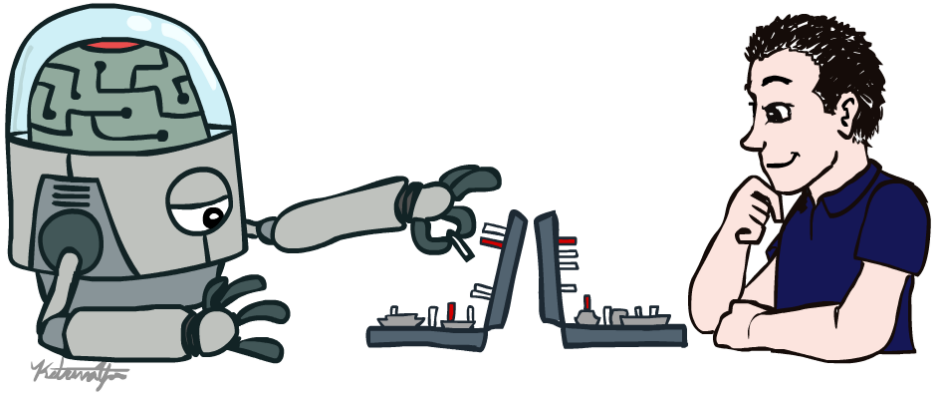
CS 411: Artificial Intelligence I
Introduction



Instructor: Prof. Brian Ziebart

University of Illinois at Chicago

[Slides adapted from those created by Dan Klein and Pieter Abbeel for CS188 Intro to AI at UC Berkeley. All materials available at http://ai.berkeley.edu.]

Course Staff

- Instructor:
  - Prof. Brian Ziebart
    - Office Hours: MW 9-10am in 1108 SEO or by appointment
- Teaching Assistants:
  - Vahid Noroozi (Full TA)
    - Office Hours: Th 2:30-4:30pm
  - Zhan Shi (Half TA)
    - Office Hours: W 1:00-3:00pm

Course Information

- Communication:
  - Piazza
    - https://piazza.com/uic/spring2018/cs411
    - Syllabus
    - Lecture slides
    - Homework release
    - Discussion/Q&A
  - Blackboard
    - Homework Submission
    - Grades

Course Information

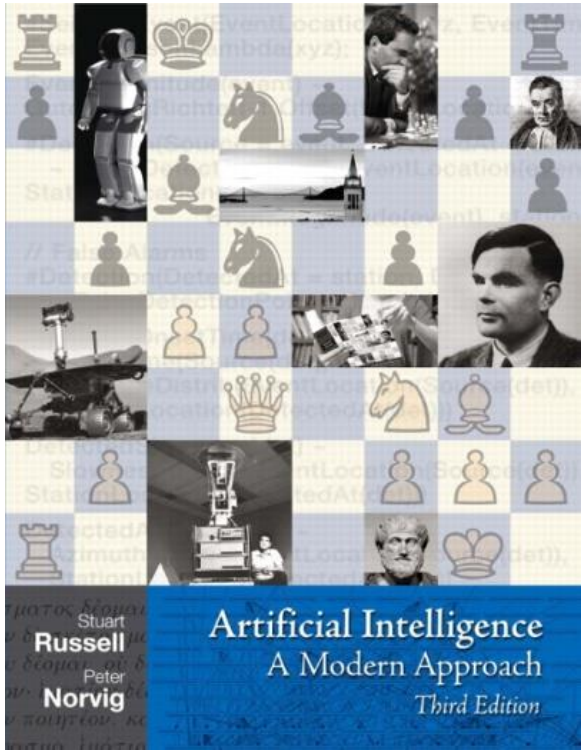
- Prerequisite:
  - CS 251
  - There will be a lot of math (and programming)
- Assessment:
  - 3-5 homework assignments:
    - Programming portion
    - Written portion
  - Two midterms, one final
  - Academic integrity policy – unless the assignment explicitly allows you to work together, work should be individually done!

Course Information

- Grading:
  - Homework assignments: 30% (6%-10% each)
  - Midterm exam: 40% (20% each)
  - Final exam: 30%
  - Letter grades given on a curve
    - Cutoff between A and B no more than 90%, probably much less
    - Separate grading scales for undergraduate and graduate students

