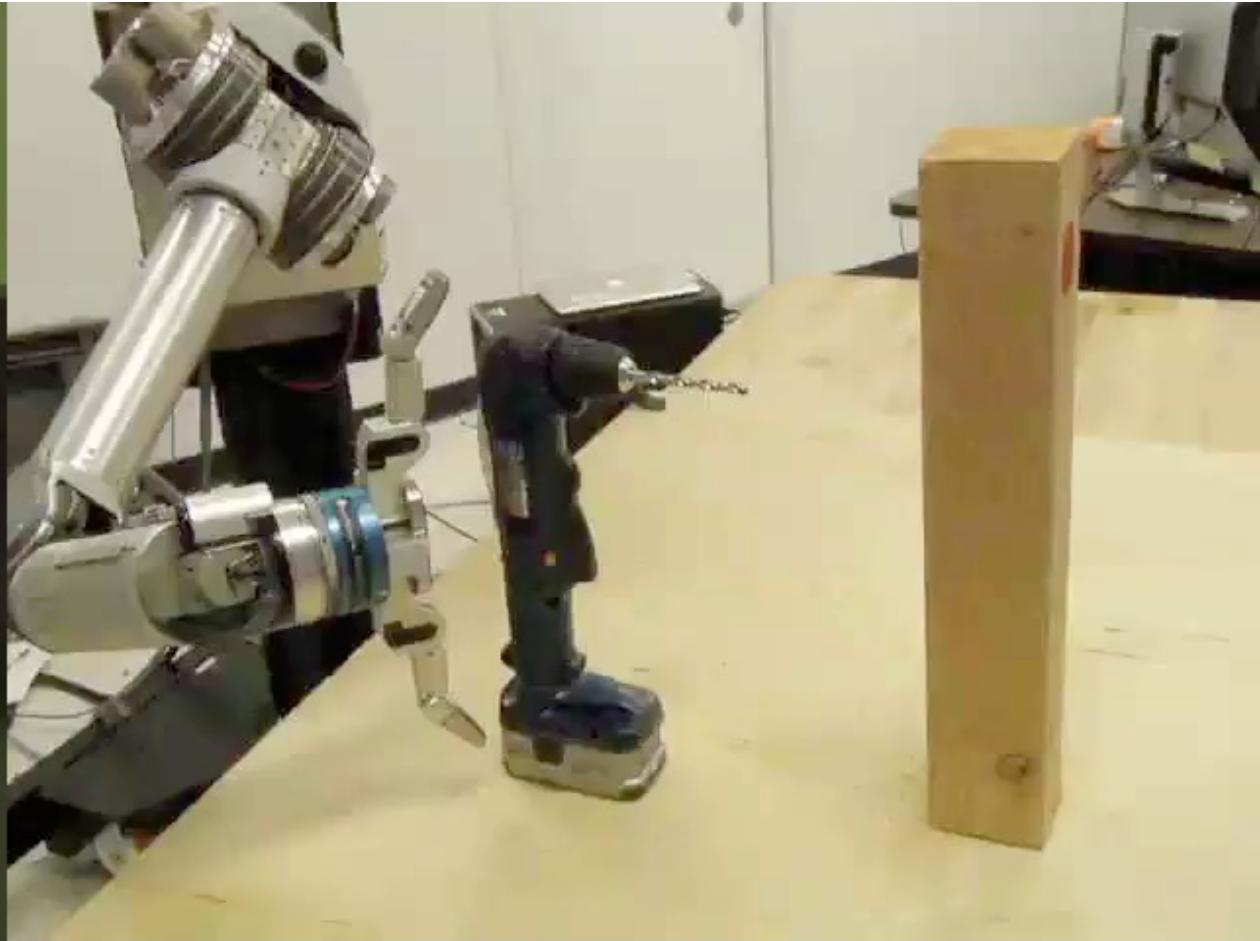
Q*bert

Robotics

- Robotics
 - Part mech. eng.
 - Part AI
 - Reality much harder than simulations!
- Technologies
 - Vehicles
 - Rescue
 - Help in the home
 - Lots of automation...
- In this class:
 - We ignore mechanical aspects
 - Methods for planning
 - Methods for control



