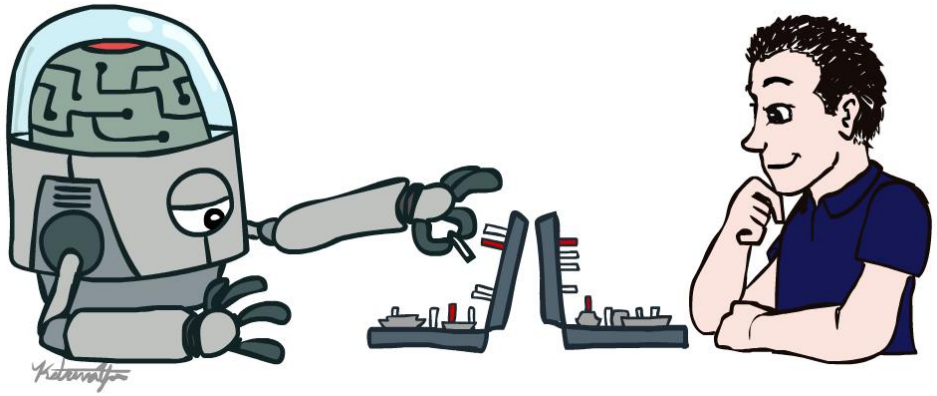
CS 188: Artificial Intelligence

Introduction



Instructor: Pieter Abbeel

University of California, Berkeley

(slides by Dan Klein and Pieter Abbeel)

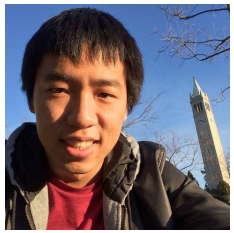
Course Staff

Professor

Pieter Abbeel

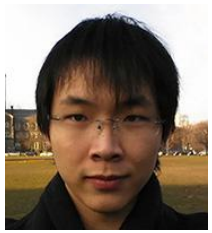
GSIs

Alvin Wong



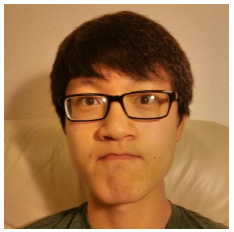
Alex Lee

Chelsea Finn

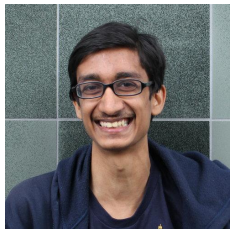


Chi Jin

Lisa Hendricks



John Du



Rohin Shah

Sandy Huang

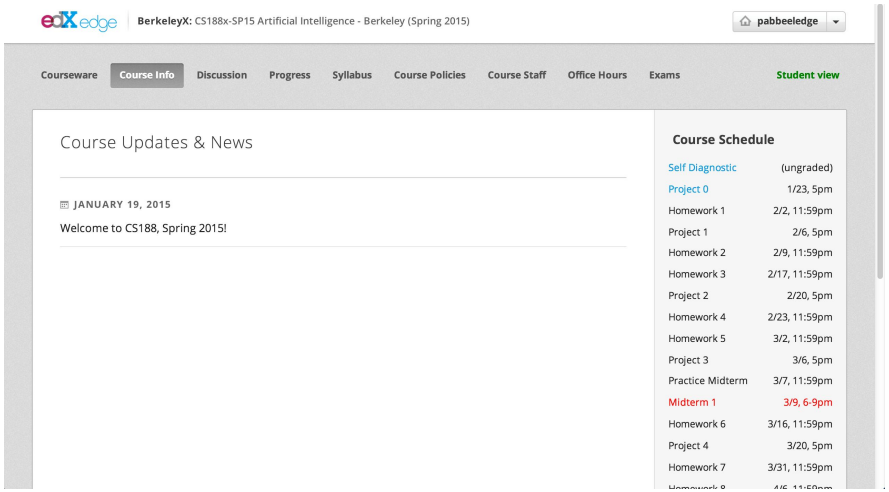
Shubham Tulsiani

Zoe McCarthy

Course Information

- Communication:
  - Announcements on webpage
  - Questions? Discussion on piazza
  - Staff email: cs188-staff@lists
  - This course is webcast (Sp15 live videos)
  - + Fa12 edited videos (1-11)
  - + Fa13 live videos
- Course technology:
  - Somewhat new infrastructure
  - Autograded projects, interactive homework (unlimited submissions!)
  - Help us make it awesome!

