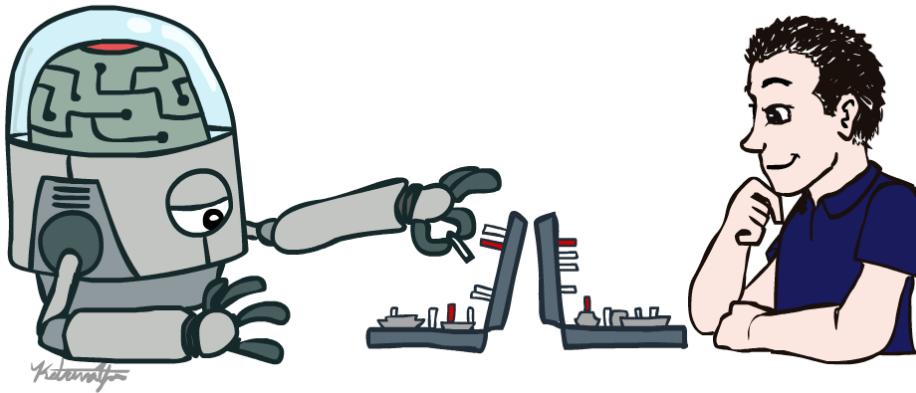


CSE 571: Artificial Intelligence

Introduction



Instructor: Heni Ben Amor

Course Staff

Professor



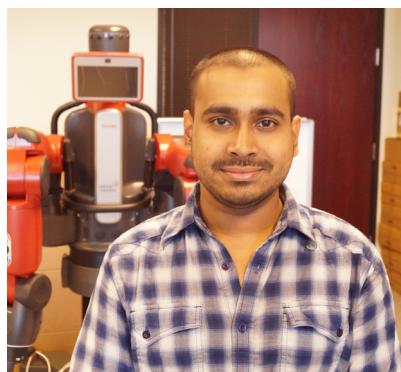
Heni Ben Amor

Research Assistant



Kevin S. Luck

Teaching Assistants



Indranil Sur



Mohammad F. Bajestani

Course Information

- **Communication:**

- Announcements on Blackboard
- Questions? Discussion on Blackboard
- Office Hours will be communicated over Blackboard
- **Staff email: TBA**

- **Is this course the same as CS188 @Berkeley?:**

- **No!**
- CS188 is used as a skeleton for our AI class
- We are going to deviate from their lecture material!
- Therefore, you should attend the class

The screenshot shows the 'Course Home' page of a Blackboard course. The left sidebar contains links for Announcements, Course Home, Content, Course Information, Discussions, Programming Assignments, Groups, Assignments, Staff Information, My Grades, Homework Dummy, and Tools. The main content area has sections for 'My Announcements' (empty), 'My Tasks' (empty), and 'To Do'. The 'To Do' section includes a 'What's Past Due' list, a date selector set to 08/17/2016, and buttons for 'All Items', 'Today', 'Tomorrow', 'This Week', and 'Future'. The bottom right corner shows a message: 'Nothing Due Today' and 'Last Updated: August 17, 2016 8:26 PM'.

Course Information

Prerequisites (recommended):

- Classes in Algorithms and Data Structures
- Solid mathematical background in linear Algebra, Analysis etc.
- **There will be a lot of math (and programming)!**
- **Work and Grading:**
 - ~5 programming projects: Python, groups of 1 or 2
 - Submission over Blackboard
 - bi-weekly
 - ~5-7 homework assignments:
 - Written and solved in groups or alone (instructions will be given on the assignment itself)
 - Submission in Class every Thursday (handwritten and stapled submission!)
- One midterms, one final
- Academic integrity policy

Homework and Project deadlines will be on every second Thursday!

