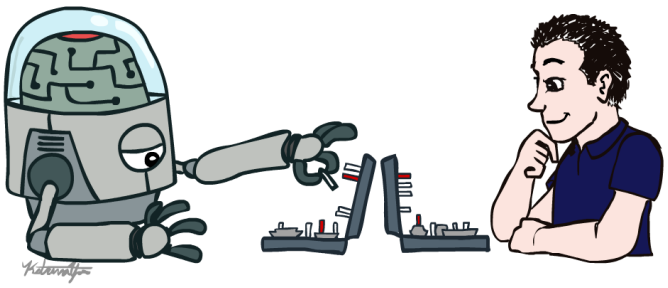
Artificial Intelligence

Chapter 1
Introduction

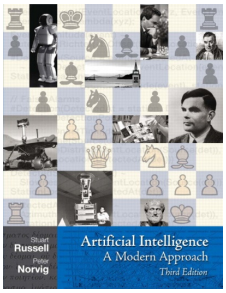


Updates and Additions: Dr. Siamak Sarmady

By: Dan Klein and Pieter Abbeel
University of California, Berkeley

Textbook

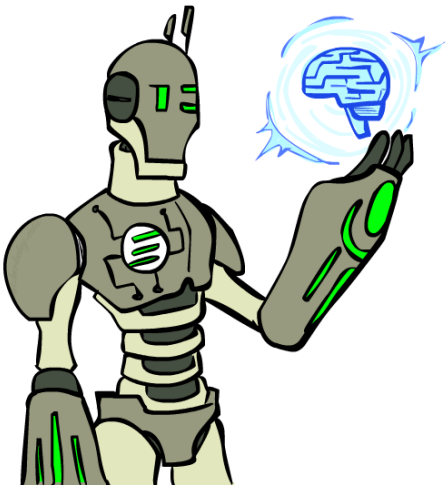
Russell & Norvig, AI: A Modern Approach, 3rd Ed.



Warning: Presentations do not necessarily follow the book.

Today

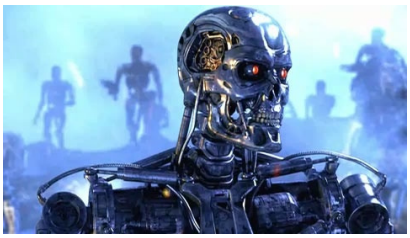
- What is artificial intelligence?
- What can AI do?
- What is this course?



Sci-Fi AI?

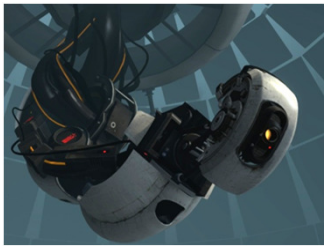
Starwars: R2D2, C3PO

Terminator



Matrix

Battlestar Galactica



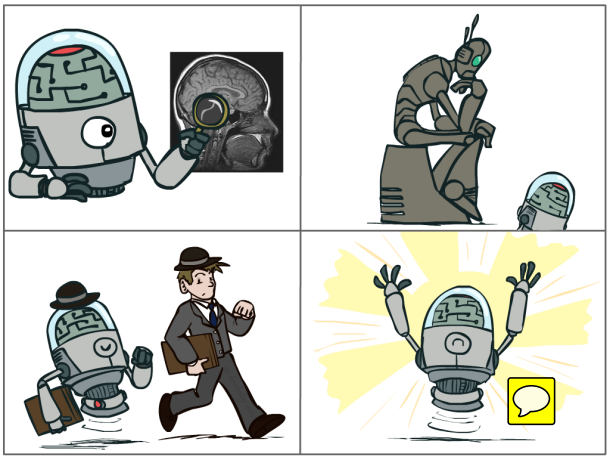
Glados

What is AI?