Sign up at: inst.eecs.berkeley.edu/~cs188



Course Information

- Prerequisites:
  - CS 61A and CS 61B and CS 70
  - There will be a lot of math (and programming)
- Work and Grading:
  - 6 programming projects: Python, groups of 1 or 2
    - 5 late days for semester, maximum 2 per project
  - ~9 homework assignments:
    - Online, interactive, solve together, submit alone
  - Two midterms, one final
  - Fixed scale
  - Participation can help on margins
  - Academic integrity policy
- Contests!

Exam Dates

- Midterm 1: Monday 3/9 6-9pm
- Midterm 2: Monday 4/20 6-9pm
- Final Exam: Wednesday 5/13 11:30-2:30pm

Laptops in Lecture

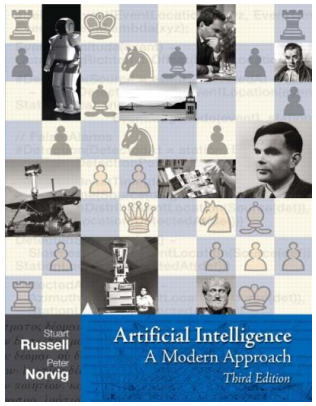
(starting next lecture)

- Not going to resolve the laptops-in-lecture debate, but to address desires of both populations, we suggest:
  - Students who want to use their laptops
    - Towards the right
  - Students who want to be in a laptop-free zone
    - Towards the left

    (from a forward facing student's perspective)

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.

Discussion Section (Optional Attendance)

- Topic: review / warm-up exercises.

- Currently, none of you are assigned to sections.
- You are welcome to attend any section of your preference.
- Piazza survey later this week to help keep sections balanced.

- From past semesters' experience we know sections will be (over)crowded the first two weeks of section, but then onwards section attendance will be lower and things will sort themselves out. Note that webcasts of section will be available this semester.

- There is no section in the week of 1/20 - 1/23.

Exam Practice Sessions (Optional Attendance)

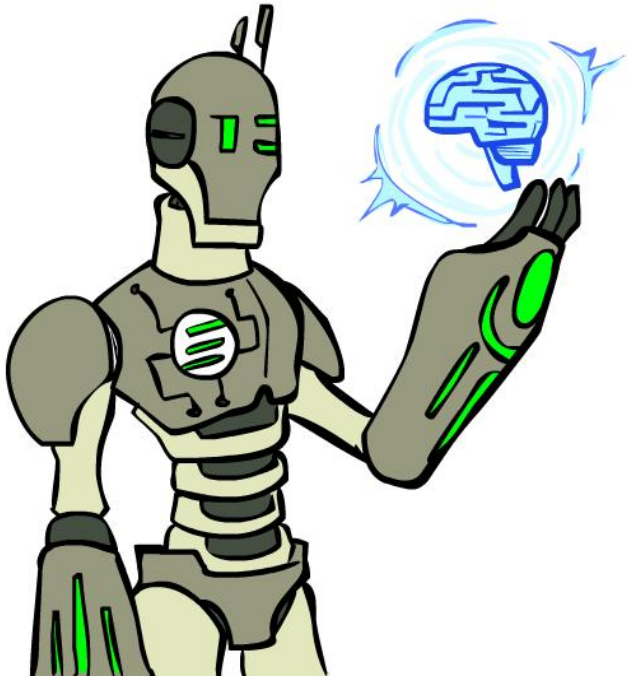
- NEW!
- Sessions dedicated to solving past exam problems. GSIs will be present to guide you through these old exam problems.
- Similar to sections, there will be a poll on Piazza later this week soliciting which session you intend to attend.
- These will start the week of 2/9 - 2/13.
- There will be a webcast.

