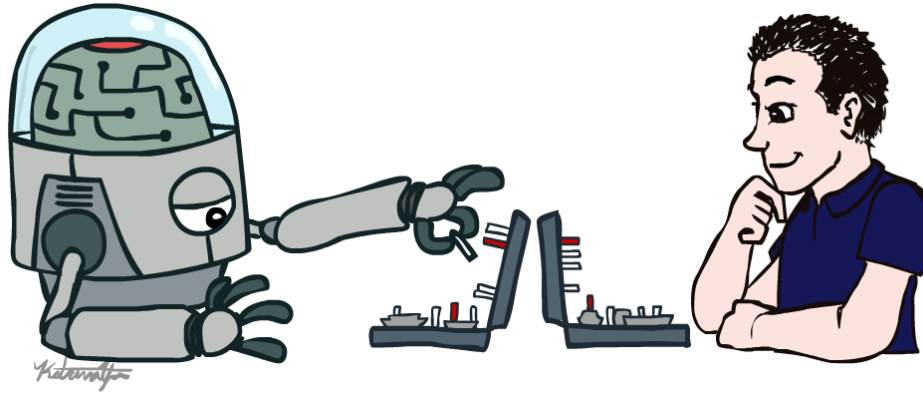


CS 6300: Artificial Intelligence

Introduction

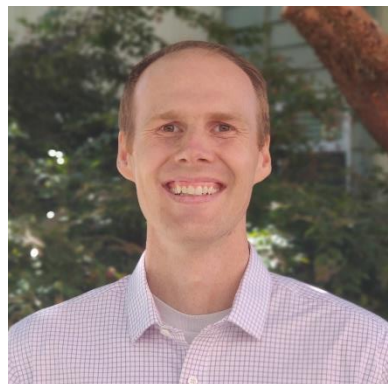


Instructor: Daniel Brown

University of Utah

Course Staff

Professor



Daniel Brown

TAs



Emma Pinegar



Yuan Zhuang

Course Information

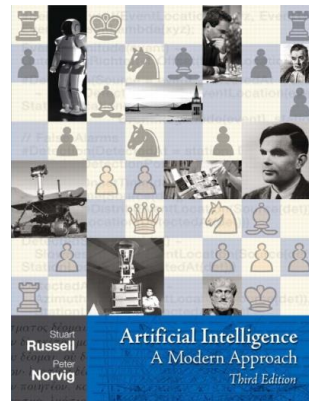
- **Communication:**
 - Announcements on Canvas
 - Questions? Discussion on piazza
- **Course format:**
 - Homeworks and programming assignments turned in via Gradescope.
 - In class midterms and final.
- **Class Website:**
 - <https://www.cs.utah.edu/~dsbrown/classes/cs6300/>

Course Information

- There will be a lot of math (and programming)
- Work and Grading:
 - 5 programming projects: Python,
 - 10% penalty for each day late.
 - ~10 homework assignments.
 - Hands on experience working through math.
 - Two midterms, one final
 - Class participation can help if your grade is on the margins

Textbook

- Not required, but for students who want to read more we recommend
 - Russell & Norvig, AI: A Modern Approach, 3rd Ed.



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

Textbook

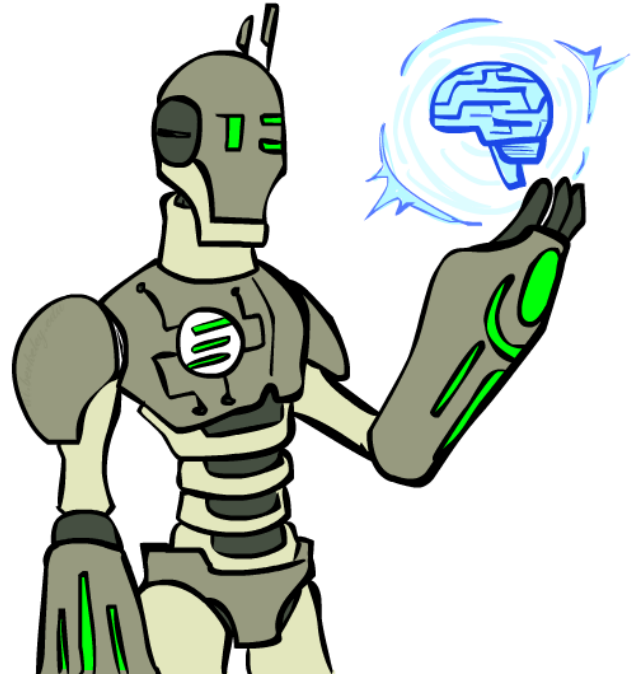
- Also not required, but for students who want to read more about Reinforcement Learning we recommend
 - Sutton and Barto “Reinforcement Learning: An Introduction”
 - Some notation in our class will be closer to Sutton and Barto than Russell and Norvig

