

Today

- o What is artificial intelligence?
- o Where did it come from/
What can AI do?
 - o What should we and shouldn't
we worry about? What can we
do about the things we should
worry about?
- o What is this course?



What is AI?

The science of making machines that:

- “Artificial intelligence is a computerised system that exhibits behaviour that is commonly thought of as requiring intelligence.” (1)
- “Artificial Intelligence is the science of making machines do things that would require intelligence if done by man.” (2)

The founding father of AI, Alan Turing, defines this discipline as:

- “AI is the science and engineering of making intelligent machines, especially intelligent computer programs.” (3)

Rational Decisions

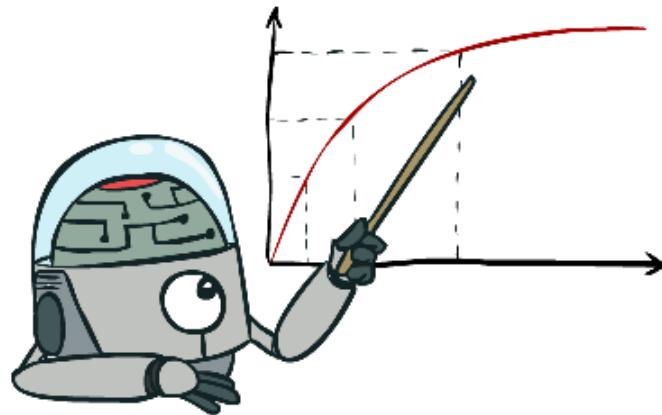
We'll use the term **rational** in a very specific, technical way:

- 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**

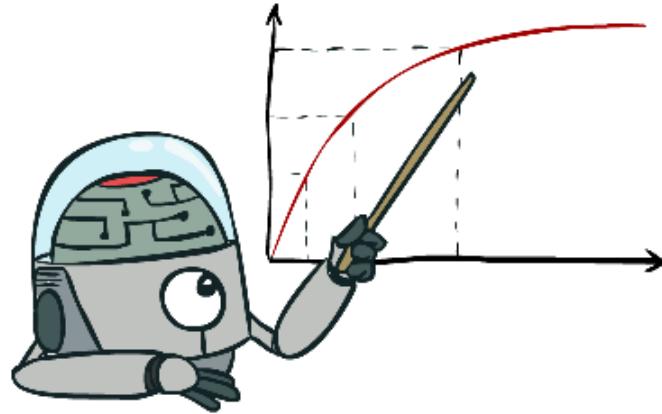
A better title for this course would be:

Computational Rationality

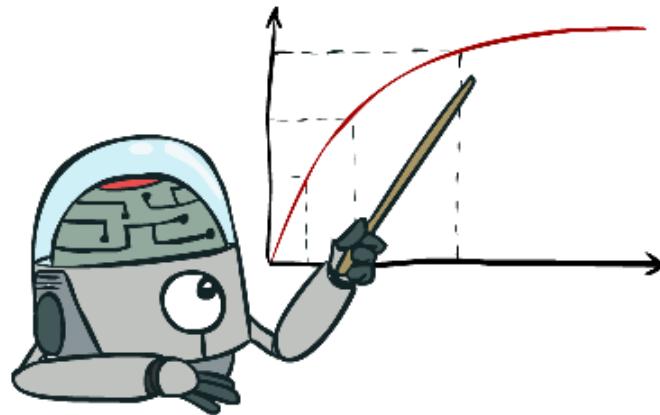
Maximize Your Expected Utility



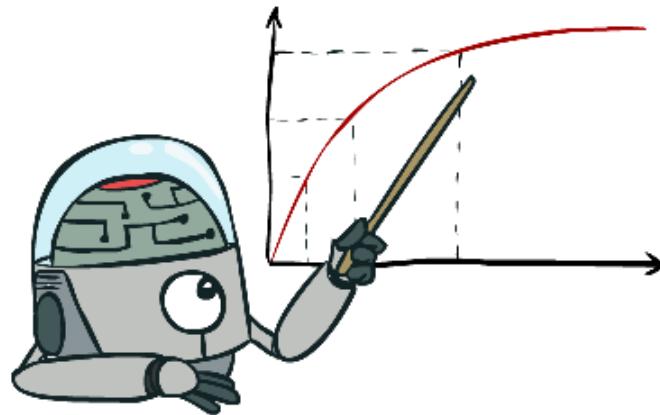
Maximize Your Expected Utility



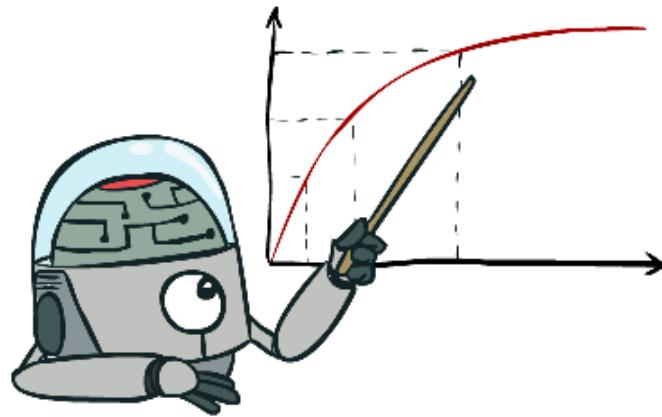
Maximize Your Expected Utility



Maximize Your Expected Utility

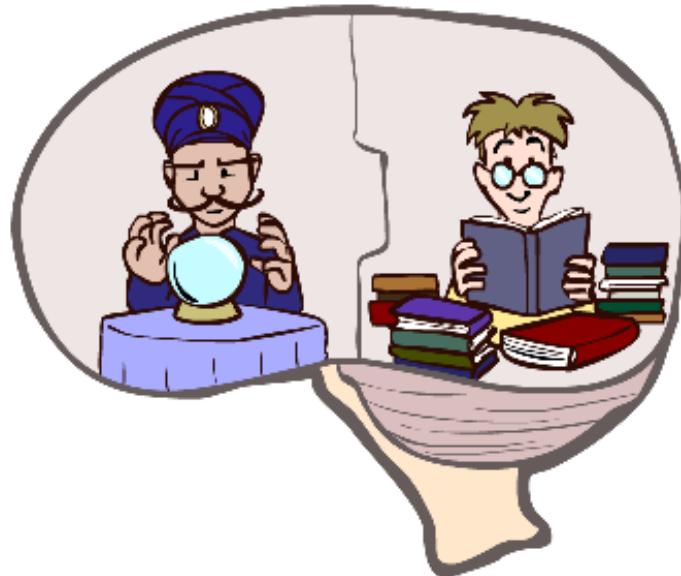


Maximize Your Expected Utility



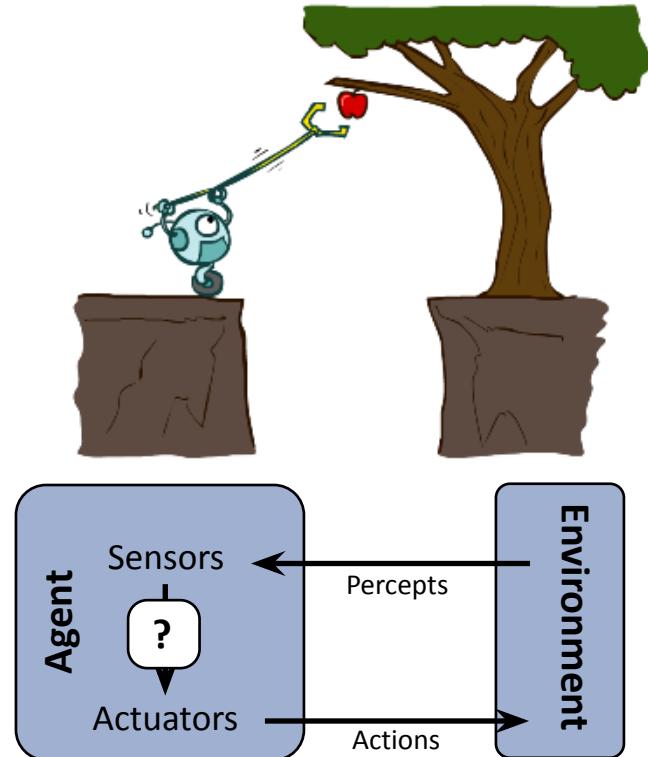
What About the Brain?