Important This Week

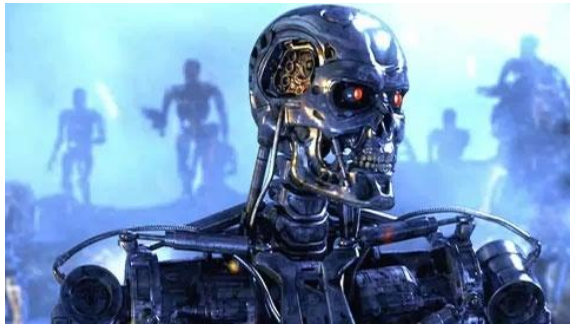
- Important this week:
  - Register for the class on edx
  - Register for the class on piazza --- our main resource for discussion and communication
  - P0: Python tutorial is out (due on Friday 1/23 at 5pm)
  - One-time (optional) P0 lab hours this week: Wed 2-3pm 273 Soda AND Thu 5-7pm 277 Soda
  - Get (optional) account forms in front after class (or during lab hours)
  - Math self-diagnostic up on web page --- important to check your preparedness for second half
  - Mark exam dates in your calendars
- Also important:
  - Sections start next week.
  - If you are wait-listed, you might or might not get in depending on how many students drop. Contact Michael-David Sasson (msasson@cs.berkeley.edu) with any questions on the process.
  - Regular Office Hours start next week, this week there are the P0 labs and Prof. Pieter Abbeel and Head GSI Alvin office hours

Today

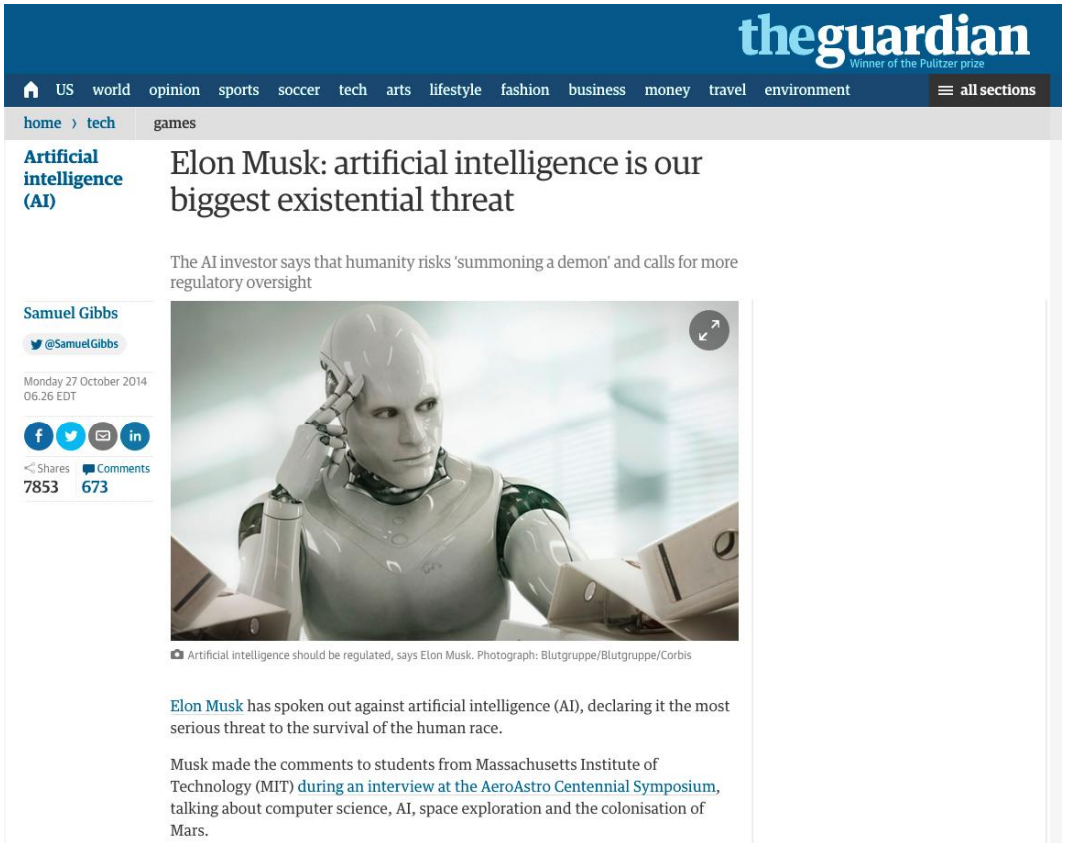
- What is artificial intelligence?
- What can AI do?
- What is this course?



Sci-Fi AI?