Important This Week

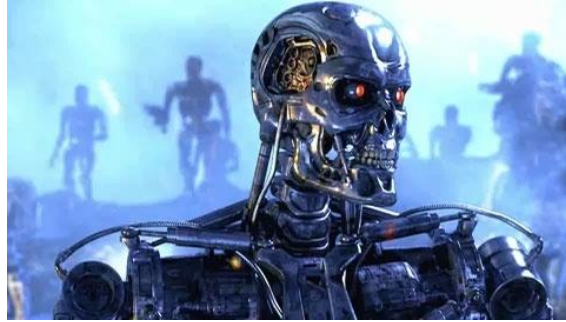
- Important this week:
 - **Register** for the class on piazza --- our main resource for discussion and communication
 - **P0: Python tutorial** is out (due on Wed 1/18 by 11:59pm)
- Also important:
 - **Office Hours**

Today

- What is artificial intelligence?
- What can AI do?
- What is this course?



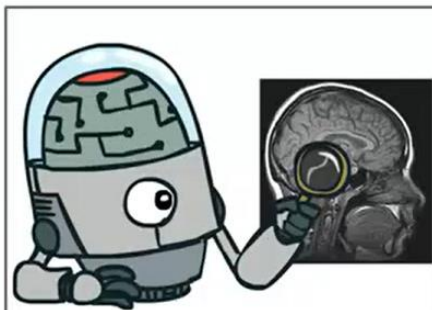
Sci-Fi AI?



What is AI?

The science of making machines that:

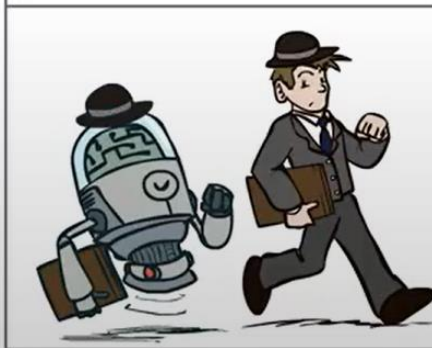
Think like people



Think rationally



Act like people



Act rationally



Rational Decisions

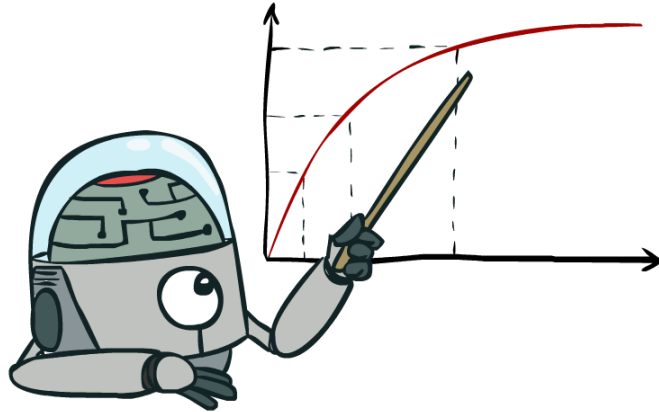
We'll use the term **rational** in a very specific, technical way:

- 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:

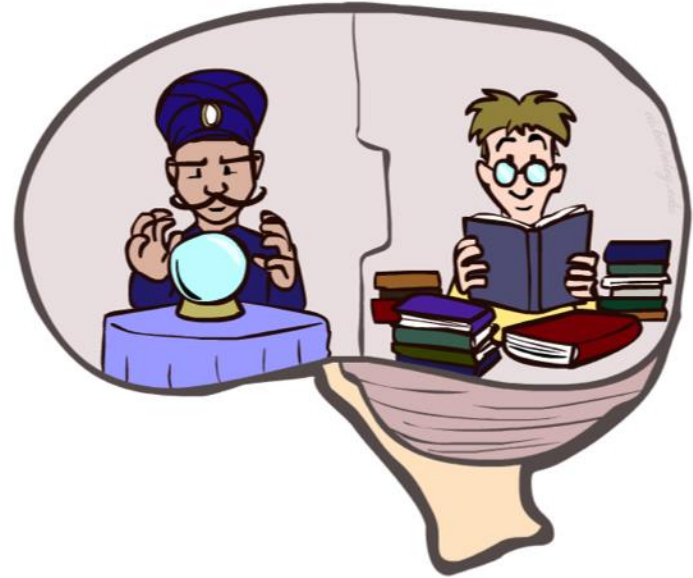
Computational Rationality

Maximize Your Expected Utility

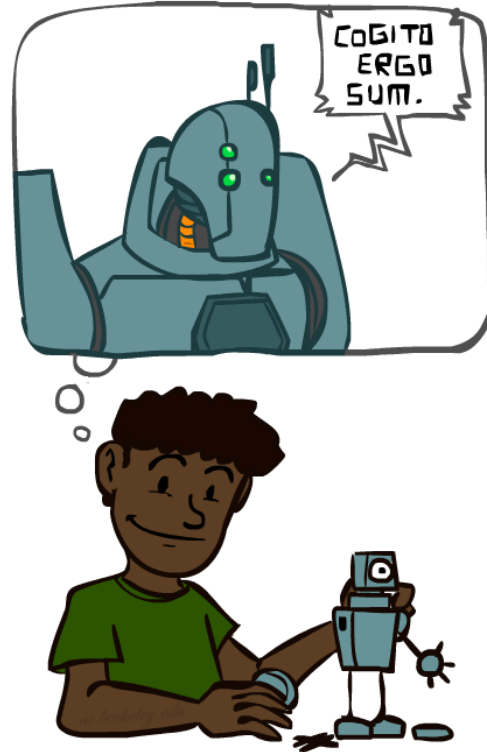


What About the Brain?