Course Information

- **Work and Grading:**

- Final grade is determined by
 - Programming Assignments (30%)
 - Assignments (30%)
 - Midterm Exam (15%)
 - Final Exam (25%)
- Grade scale:
 - A [90 – 100)%
 - A- [85 – 90)%
 - B+ [80 – 85)%
 - B [75 – 80)%
 - B- [70 – 75)%
 - C+ [65 – 70)%
 - C [55 – 65)%
 - D [40 – 55)%
 - E [0 – 40)%
- A+ is awarded at the professor's discretion based on exceptional performance
- Completing all Homework and Programming Assignments successfully (i.e. full points) => C
- There will be possibilities to achieve bonus points

**Homeworks and Projects
are an important part of
this lecture!**

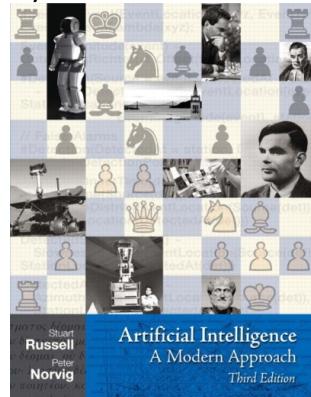
Course Information

- **Material:**
 - Slides will be available in Blackboard after class
 - Assignments will be made available through Blackboard
 - Additional Material:
 - As mentioned, this class is based upon CS 188
 - There is a lot of material like videos, example homeworks etc available on their webpage:
<http://ai.berkeley.edu>

**Again, this course is NOT identically to CS188!
(since you are graduate students)**

Textbook

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

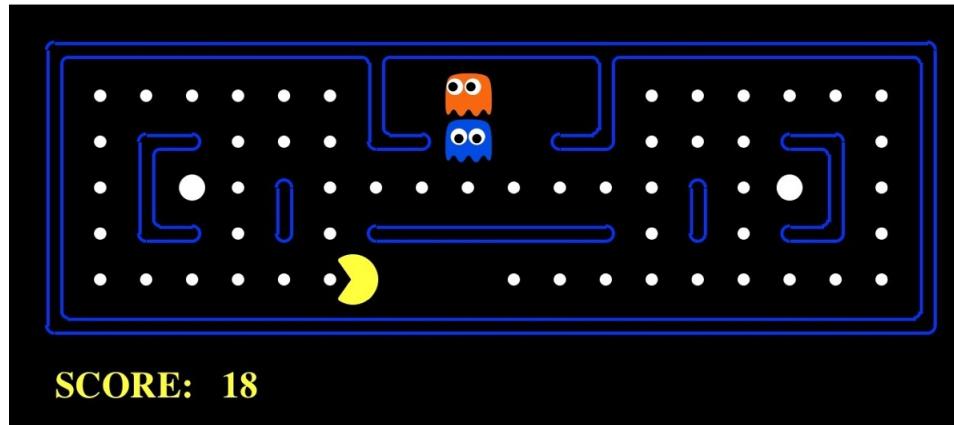


The Project

Trailer!

(check sound!)

The Project



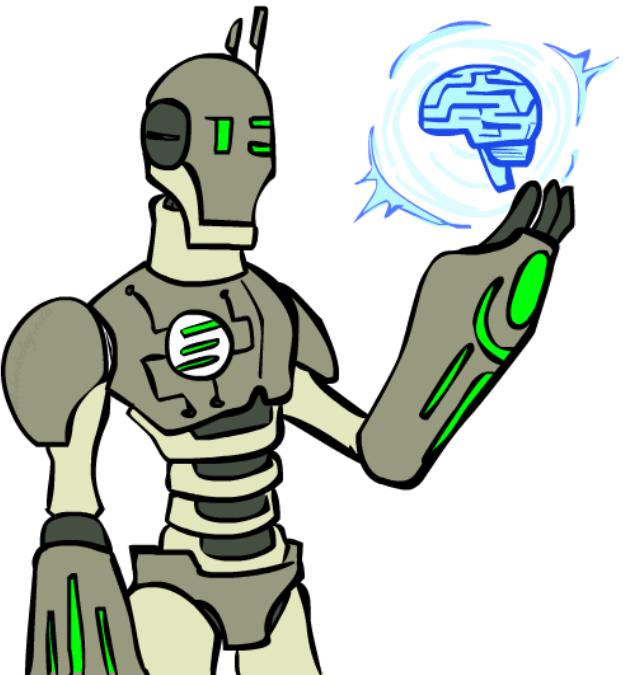
Throughout this class you will let Pacman become
an intelligent and successful agent in his fight
against the ghosts!