Textbook

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



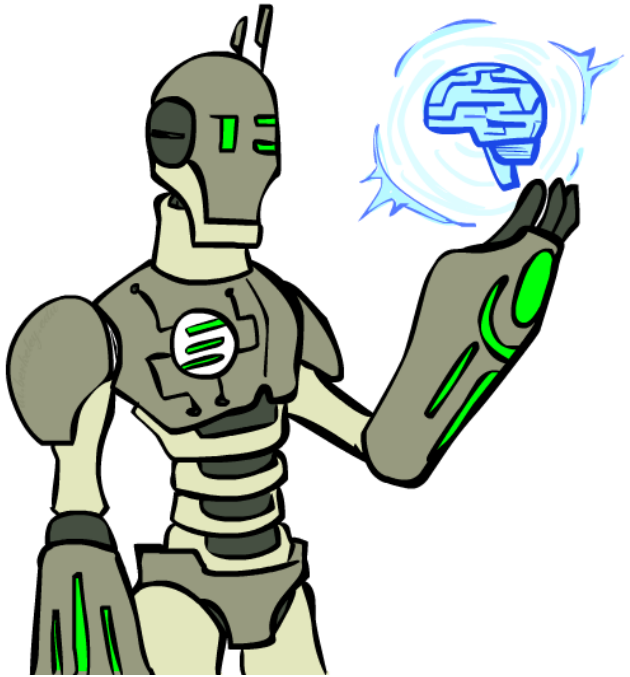
Important This Week

- Important this week:
  - **Register** for the class on Piazza (you should be already if registered) --- our main resource for discussion and communication
  - **P0: Python tutorial** out soon

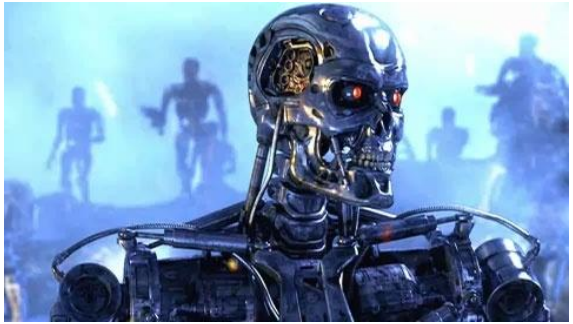
- Readings:
  - **Today**: Ch. 1 and 2
  - **Monday**: Section 3.1-3.4
  - **Wednesday**: Section 3.5-3.6

Today

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



Sci-Fi AI?



Technologist view of AI?

“With artificial intelligence we’re summoning the demon.” – Elon Musk

"A question no one seemed to be answering is: What if we succeed?” – Stewart Russell

“I am optimistic. I think you can build things and the world gets better. But with AI especially, I am really optimistic” – Mark Zuckerberg

"The so-called control problem that Elon is worried about isn't something that people should feel is imminent“ – Bill Gates

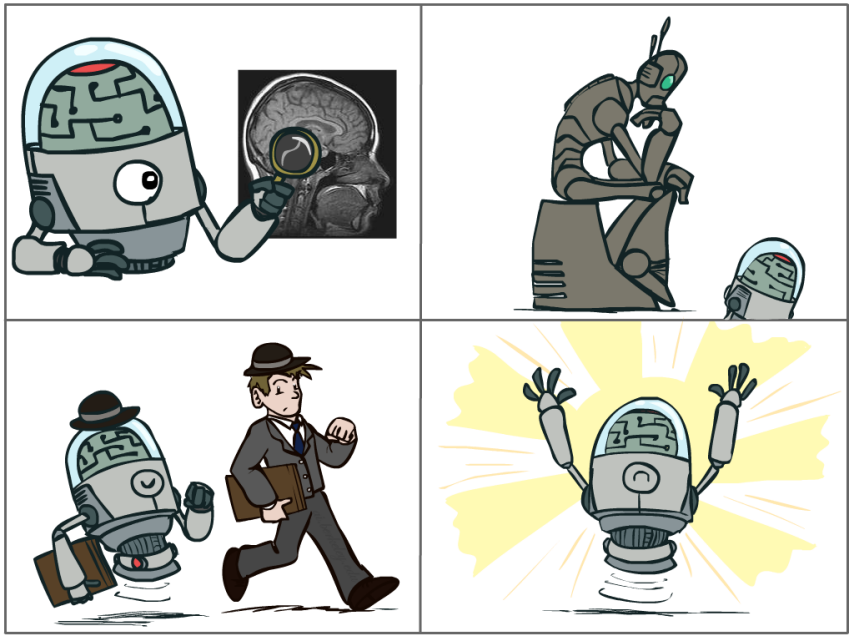
What is AI?

The science of making machines that:

What is AI?

The science of making machines that:

Think like people



Think rationally

Act like people

Act rationally

Rational Decisions

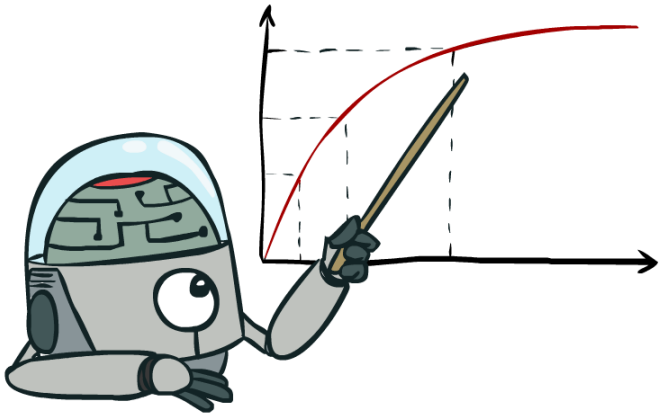
We'll use the term **rational** in a very specific, technical way:

- 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:

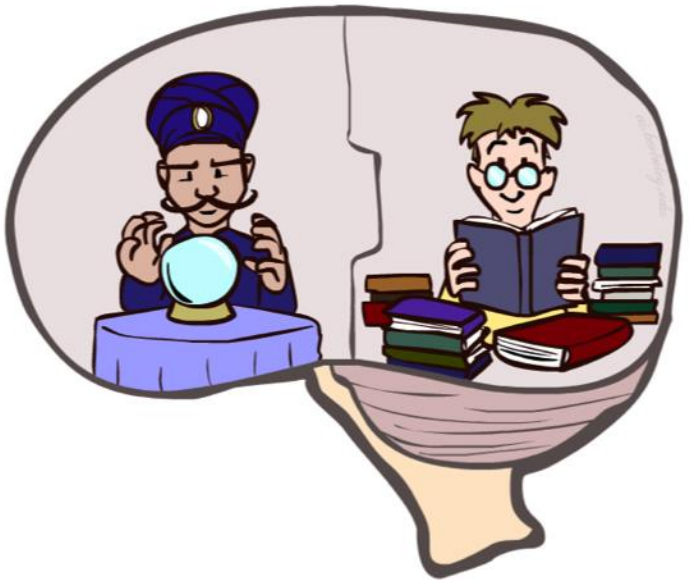
Computational Rationality

Maximize Your Expected Utility

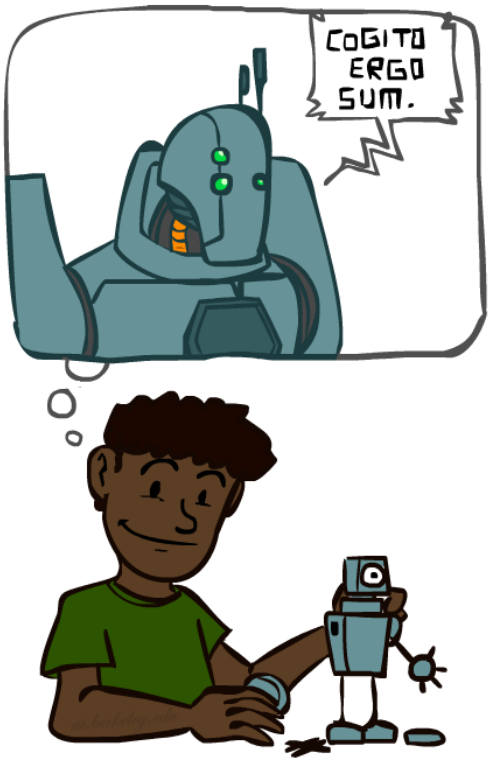


What About the Brain?

- 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



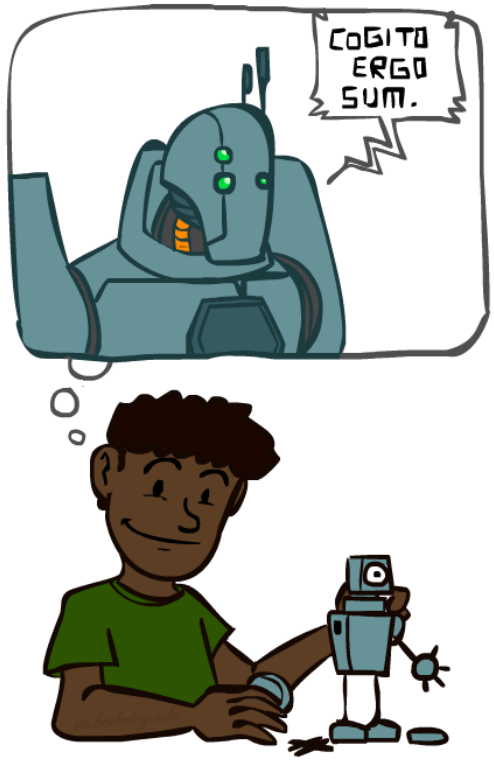
A (Short) History of AI



Demo: HISTORY – MT1950.wmv

A (Short) History of AI

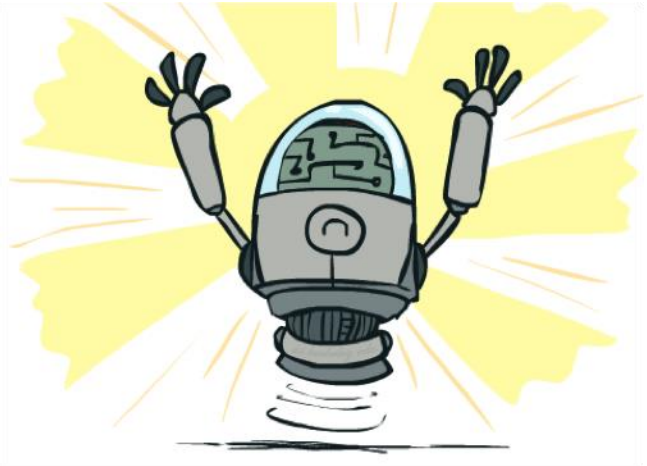
- 1940-1950: Early days
  - 1943: McCulloch & Pitts: Boolean circuit model of brain
  - 1950: Turing's “Computing Machinery and Intelligence”
- 1950—70: Excitement: Look, Ma, no hands!
  - 1950s: Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's Geometry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



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 Halsted Avenue?
- ✓ Buy a week's worth of groceries on the web?
- ✗ Buy a week's worth of groceries at the farmer's market?
- ? 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?