- 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

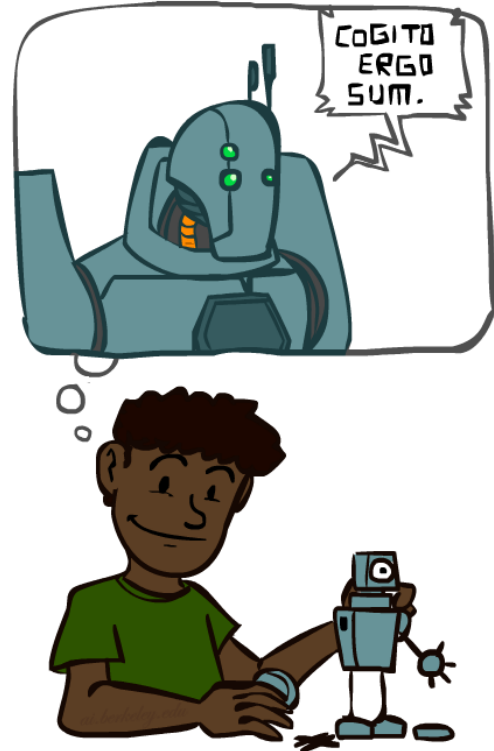


A (Short) History of AI



A (Short) History of AI

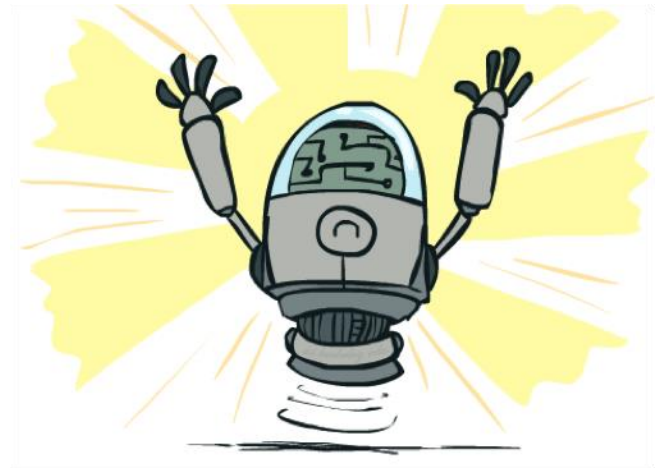
- **1940-1950: Early days**
 - 1943: McCulloch & Pitts: Boolean circuit model of brain
 - 1950: Turing's "Computing Machinery and Intelligence"
- **1950—70: Excitement: Look, Ma, no hands!**
 - 1950s: Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's 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 and statistics, focus on uncertainty
 - General increase in technical depth
 - Agents and learning systems... "AI Spring"?
- **2014—: Deep Learning and Scaling Things Up**
 - Big data
 - Powerful compute (e.g. GPUs)



What Can AI Do?

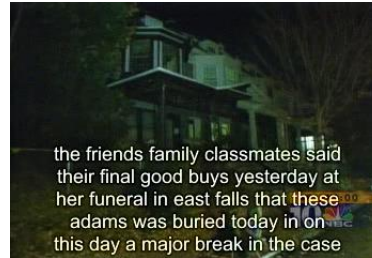
Quiz: Which of the following can be done at present?

- ✓ Play a decent game of table tennis?
- ✓ Play a decent game of Jeopardy?
- ✓ Drive safely along a curving mountain road?
- ✓ Buy a week's worth of groceries on the web?
- ✗ Buy a week's worth of groceries at Walmart?
- ⚡ Discover and prove a new mathematical theorem?
- ⚡ Converse successfully with another person for an hour?
- ⚡ Perform a surgical operation?
- ✗ Come into your apartment and unload your dishwasher
- ✓ Translate spoken Chinese into spoken English in real time?
- ⚡ Write decent poetry?
- ⚡ Create aesthetically pleasing artwork



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

"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...

Chat GPT

The image is a screenshot of a web browser displaying the OpenAI blog post titled "ChatGPT: Optimizing Language Models for Dialogue". The browser's address bar shows the URL "https://openai.com/blog/chatgpt/". The page features the OpenAI logo in the top left and navigation links for "API", "RESEARCH", "BLOG", and "ABOUT" in the top right. The main content area has a dark green background with the title in large white font. Below the title is a paragraph of text describing the model's capabilities. A pink button labeled "TRY CHATGPT" is positioned at the bottom left of the article content. To the right of the text is a large, stylized graphic consisting of horizontal bars in shades of purple and green, resembling a bar chart or data visualization. The browser's taskbar at the bottom shows the system tray with a temperature of 43°F, weather status "Raining now", and the date "1/10/2023".

Introducing ChatGPT research release [Try](#) [Learn more](#)

OpenAI [API](#) [RESEARCH](#) [BLOG](#) [ABOUT](#)

ChatGPT: Optimizing Language Models for Dialogue

We've trained a model called ChatGPT which interacts in a conversational way. The dialogue format makes it possible for ChatGPT to answer followup questions, admit its mistakes, challenge incorrect premises, and reject inappropriate requests. ChatGPT is a sibling model to InstructGPT, which is trained to follow an instruction in a prompt and provide a detailed response.

[TRY CHATGPT](#)

43°F Raining now 3:22 PM 1/10/2023

Text to Images (DALL-E)