The multidisciplinary science of making machines that:

Think like people
cognitive science, neuroscience

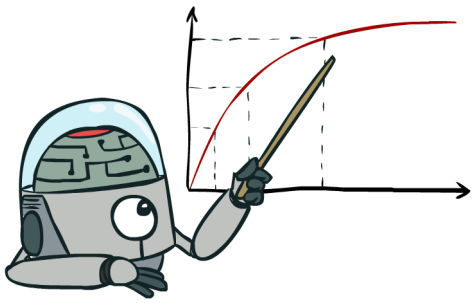
Act like people
dating back to Alan Turing... general talk ... imitations … it wasn't really leading us to build intelligence



Think rationally
long tradition, Aristotle... very difficult, how you end up acting is more important

Act rationally
This is what we most need

Maximize Your Expected Utility



Rational Decisions

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

- **Rational:** maximally achieving pre-defined goals (Students: learn as much as possible)
- **Rationality:** only concerns what decisions are made (not the thought process behind them) – (e.g. the robot which examines random directions, but eventually goes toward the target)

- **Utility:** result...a real number assigned to each outcome
- Goals are expressed in terms of the **utility** of outcomes
- Being rational means maximizing your expected utility (Students: maximum marks)

A better title for this course would be:

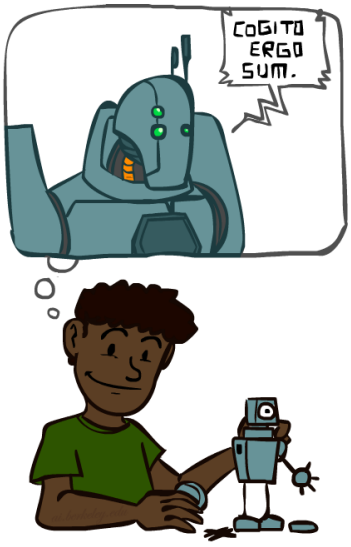
Computational Rationality

What About the Brain?

Should we make AI exactly like 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"… note that we don't need to have bird wings to fly…
- Lessons learned from the brain: memory and simulation are key to decision making

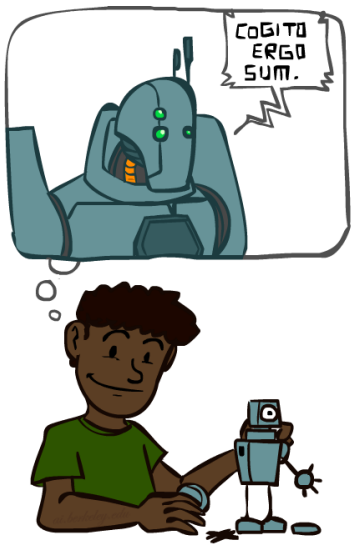
A (Short) History of AI



Demo: HISTORY – MT1950.wmv

A (Short) History of AI

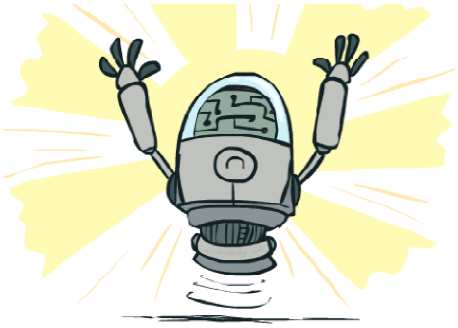
- 1940-1950: Early days
  - 1943: McCulloch & Pitts: Boolean circuit model of brain
  - 1950: Turing's "Computing Machinery and Intelligence"
- 1950—70: Excitement: Look, Ma, no hands!
  - 1950s: Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's Geometry 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?

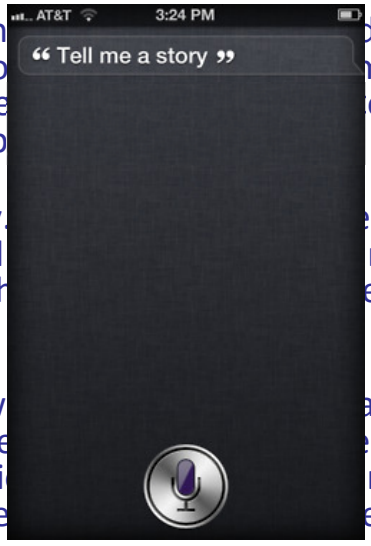
Quiz: Which of the following can be done at present?