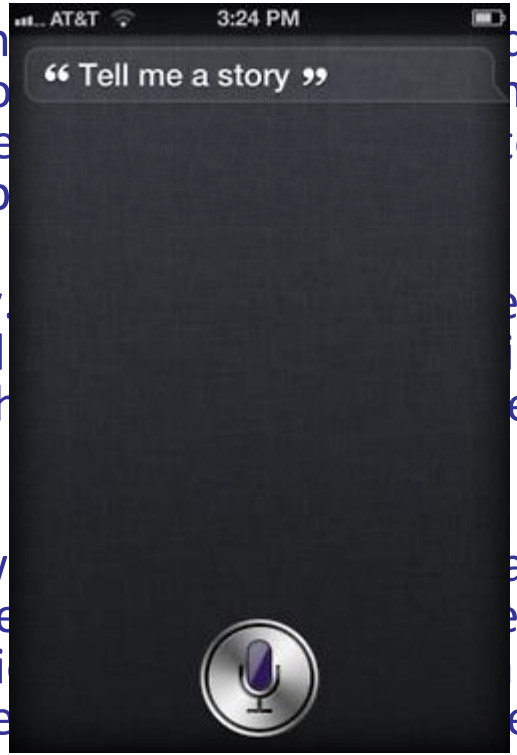


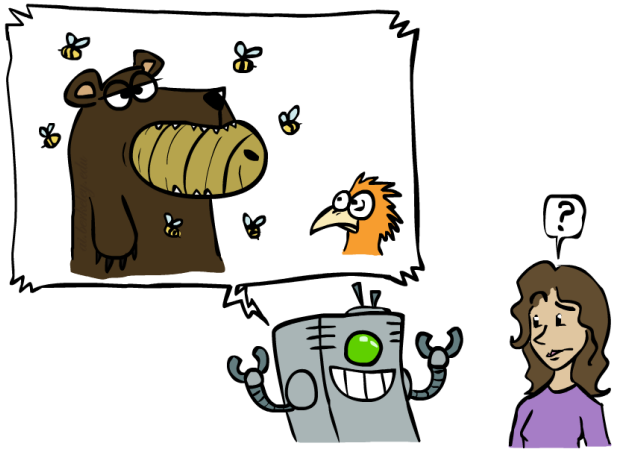
Unintentionally Funny Stories

- 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 ing. 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.avi


46 11:00
10 NBC

Natural Language

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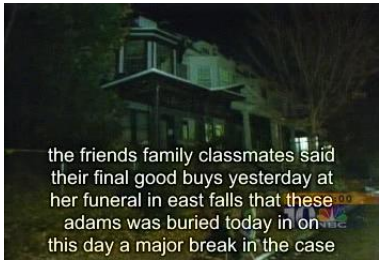
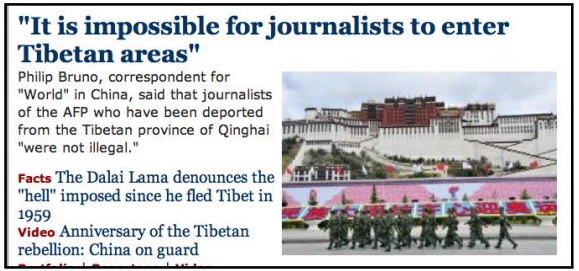


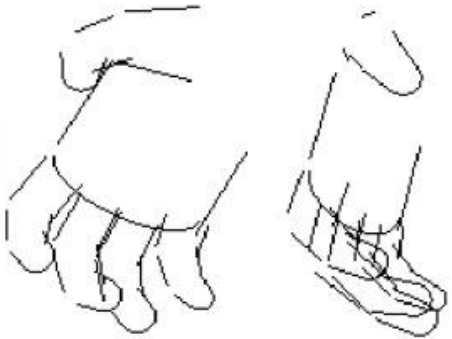
- Language processing technologies
  - Question answering
  - Machine translation

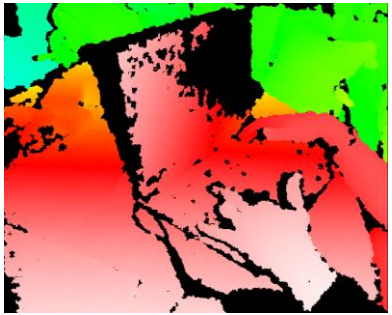


  - Web search
  - Text classification, spam filtering, etc…

Vision (Perception)