Robots



Robots

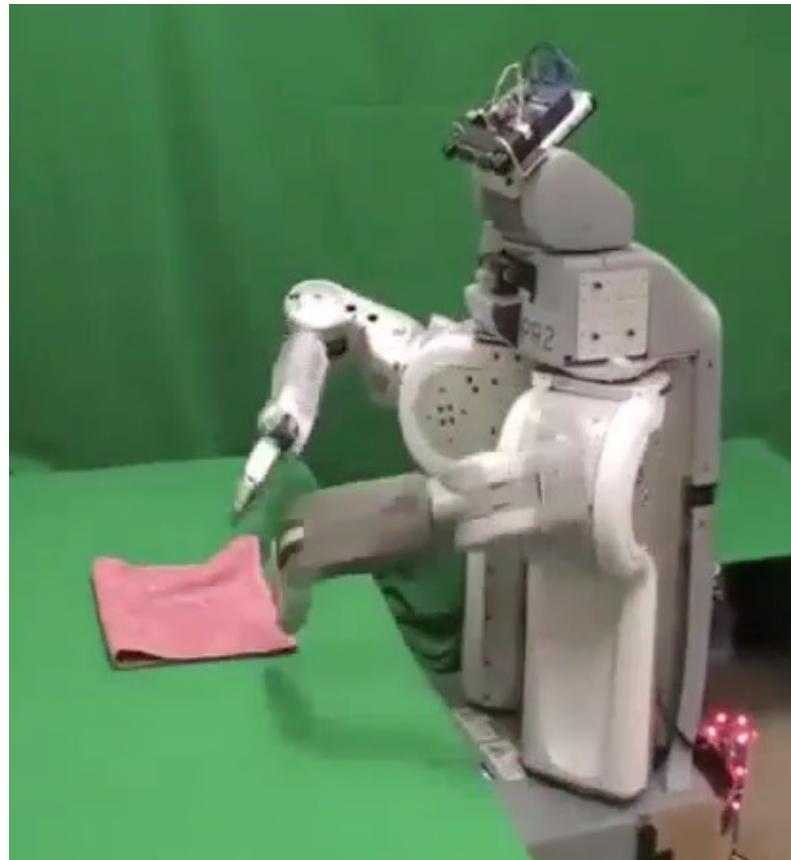


Utility?