AI in the News



theguardian
Winner of the Pulitzer prize

US world opinion sports soccer tech arts lifestyle fashion business money travel environment all sections

home › tech games

Artificial intelligence (AI)

Elon Musk: artificial intelligence is our biggest existential threat

The AI investor says that humanity risks 'summoning a demon' and calls for more regulatory oversight

Samuel Gibbs

@SamuelGibbs

Monday 27 October 2014 06.26 EDT

Shares 7853 Comments 673

Artificial intelligence should be regulated, says Elon Musk. Photograph: Blutgruppe/Blutgruppe/Corbis

Elon Musk has spoken out against artificial intelligence (AI), declaring it the most serious threat to the survival of the human race.

Musk made the comments to students from Massachusetts Institute of Technology (MIT) during an interview at the AeroAstro Centennial Symposium, talking about computer science, AI, space exploration and the colonisation of Mars.

Source: The Guardian, 10/27/2014

AI in the News

Elon Musk Donates $10M To Make Sure AI Doesn't Go The Way Of Skynet

Posted Jan 15, 2015 by **Darrell Etherington** (@drizzled)

8,386 SHARES

Next Story

Tesla and SpaceX chief executive Elon Musk has gone on record before proclaiming the potential risks of artificial intelligence, and now he's putting his money where his mouth is. The intrepid inventor and entrepreneur announced a donation of $10 million to help fund research to "keep AI beneficial" to humanity today. The funds go to the Future of Life Institute (FLI), an organization run by volunteers dedicated to research aimed at "mitigate[ing] existential risks facing humanity," and specifically those related to our ongoing progress towards AI that can approach human capabilities.

Source: TechCrunch, 1/15/2015

AI in the News

SCIENCE

Study to Examine Effects of Artificial Intelligence

By JOHN MARKOFF DEC. 15, 2014

Email
Share
Tweet
Pin
Save
More

Scientists have begun what they say will be a century-long study of the effects of artificial intelligence on society, including on the economy, war and crime, officials at Stanford University announced Monday.

The project, hosted by the university, is unusual not just because of its duration but because it seeks to track the effects of these technologies as they reshape the roles played by human beings in a broad range of endeavors.

"My take is that A.I. is taking over," said Sebastian Thrun, a well-known roboticist who led the development of Google's self-driving car. "A few humans might still be 'in charge,' but less and less so."

Artificial intelligence describes computer systems that perform tasks traditionally requiring human intelligence and perception. In 2009, the president of the Association for the Advancement of Artificial Intelligence, Eric Horvitz, organized a meeting of computer scientists in California to discuss the possible ramifications of A.I. advances. The group concluded that the advances were largely positive and lauded the "relatively graceful" progress.

But now, in the wake of recent technological advances in computer vision, speech recognition and robotics, scientists say they are increasingly concerned that artificial intelligence technologies may permanently displace human workers, roboticize warfare and make of Orwellian surveillance techniques easier to develop, among other disastrous effects.

Source: NY Times, 12/15/2014

What is AI?

The science of making machines that:

Rational Decisions

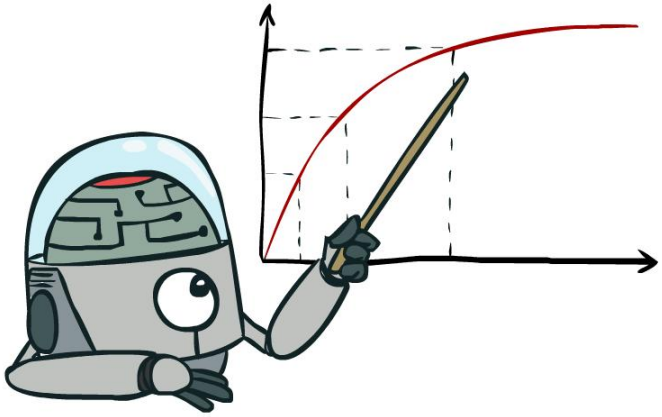
We'll use the term rational in a very specific, technical way:

- 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:

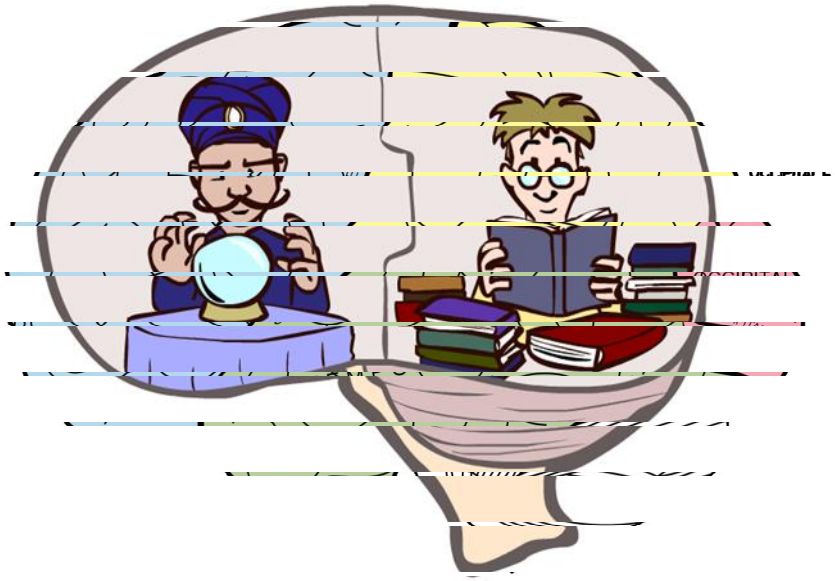
Computational Rationality

Maximize Your Expected Utility

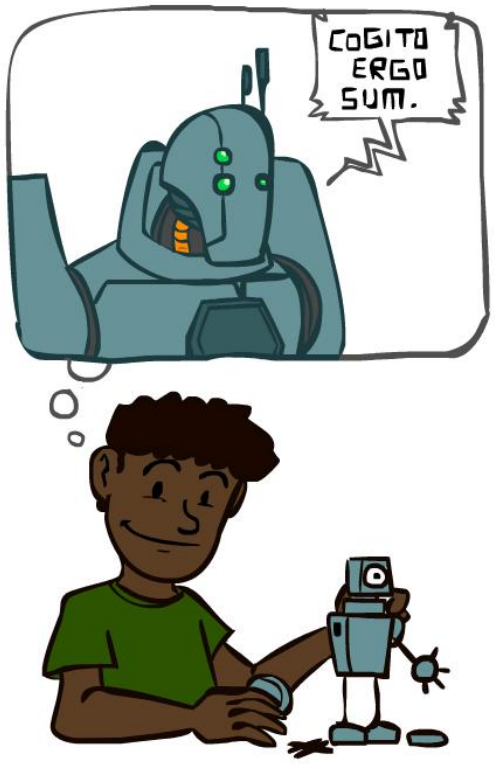


What About the Brain?

- 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



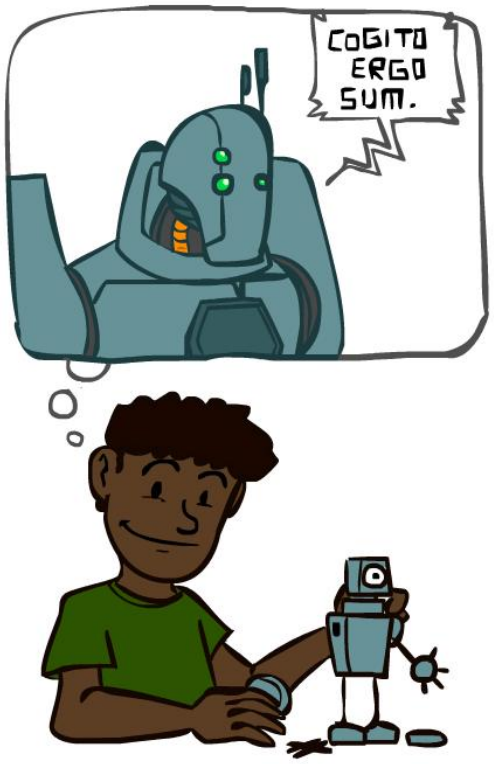
A (Short) History of AI



Demo: HISTORY – MT1950.wmv

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?