- Object and face recognition
- Scene segmentation
- Image classification

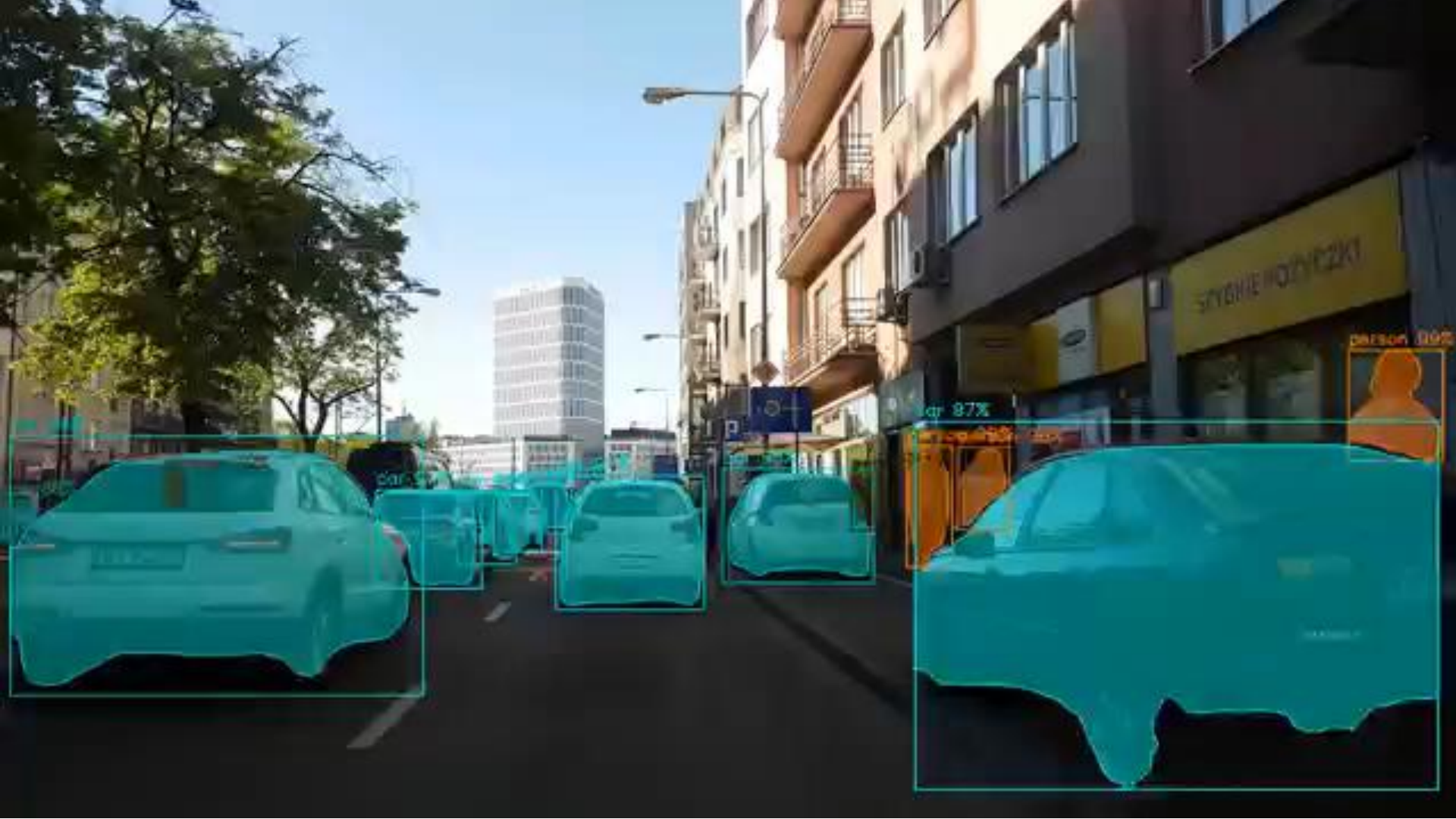




Images from Erik Sudderth (left), wikipedia (right)

Demo: VISION – lec_1_obj_rec_0.mpg

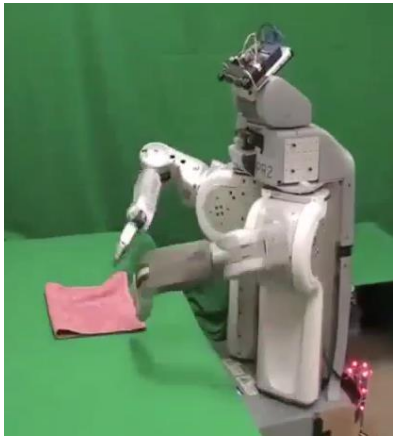

cat(2)