- 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

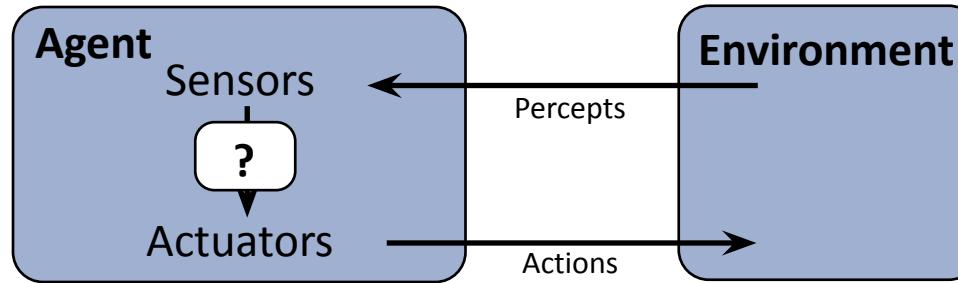
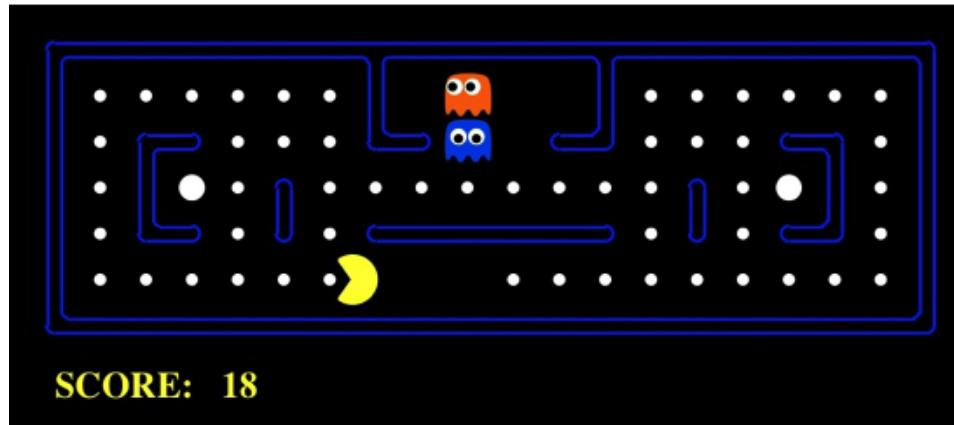


Designing Rational Agents

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



Pac-Man as an Agent



AI

Machine Learning
[learning decisions;
sometimes independent]

Robots
[physically
embodied]

Rational
Agents
[decisions]