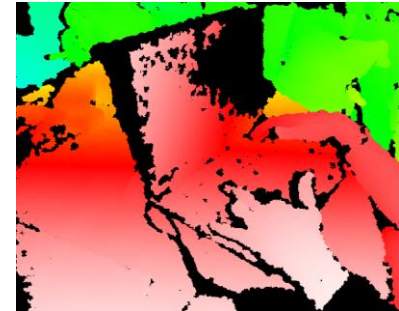
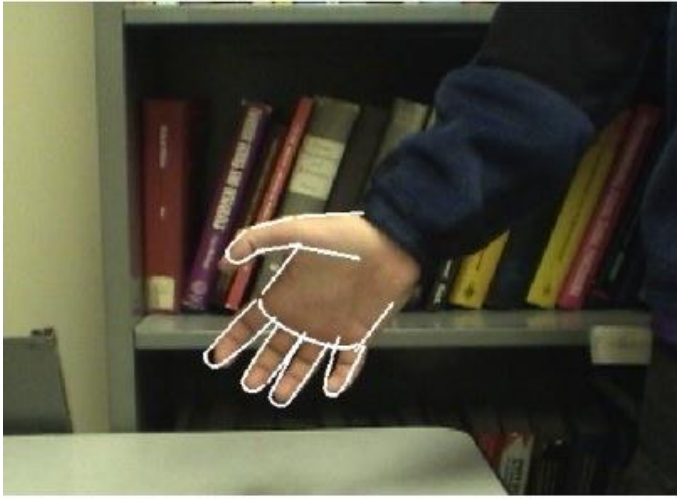
- “An astronaut riding a horse in a photo-realistic way”



- “An armchair in the shape of an avocado.”

Vision (Perception)

- Object and face recognition
- Scene segmentation
- Image classification

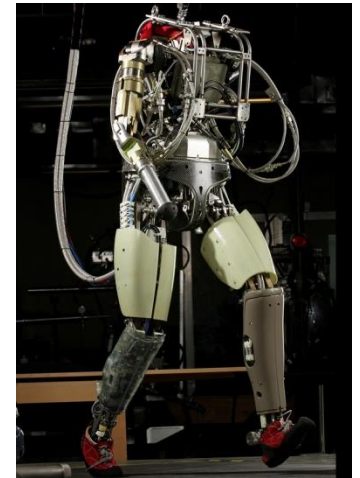
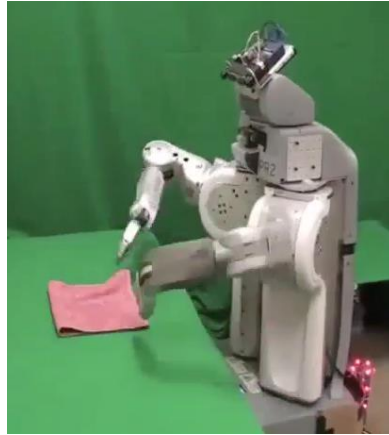


Demo1: VISION – lec_1_t2_video.flv

Demo2: VISION – lec_1_obj_rec_0.mpg

Robotics

- Robotics
 - Part mech. eng.
 - Part AI
 - Reality much harder than simulations!
- Technologies
 - Autonomous Vehicles
 - Rescue
 - Soccer!
 - Lots of automation...
 - But increasing amounts of learning...
- In this class:
 - We ignore mechanical aspects
 - Methods for planning
 - Methods for control



Images from UC Berkeley, Boston Dynamics, RoboCup, Google

Boston Dynamics Atlas



<https://vision-locomotion.github.io/>



Logic

- Logical systems
 - Theorem provers
 - NASA fault diagnosis
 - Question answering
- Methods:
 - Deduction systems
 - Constraint satisfaction
 - Satisfiability solvers (huge advances!)