Important This Week

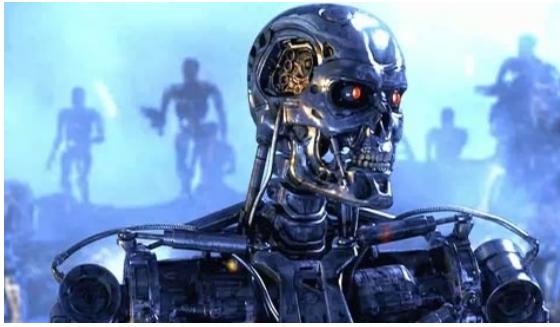
- Important this week:
 - **Register** for the class on blackboard
 - **P0: Python tutorial** is out (due on Thursday 8/25 at 23:59)
 - P0 is individual work & submission
 - Register yourself with your group (1-2 students) on Blackboard (registration is open till 1. September) - You can use the Forum to find a team partner
 - Important: If you want to work alone, you still have to register yourself for one group! (This group would have only you as a group member) Without group registration no project submission is possible later on.
- Also important:
 -

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:

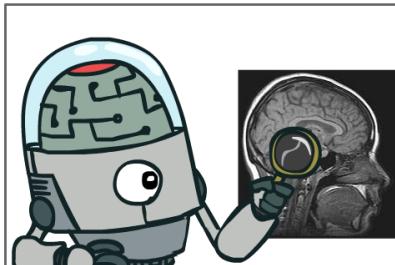


Think
rationally

What is AI?

The science of making machines
that:

Think like
people

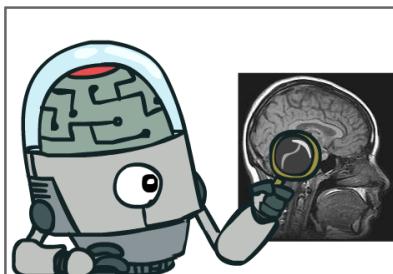


Think
rationally

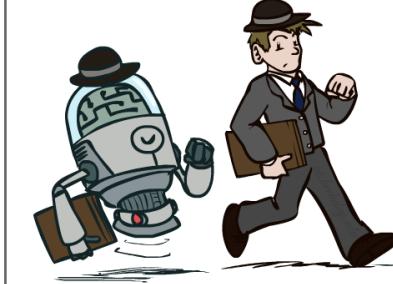
What is AI?

The science of making machines
that:

Think like
people



Act like people

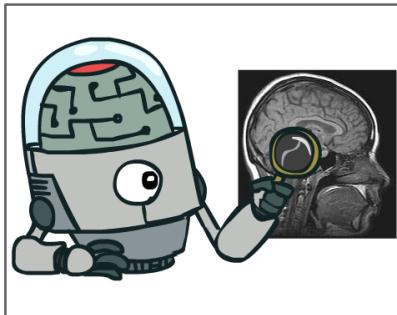


Think
rationally

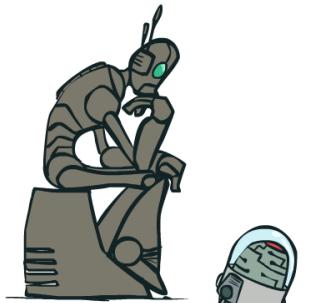
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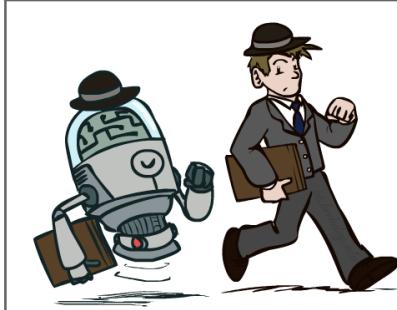
Think like
people