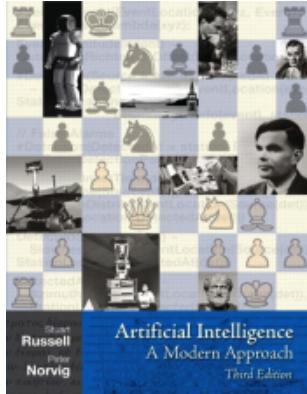
Human-AI
Interaction

NLP

Computer
Vision

Textbook

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



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

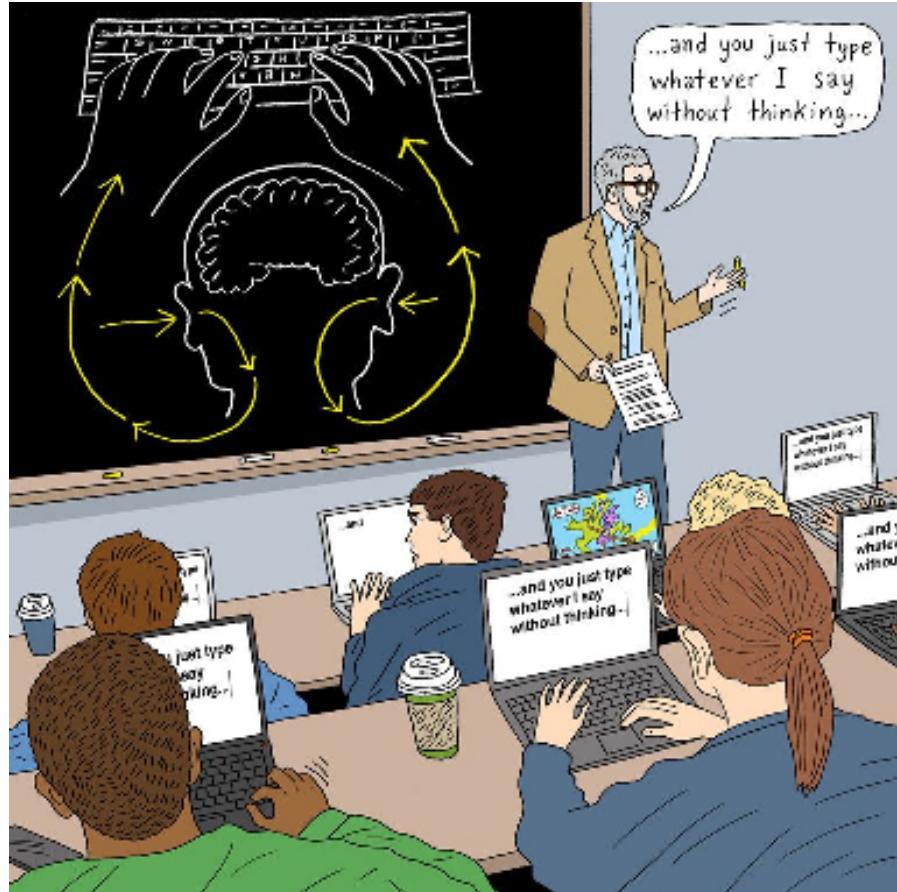
Laptops in Lecture

The New York Times

*Laptops Are Great. But Not
During a Lecture or a Meeting.*

Economic View

By SUSAN DYNARSKI NOV. 22, 2017

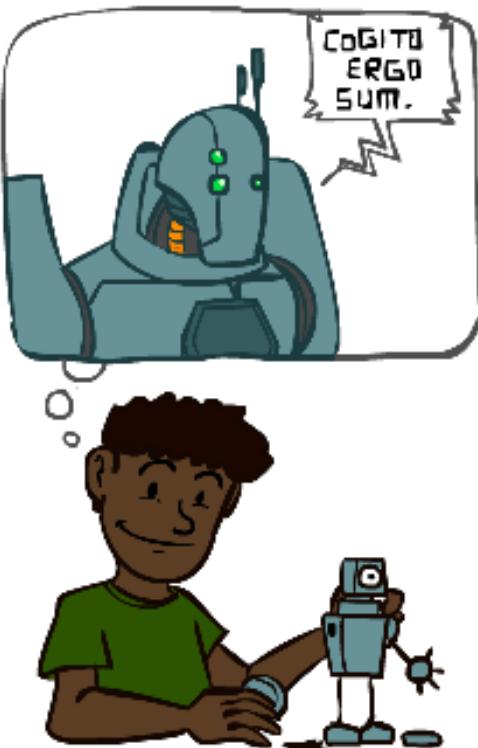


Laptops in Lecture

(starting next lecture)