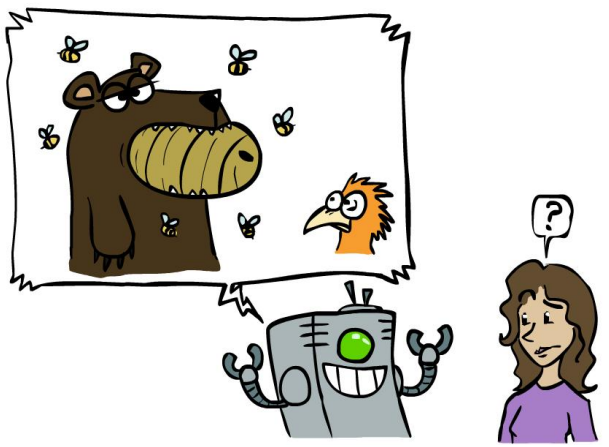
- ✓ Play a decent game of table tennis?
- ✓ Play a decent game of Jeopardy?
- ✓ Drive safely along a curving mountain road?
- ? Drive safely along Telegraph Avenue?
- ✓ Buy a week's worth of groceries on the web?
- ✗ Buy a week's worth of groceries at Berkeley Bowl?
- ? Discover and prove a new mathematical theorem?
- ✗ Converse successfully with another person for an hour?
- ? Perform a surgical operation?
- ✓ Put away the dishes and fold the laundry?
- ✓ Translate spoken Chinese into spoken English in real time?
- ✗ Write an intentionally funny story?

Unintentionally Funny Stories

- One day Joe Bear was hun d Irving Bird where some ho m there was a beehive in the o the oak tree. He ate the b

- Henry Squirrel was thirsty. e river bank where his good ng. Henry slipped and fell in th ed. The End.

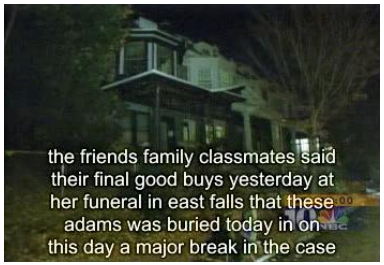
- Once upon a time there w a vain crow. One day the crow was sitting in his tree eese in his mouth. He noticed that he was holding the pi me hungry, and swallowed the cheese. The fox walke e End.



[Shank, Tale-Spin System, 1984]

Natural Language

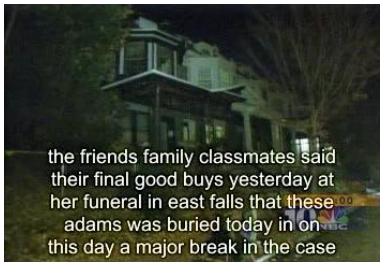
- Speech technologies (e.g. Siri)
  - Automatic speech recognition (ASR)
  - Text-to-speech synthesis (TTS)
  - Dialog systems



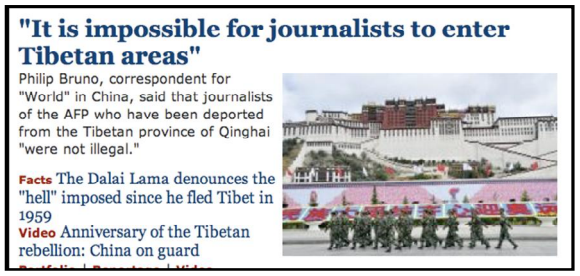
Demo: NLP – ASR tvsample.wmv

Natural Language

- Speech technologies (e.g. Siri)
  - Automatic speech recognition (ASR)
  - Text-to-speech synthesis (TTS)
  - Dialog systems



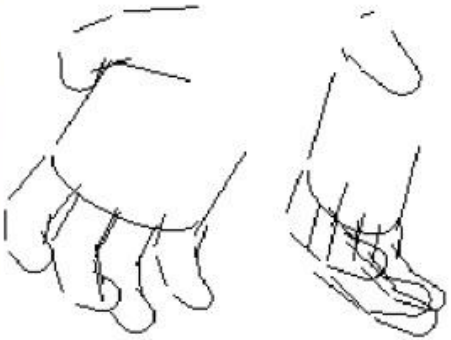
- Language processing technologies
  - Question answering
  - Machine translation