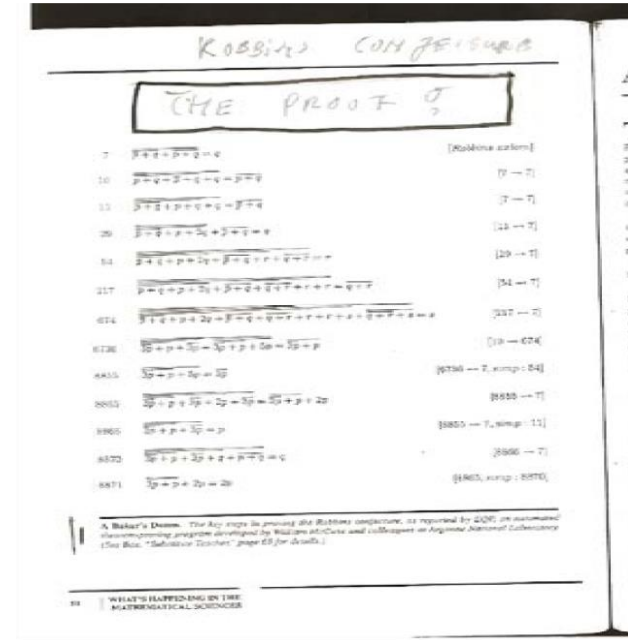


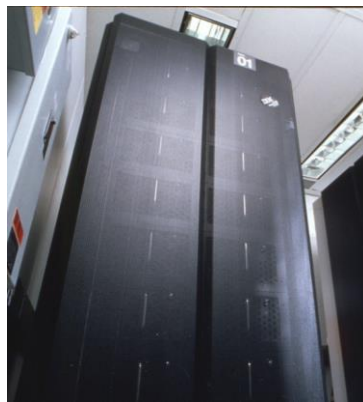
Image from Bart Selman

Game Playing

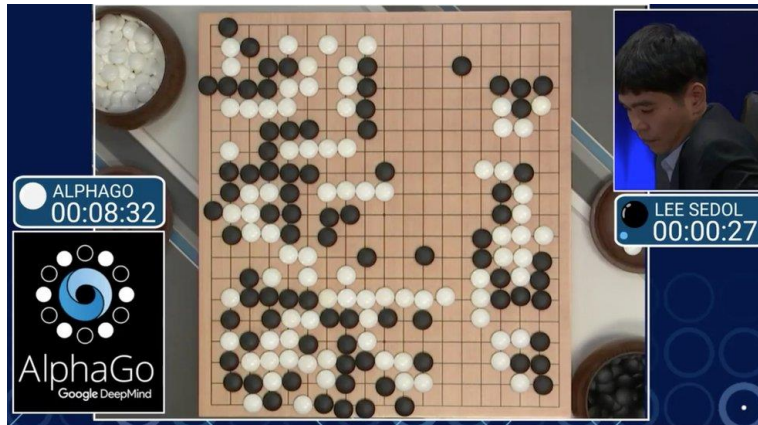
- **Classic Moment: May, '97: Deep Blue vs. Kasparov**
 - First match won against world champion
 - “Intelligent creative” play
 - 200 million board positions per second
 - Humans understood 99.9 of Deep Blue's moves
 - Can do about the same now with a PC cluster
- **Open question:**
 - How does human cognition deal with the search space explosion of chess?
 - Or: how can humans compete with computers at all??
- **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.”
- **Huge game-playing advances recently, e.g. in Go!**