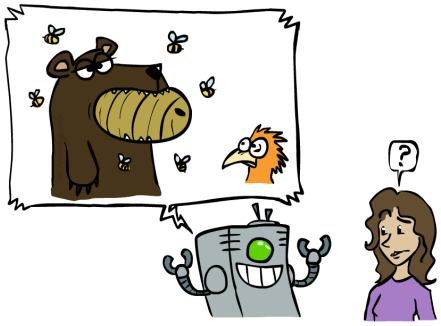
- ✓ Play a decent game of table tennis?
- ✓ Play a decent game of Jeopardy?
- ✓ Drive safely along a curving mountain road?
- ? Drive safely along Telegraph Avenue?
- ✓ Buy a week's worth of groceries on the web?
- ✗ Buy a week's worth of groceries at Berkeley Bowl?
- ? Discover and prove a new mathematical 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





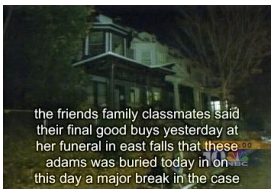
- Henry Squirrel was thirsty. river bank where his good ng. Henry slipped and fell in th ed. The End.

- 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. Cortana, 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…

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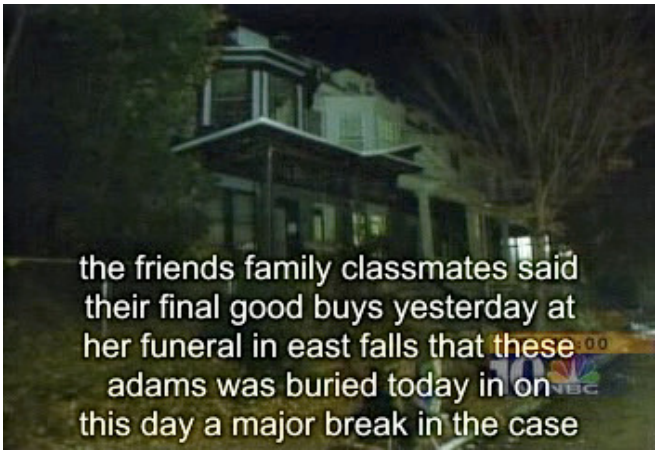