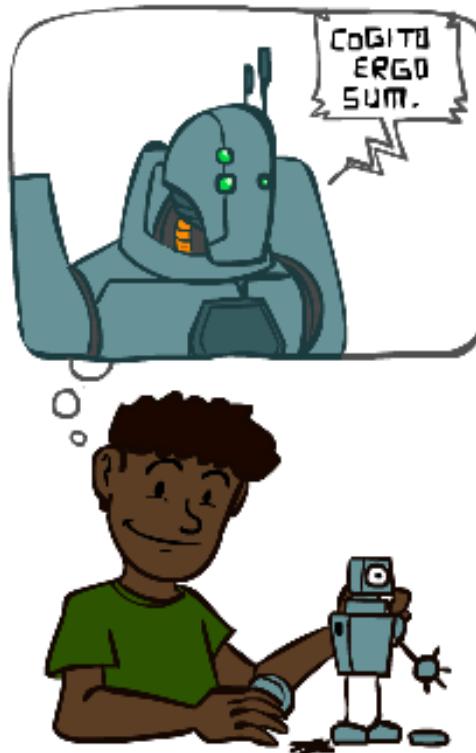
- o We prefer if you don't use electronics in lecture.
- o Laptops detract more from the people behind you than yourself.
- o Solution: Sit in back or sides with laptop (please).

A (Short) History of AI



A (Short) History of AI

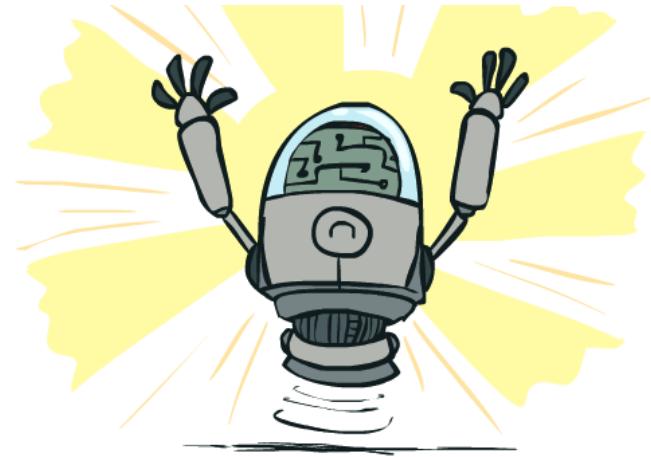
- o 1940-1950: Early days
 - o 1943: McCulloch & Pitts: Boolean circuit model of brain
 - o 1950: Turing's "Computing Machinery and Intelligence"
- o 1950—70: Excitement: Look, Ma, no hands!
 - o 1950s: Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's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



What Can AI Do?

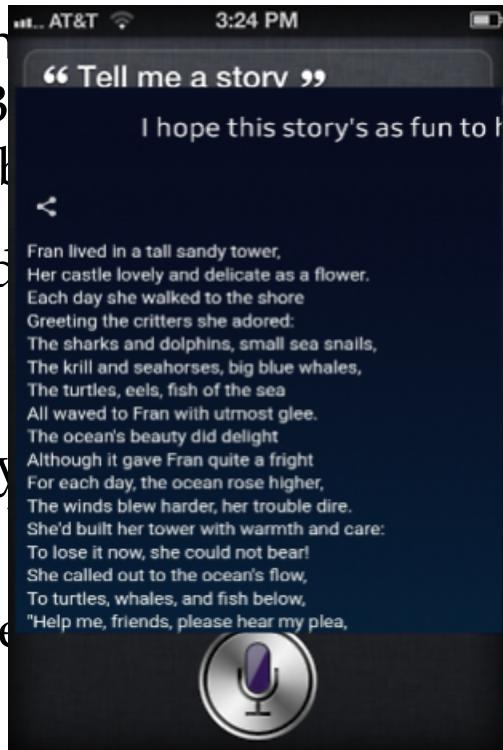
Quiz: Which of the following can be done at present?

- 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 Telegraph Avenue?
- Buy a week's worth of groceries on the web?
- Buy a week's worth of groceries at Berkeley Bowl?
- Discover and prove a new mathematical theorem?
- Perform a surgical operation?
- Translate spoken Chinese into spoken English in real time?
- Write an intentionally funny story?