Clear utility function



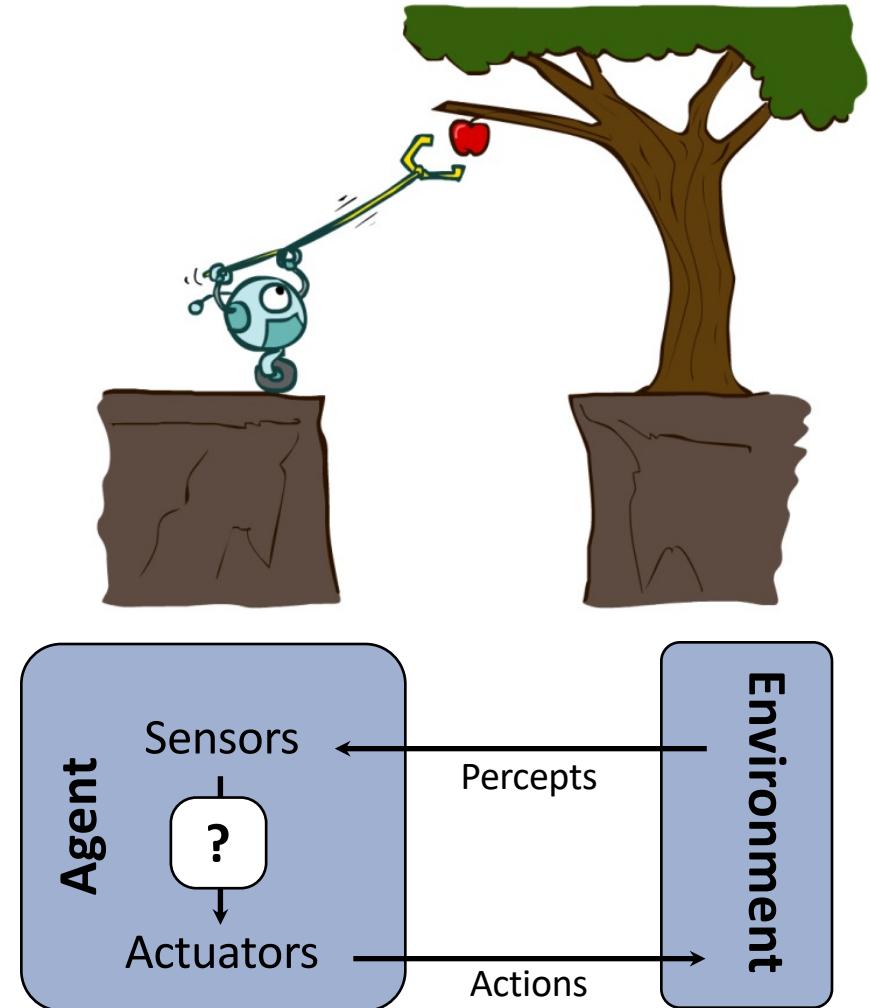
Not so clear utility function



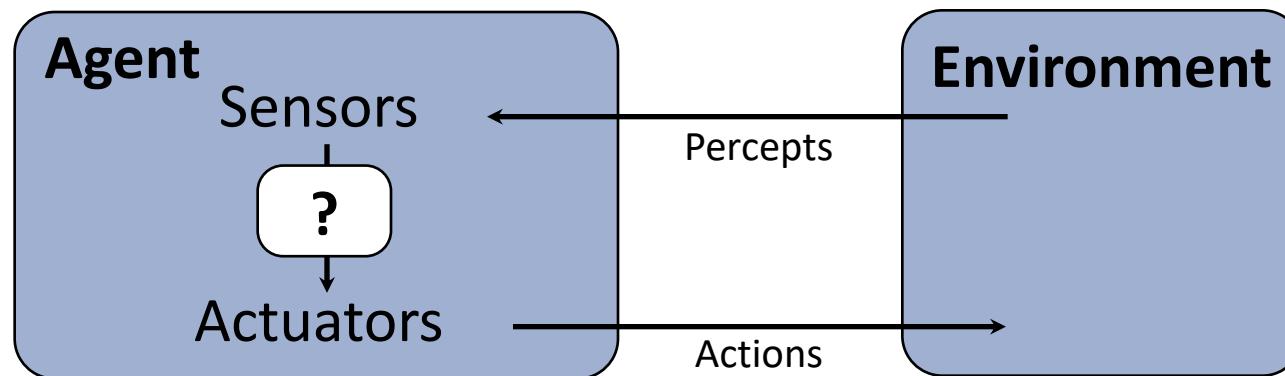
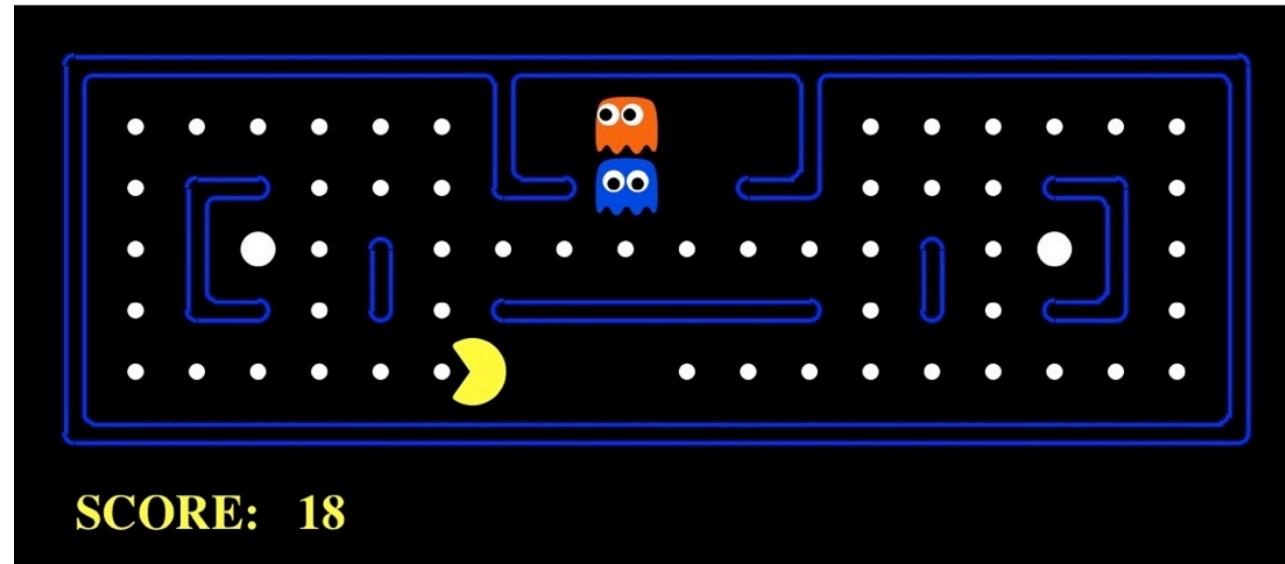