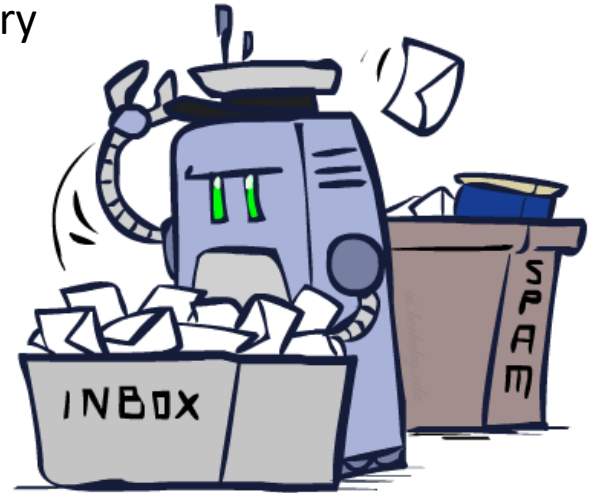
Winning at Games



Decision Making

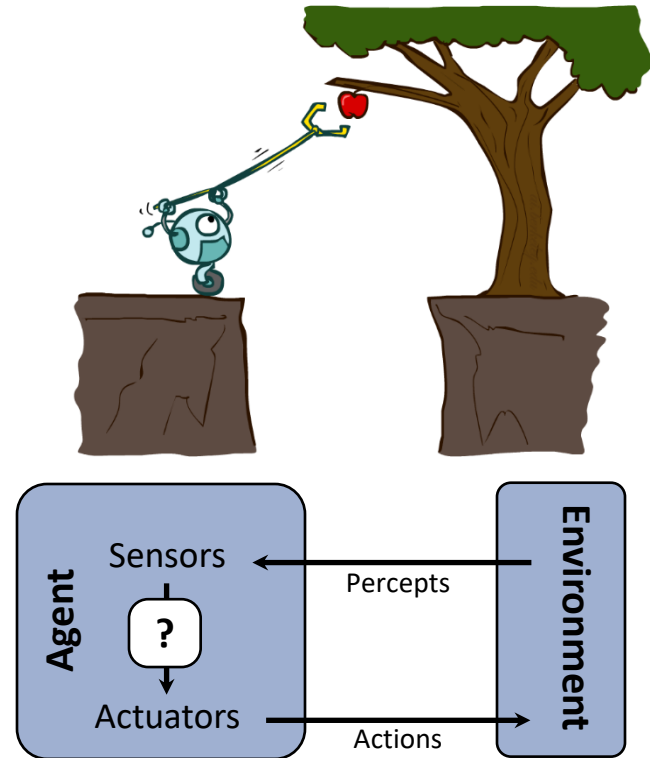
- Applied AI involves many kinds of automation

- Scheduling, e.g. airline routing, military
- Route planning, e.g. Google maps
- Medical diagnosis
- Web search engines
- Spam classifiers
- Automated help desks
- Fraud detection
- Product recommendations
- ... Lots more!

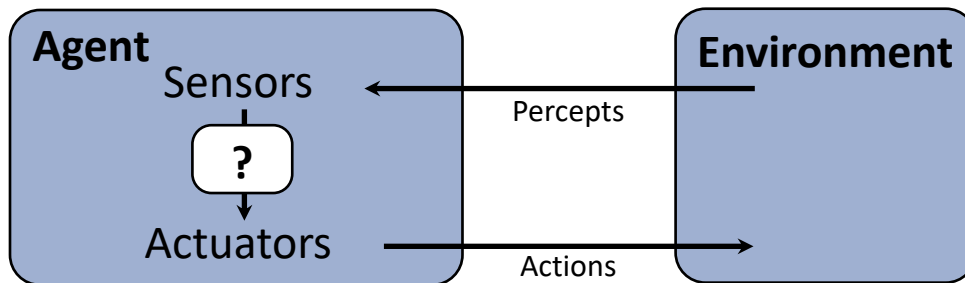
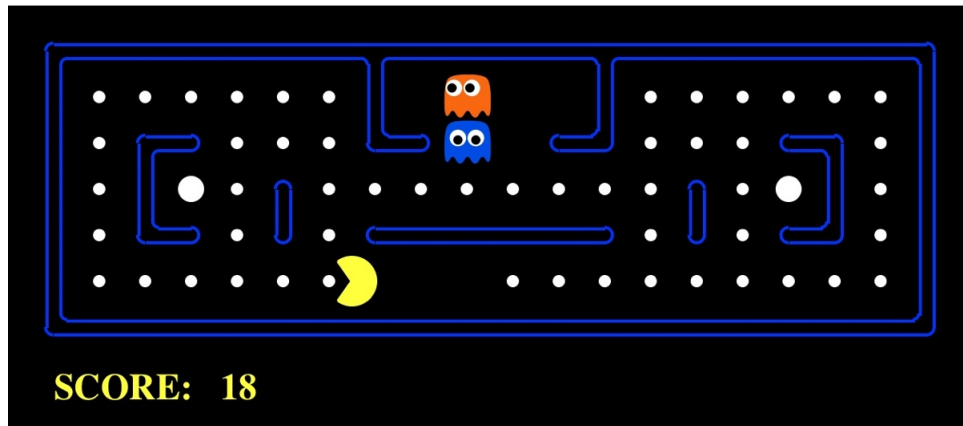


Designing Rational Agents

- 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



Pacman

- Google: “play pacman doodle”

Course Topics

- Part I: Making Decisions
 - Fast search
 - Adversarial and uncertain search
- Part II: Markov Decision Process (MDP) Basics
 - Planning
 - Reinforcement learning
 - Imitation learning
- Part III: Reasoning Under Uncertainty
 - Bayes Nets
 - Hidden Markov Models (HMMs)
 - Partially Observable MDPs (POMDPs)