Demo: NLP – ASR tvsample.avi


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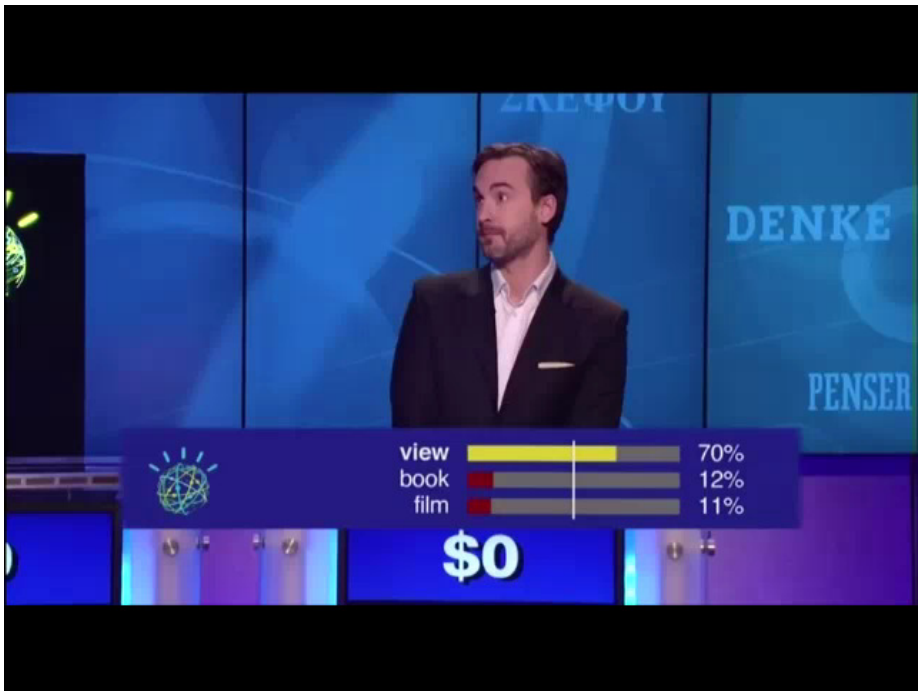
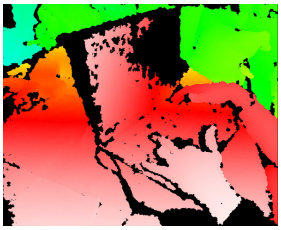
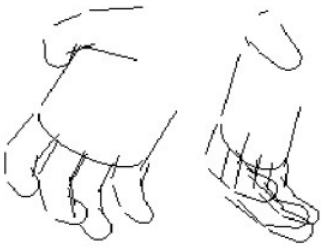
NBC



Vision (Perception)

- Object and face recognition
- Scene segmentation
- Image classification

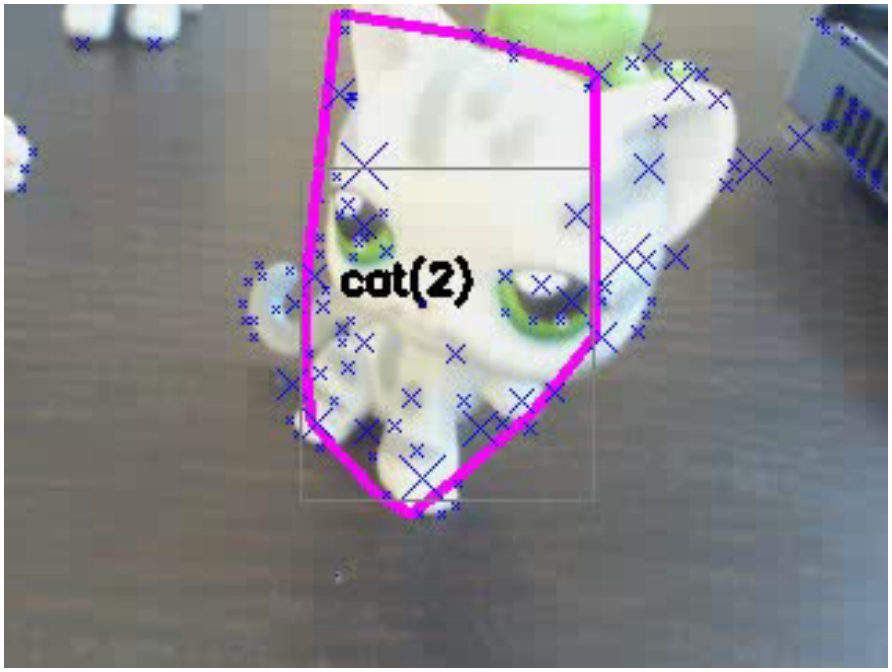




Images from Erik Sudderth (left), wikipedia (right)