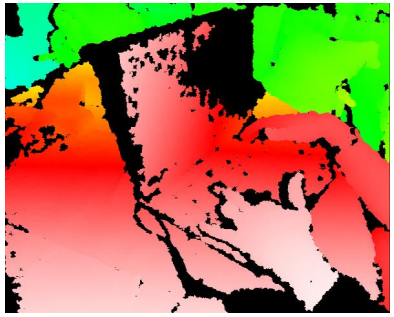


  - Web search
  - Text classification, spam filtering, etc…

Vision (Perception)

- § Object and face recognition
- § Scene segmentation
- § Image classification





Images from Erik Sudderth (left), wikipedia (right)

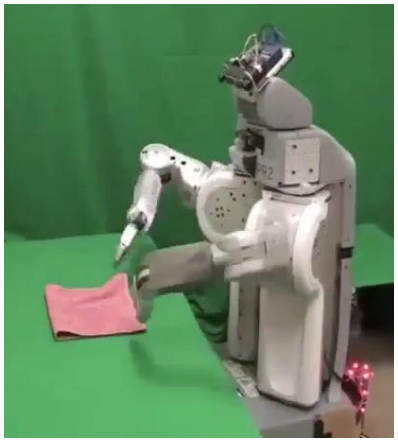
Demo1: VISION – lec_1_t2_video.flv

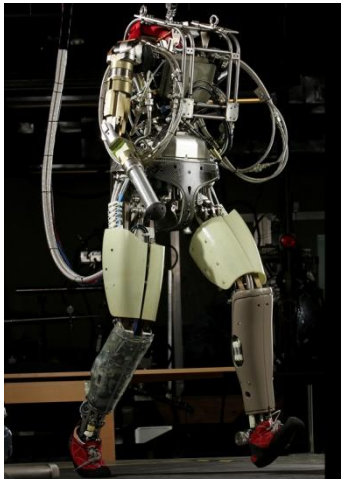
Demo2: VISION – lec_1_obj_rec_0.mpg

Robotics

Demo 1: ROBOTICS – soccer.avi
Demo 2: ROBOTICS – soccer2.avi
Demo 3: ROBOTICS – gcar.avi
Demo 4: ROBOTICS – laundry.avi
Demo 5: ROBOTICS – petman.avi

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





Images from UC Berkeley, Boston Dynamics, RoboCup, Google

Logic

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

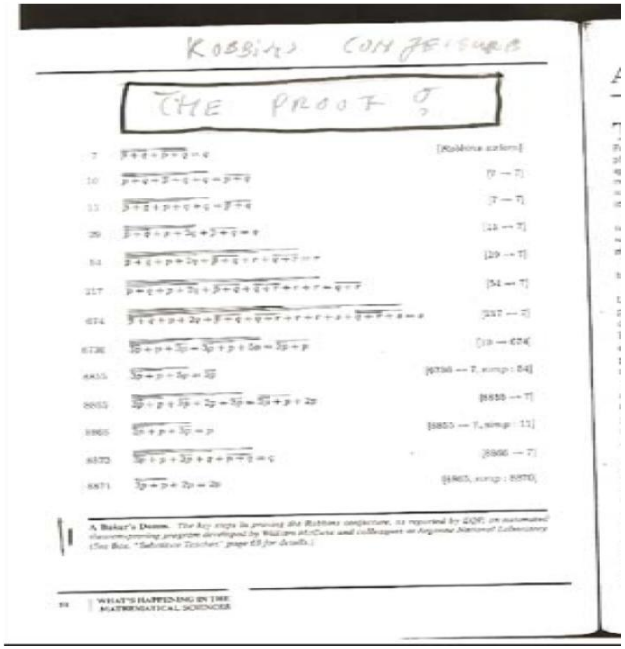


Image from Bart Selman

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!