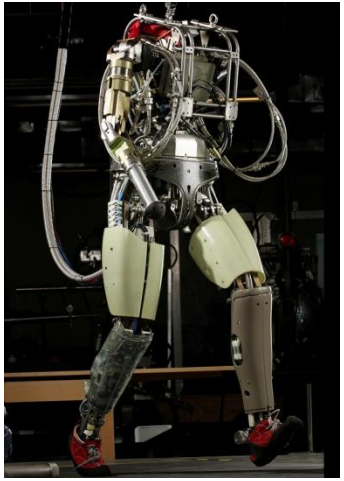

car
car 87%
person 89%

Robotics

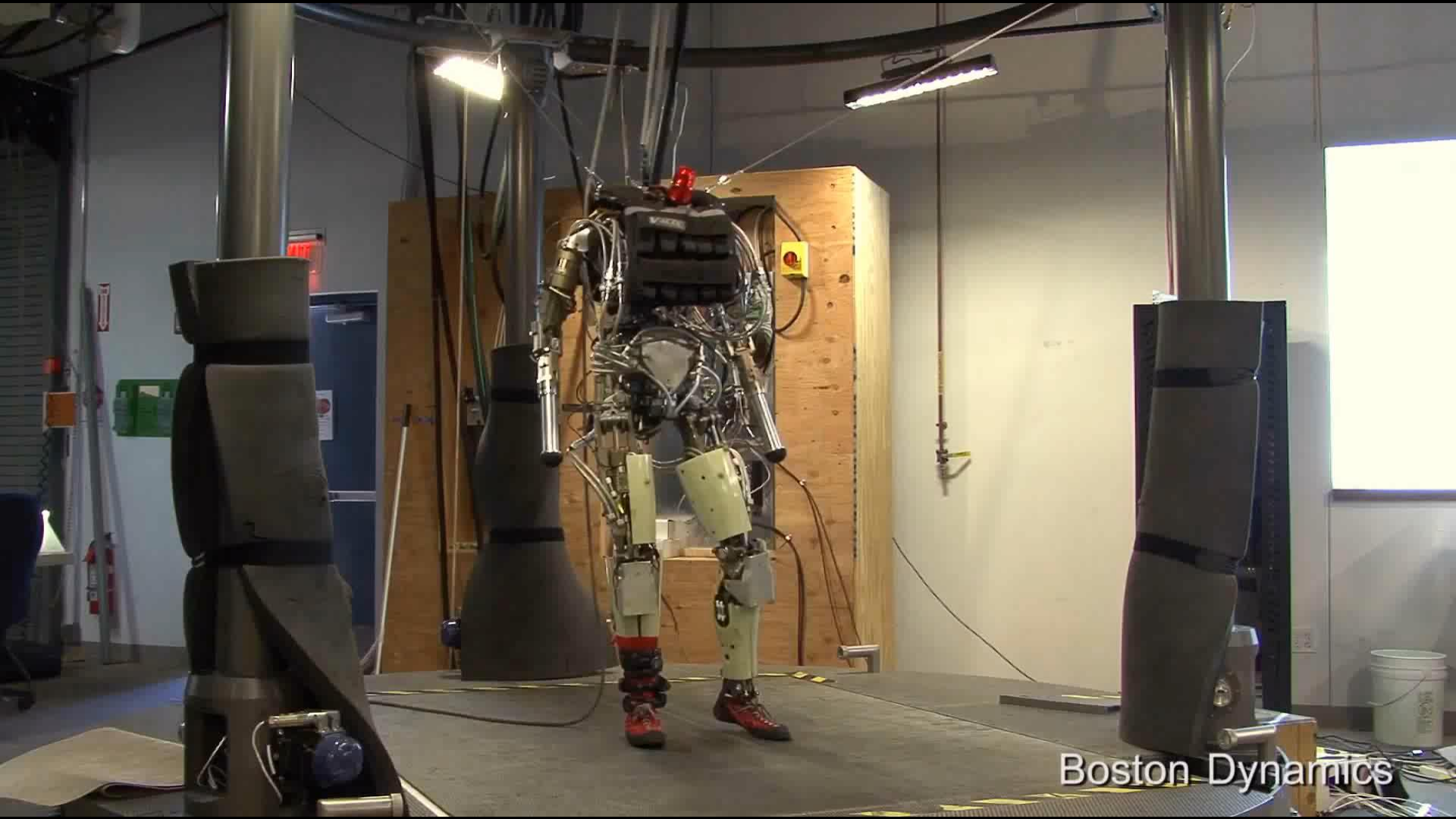
Demo: ROBOTICS – laundry.avi
Demo: ROBOTICS – gcar.avi
Demo: ROBOTICS – petman.avi

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





Images from UC Berkeley, Boston Dynamics, RoboCup, Google


Boston Dynamics

Robotic Cooperative Path Planning?

How do people move around each other in shared environments?