Designing Rational Agents

- An **agent** is an entity that *perceives* and *acts*.
- A **rational agent** selects actions that maximize its (expected) **utility**.
- Characteristics of the **percepts**, **environment**, and **action space** dictate techniques for selecting rational actions
- **This course is about:**
 - General AI techniques for a variety of problem types
 - Learning to recognize when and how a new problem can be solved with an existing technique



Pac-Man as an Agent



Instructor

Steven Bergner

- Webpage:
<https://www.sfu.ca/computing/people/faculty/stevenbergner.html>
- Email
 - Instructional team: cmpt-310-help@sfu.ca
 - Direct: steven_bergner@sfu.ca
- Research interests
 - Machine learning, Computer Vision, Signal Processing
 - Human-machine interaction, Scientific Visualization
 - Big Data & Data Science

Links

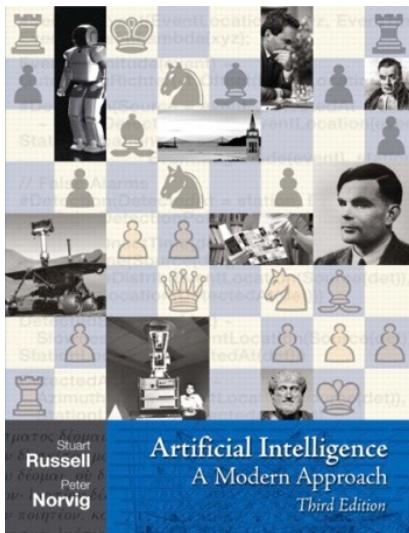
- Website: <https://coursys.sfu.ca/2023fa-cmpt-310-d1/pages/>
- Piazza: <https://piazza.com/sfu.ca/fall2023/cmpt310d100>

Grading

- 10% * 4 Assignments
- 25% Midterm exam (in-class)
- 35% Final exam

Textbook

- Not required, but for students who want to read more we recommend
 - Russell & Norvig, AI: A Modern Approach



- Warning: Not a course textbook, so our presentation does not necessarily follow the presentation in the book.