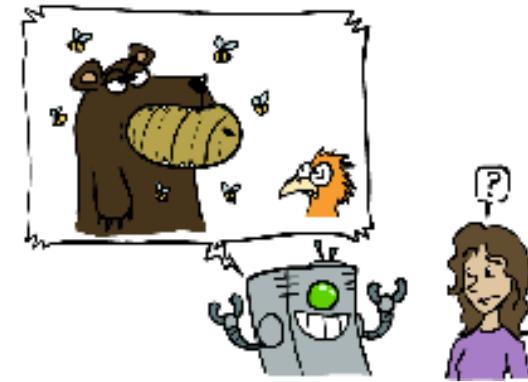
Unintentionally Funny Stories

- One day Joe Bear was hungry.
He asked his friend Irving Birdie if he knew a story.
Irving told him there was a beehive in a nearby oak tree.
Joe walked to the oak tree.
He ate the beehive. The End.



- Henry Squirrel was thirsty.
He walked over to the river bank and began to sit down.
Henry slipped and fell in the water.
Gravity drowned. The End.

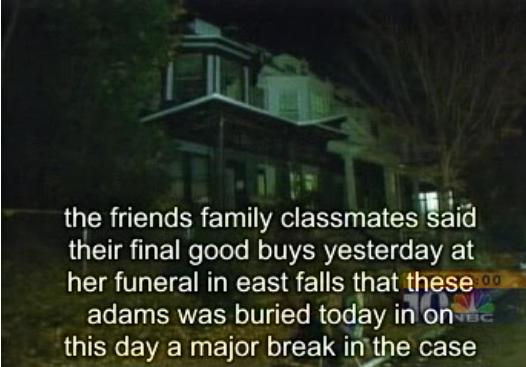
friend Bill Bird was



[Shank, Tale-Spin System, 1984]

Natural Language

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



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

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

Lire plus Le dalaï-lama dénonce l'interdiction imposée 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."

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

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

<https://play.aidungeon.io/>

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."



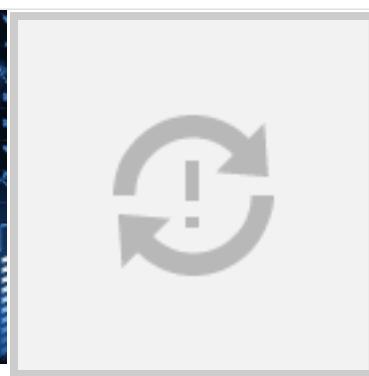
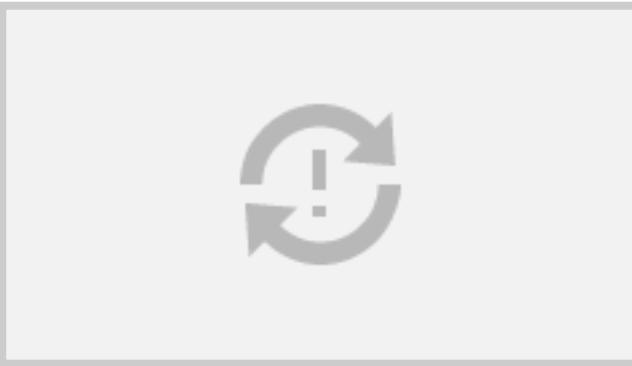
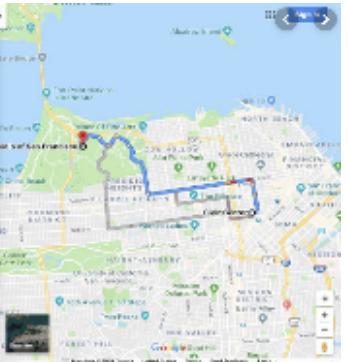
"young girl in pink shirt is swinging on swing."



"man in blue wetsuit is surfing on wave."