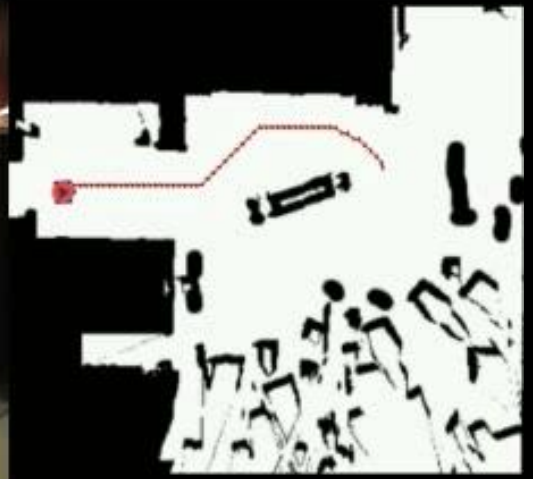
How can robots behave similarly?

[Ziebart et al. 2009]

People Tracking

Human: magenta, Robot: cyan

Predictions: green, Augmented costs: red



Logic

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

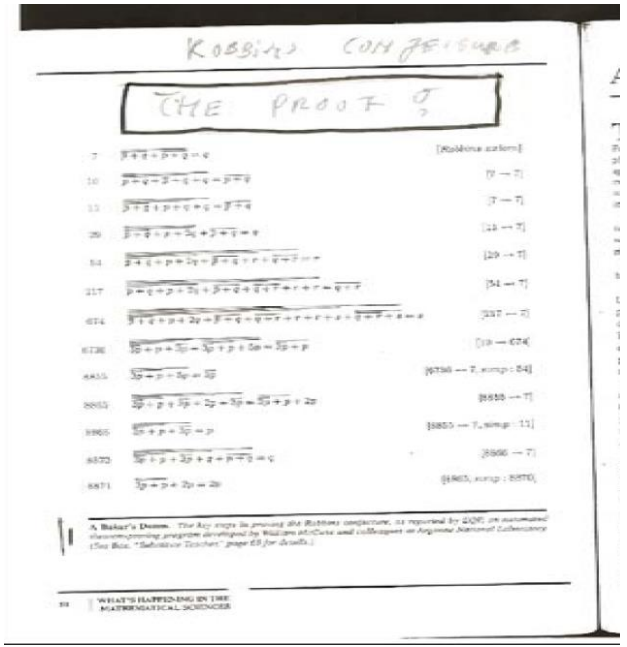
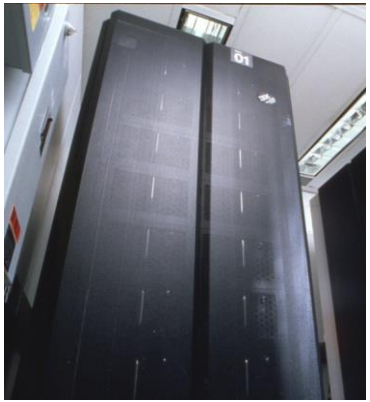


Image from Bart Selman

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

Game Playing

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  - First match won against w
  - "Intelligent creative" play
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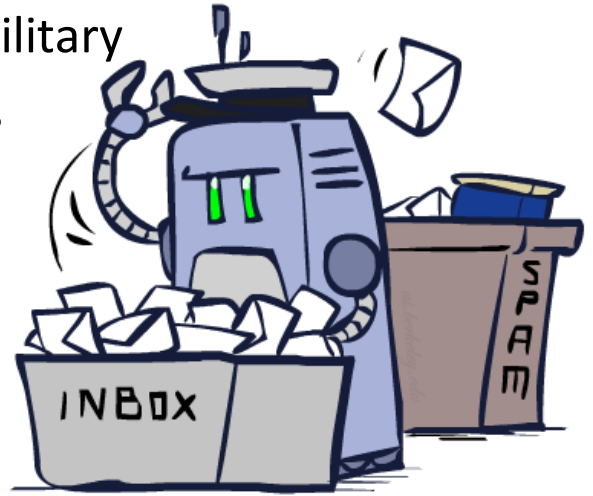
AlphaZero AI beats champion chess program after teaching itself in four hours

Google's artificial intelligence sibling DeepMind repurposes Go-playing AI to conquer chess and shogi without aid of human knowledge

AlphaZero, the game-playing AI created by Google sibling DeepMind, has beaten the world's best chess-playing computer program, having taught itself how to play in under four hours.

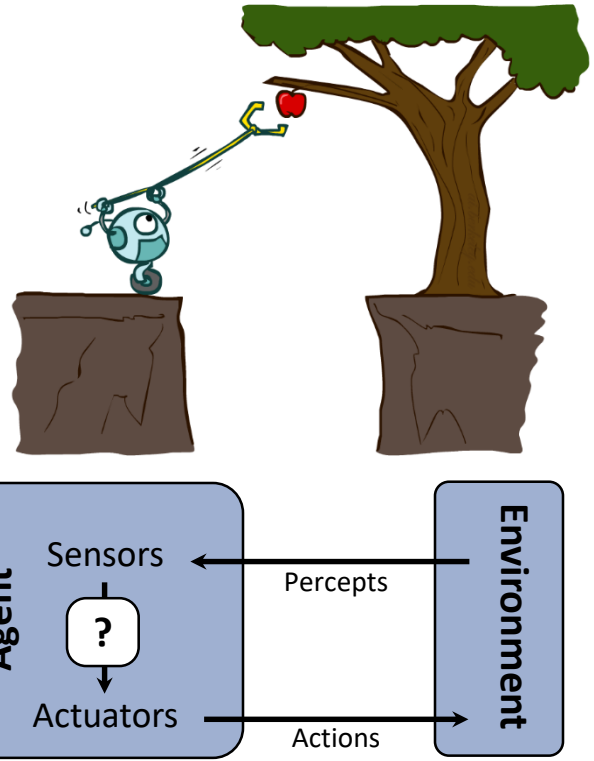
Decision Making

- 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!