Demo1: VISION – lec_1_t2_video.flv

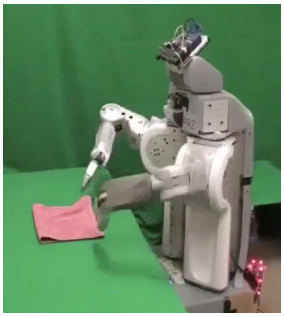
Demo2: VISION – lec_1_obj_rec_0.mpg

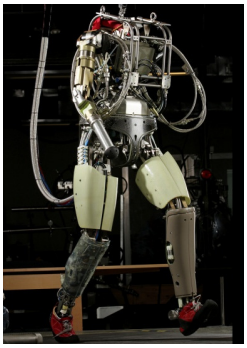


Robotics

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

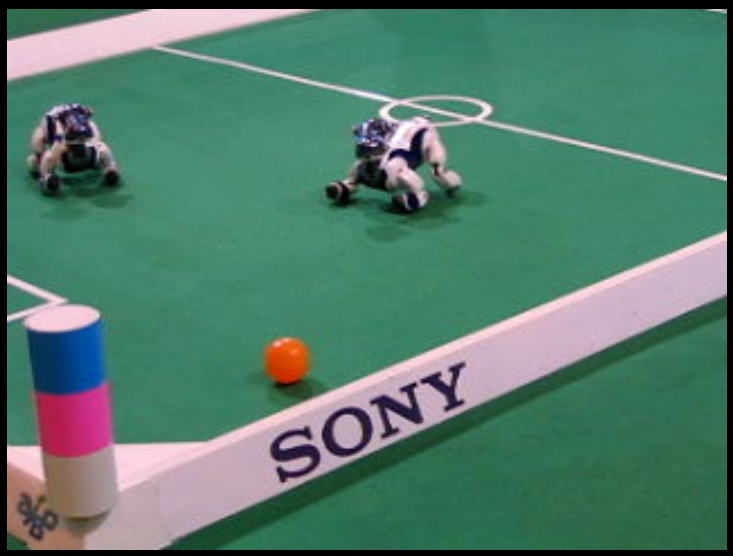
- Robotics
  - Part mech. eng.
  - Part AI
  - Reality much harder than simulations!
- Technologies
  - Vehicles
  - Rescue
  - Soccer!
  - Lots of automation…
- In this class:
  - We ignore mechanical aspects
  - Methods for planning
  - Methods for control