Karpathy & Fei-Fei, 2015; Donahue et al., 2015; Xu et al, 2015; many more

Tools for Predictions & Decisions



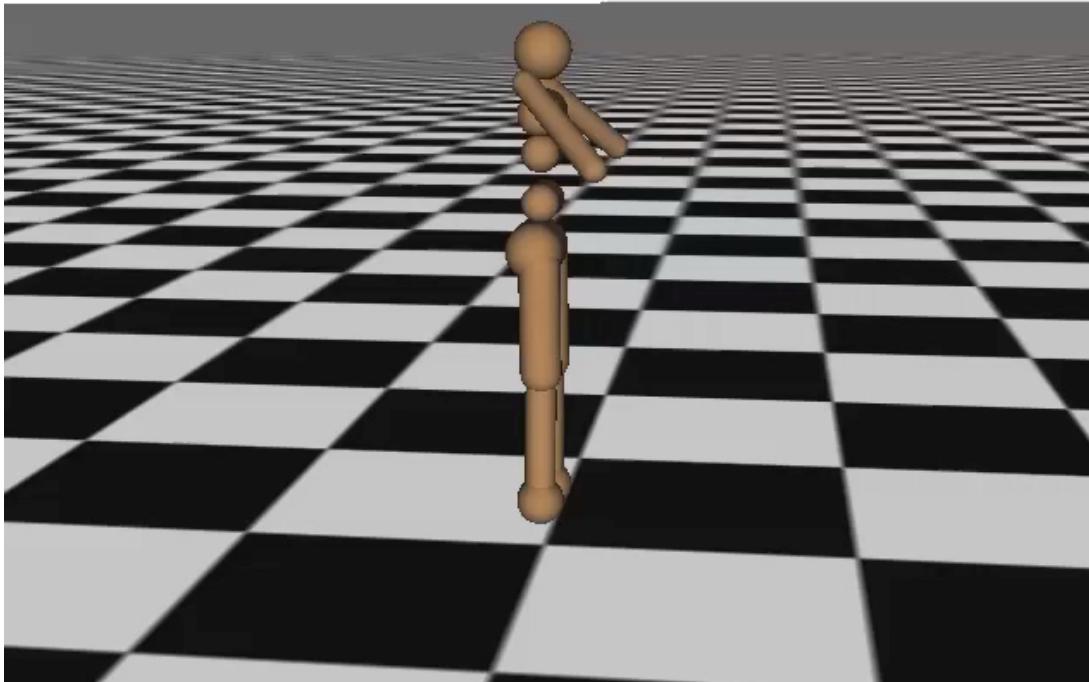
Game Agents

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



Simulated Agents

Iteration 0



Game Agents

o Reinforcement learning



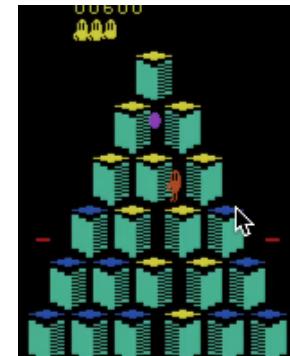
Pong



Enduro



Beamrider



Q*bert

Robotics

Demo 1: ROBOTICS – soccer.avi

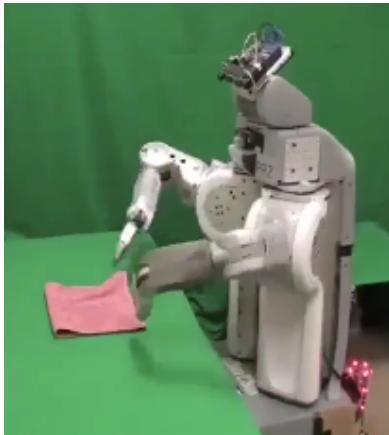
Demo 4: ROBOTICS – laundry.avi

Demo 2: ROBOTICS – soccer2.avi

Demo 5: ROBOTICS – petman.avi

Demo 3: ROBOTICS – gcar.avi

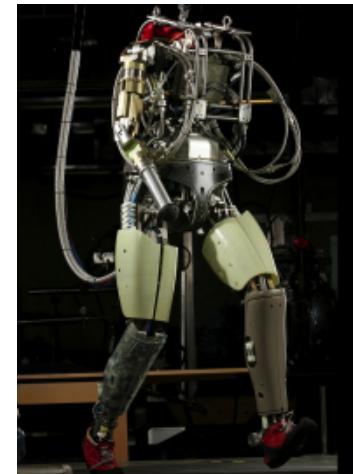
- o Robotics
 - o Part mech. eng.
 - o Part AI
 - o Reality much harder than simulations!