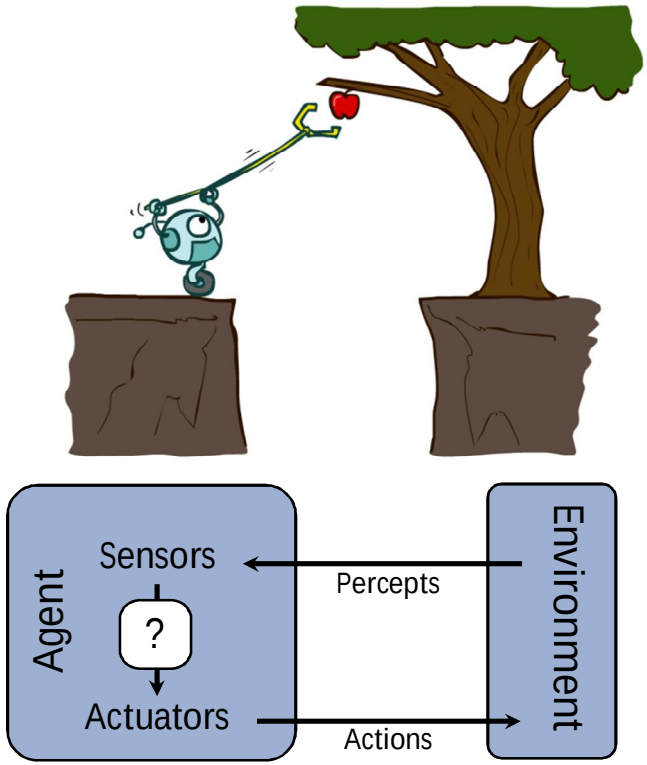
Text from Bart Selman, image from IBM’s Deep Blue pages

Decision Making

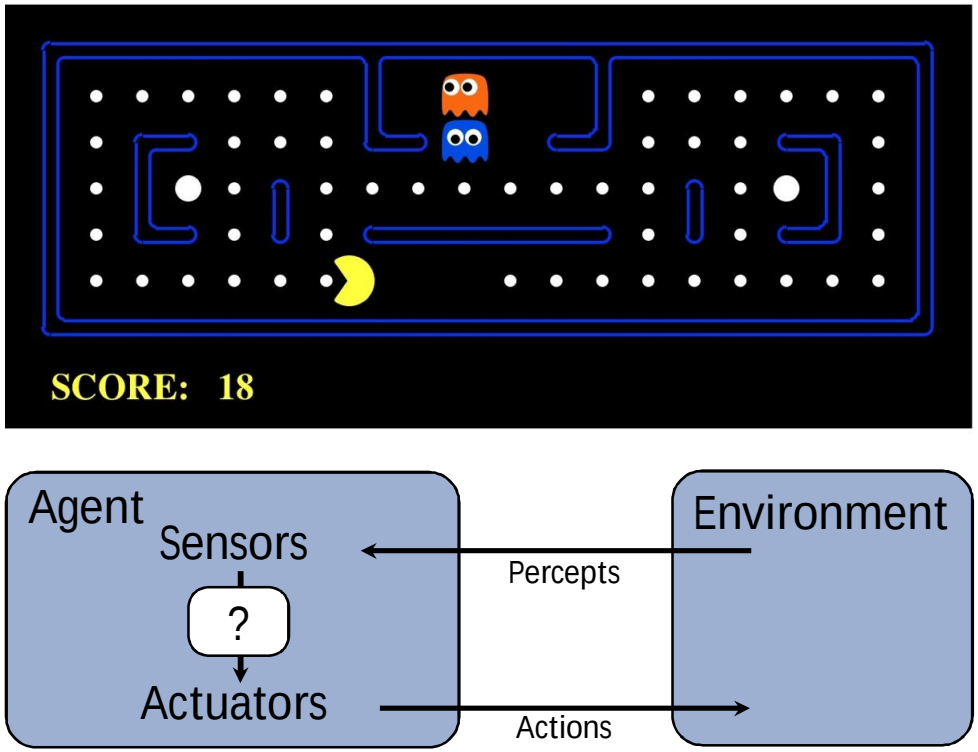
§ Applied AI involves many kinds of automation
  § Scheduling, e.g. airline routing, military
  § Route planning, e.g. Google maps
  § Medical diagnosis
  § Web search engines
  § Spam classifiers
  § Automated help desks
  § Fraud detection
  § Product recommendations
  § … Lots more!

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



Pac-Man is a registered trademark of Namco-Bandai Games, used here for educational purposes

Demo1: pacman-l1.mp4

Course Topics

- Part I: Making Decisions
  - Fast search / planning
  - Constraint satisfaction
  - Adversarial and uncertain search
- Part II: Reasoning under Uncertainty
  - Bayes' nets
  - Decision theory
  - Machine learning
- Throughout: Applications
  - Natural language, vision, robotics, games, …