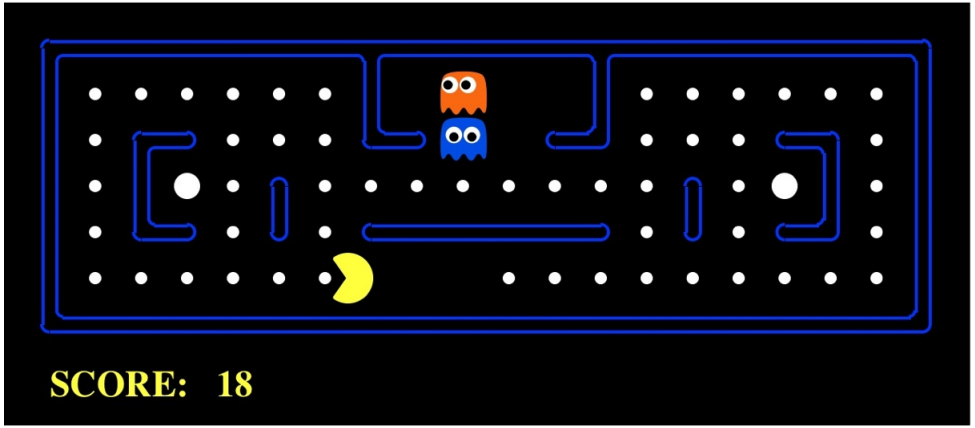


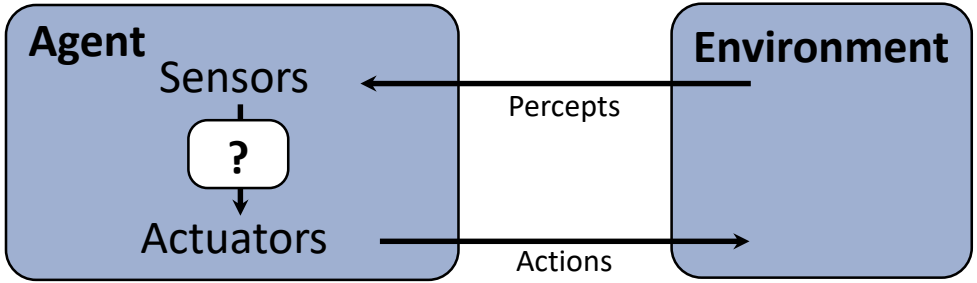
Designing Rational Agents

- 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



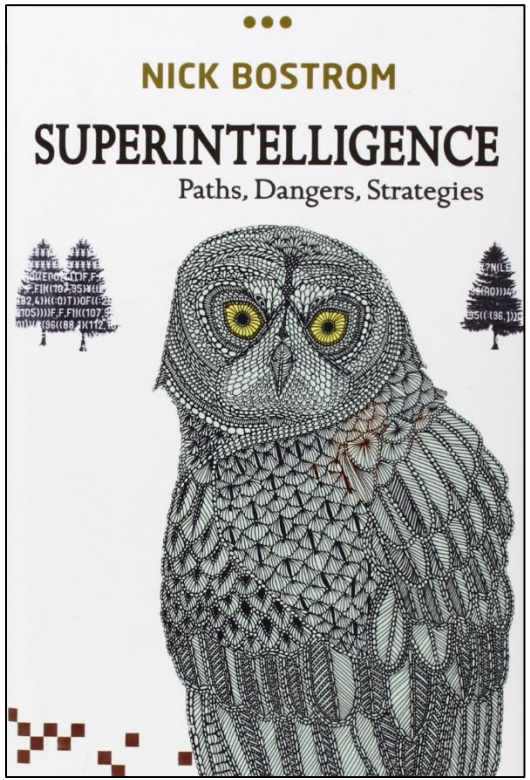


Pac-Man is a registered trademark of Namco-Bandai Games, used here for educational purposes

Demo1: pacman-l1.mp4 or L1D2


CS188 Pacman
SCORE: 0
CS 188
Organize
Name
Berkeley Towel Fold
NOVA Excerpt -- A
pacman.bat
pacman.bat
Windows Batch File
Date modified: 8/23/2012 2:04 AM
Size: 91 bytes
Date created: 8/23/2012 9:42 AM
97%
12:28 PM
8/23/2012

Should we seek human-level AI?



What happens if a “superintelligent” system is given a narrowly defined goal?

(If you’re thinking of dropping this class, it’s a good excuse!)

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, …