- o Technologies
 - o Vehicles
 - o Rescue
 - o Help in the home
 - o Lots of automation...

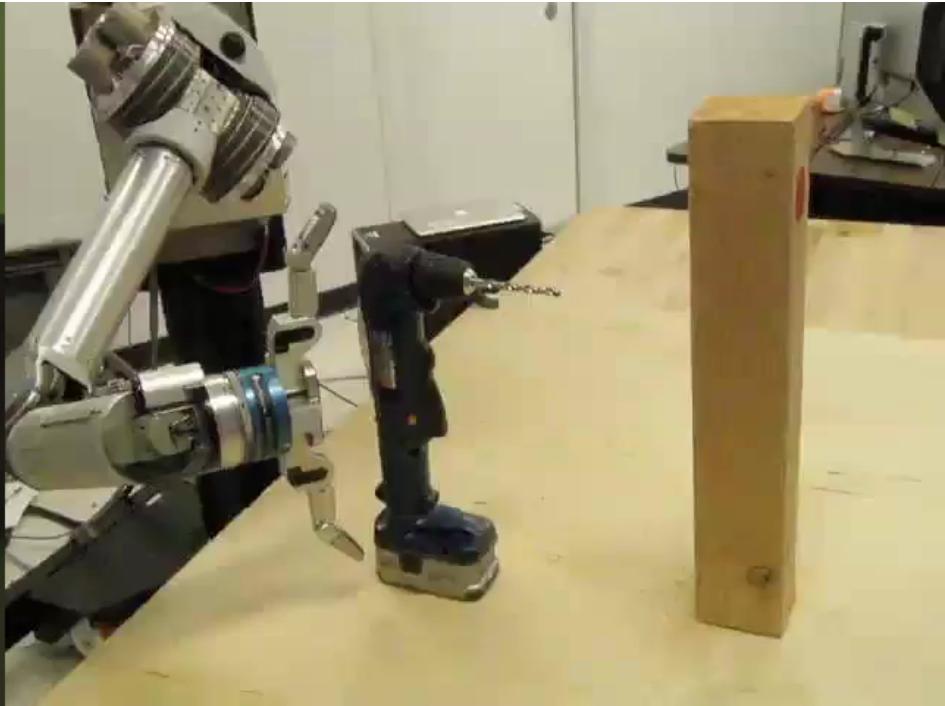


- o In this class:
 - o We ignore mechanical aspects
 - o Methods for planning
 - o Methods for control



Images from UC Berkeley, Boston Dynamics, RoboCup, Google

Robots

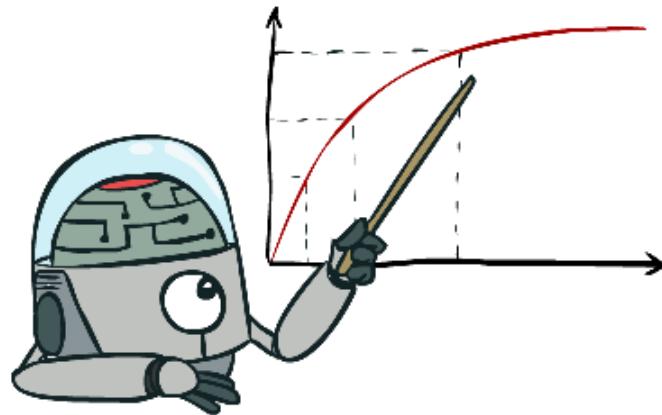


Human-AI Interaction



Personal Robotics Lab 415-750-4712

Maximize Your Expected Utility



Utility?

Clear utility function



Not so clear utility function