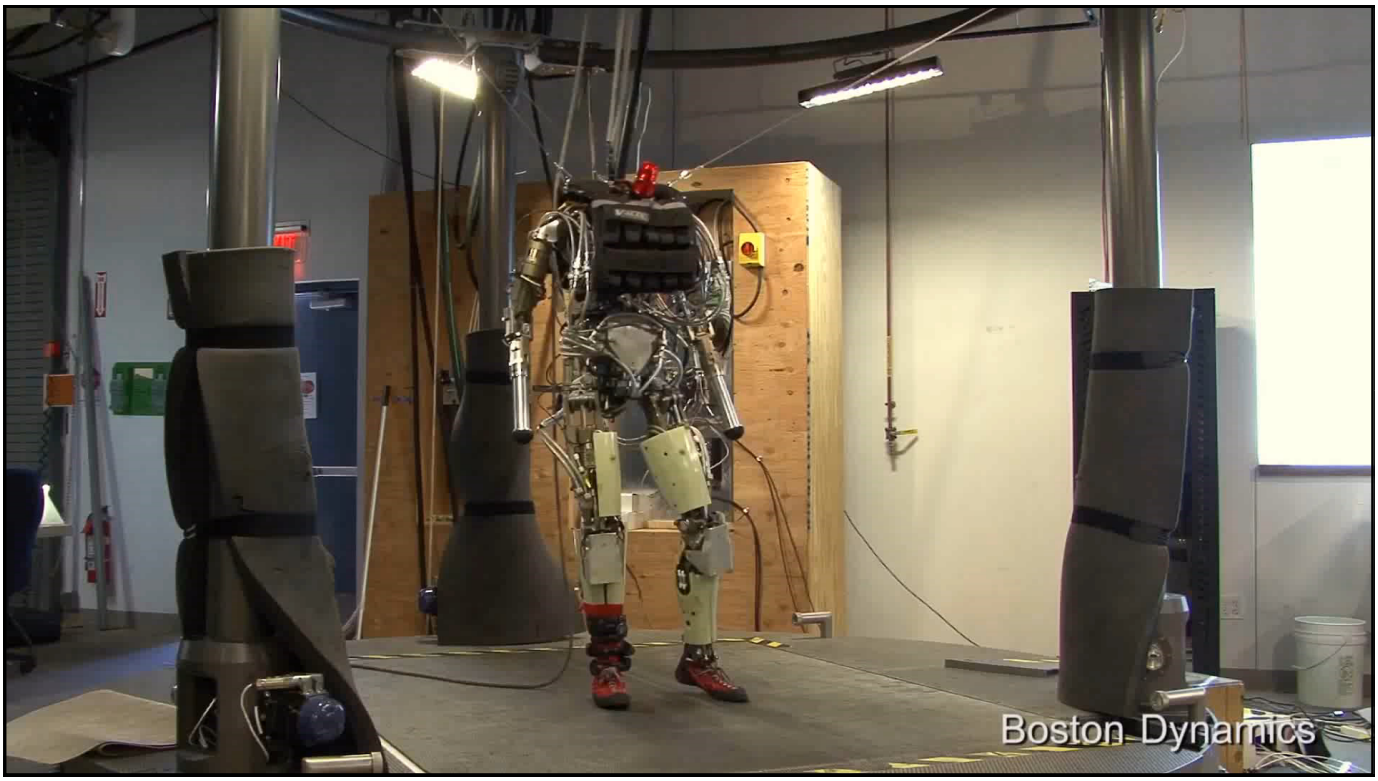




Images from UC Berkeley, Boston Dynamics, RoboCup, Google


SONY


SONY



Logic

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

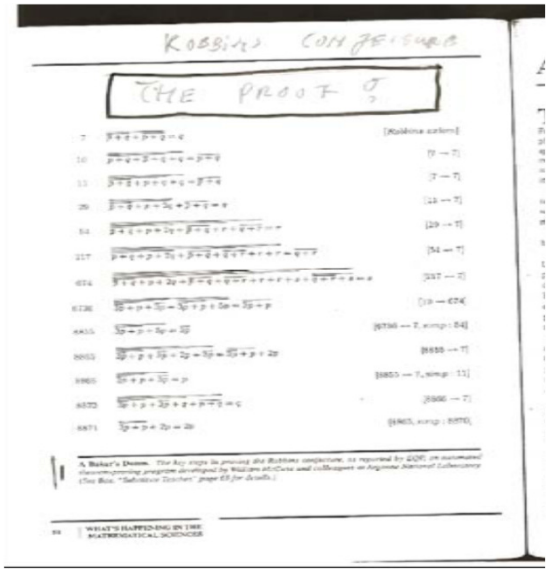
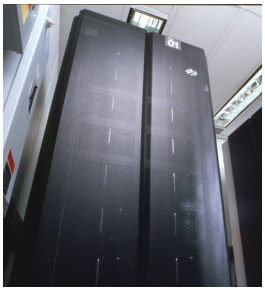


Image from Bart Selman

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

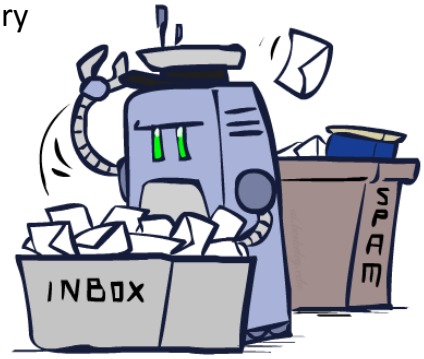


- Open question:
  - How does human cognition deal with the search space explosion of chess?
  - Or: how can humans compete with computers at all??
- 1996: Kasparov Beats Deep Blue
  "I could feel --- I could smell --- a new kind of intelligence across the table."
- 1997: Deep Blue Beats Kasparov
  "Deep 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!



Aims

- **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