Think
rationally



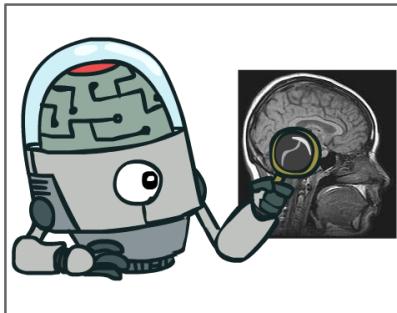
Act like people



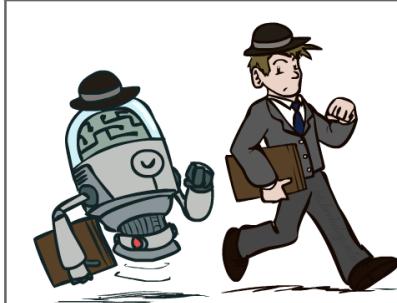
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The science of making machines
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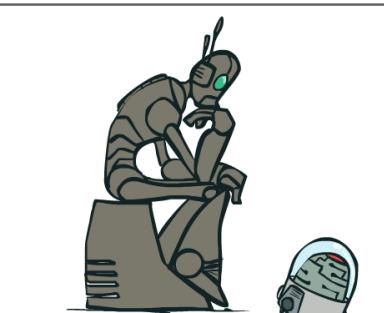
Think like
people



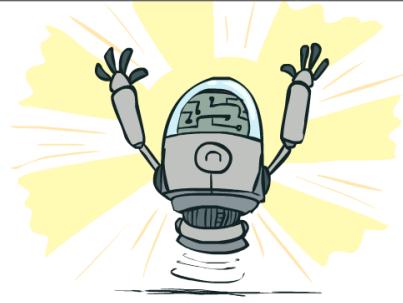
Act like people



Think
rationally



Act rationally



Rational Decisions

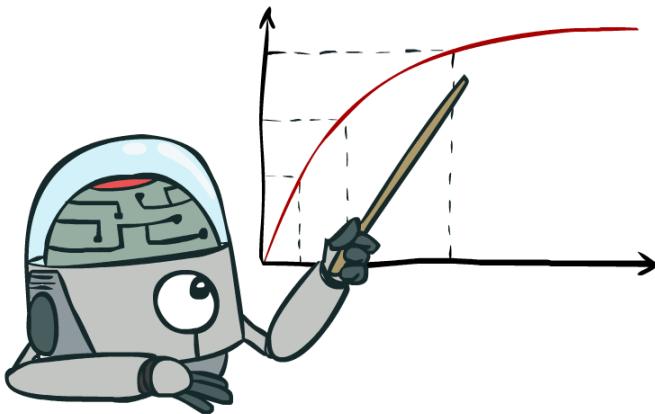
We'll use the term **rational** in a very specific, technical way:

- 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:

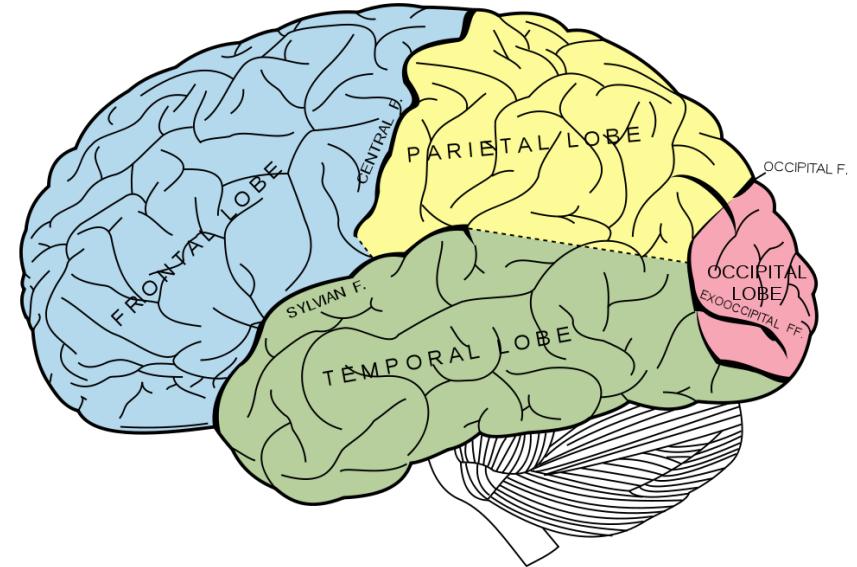
Computational Rationality

Maximize Your Expected Utility

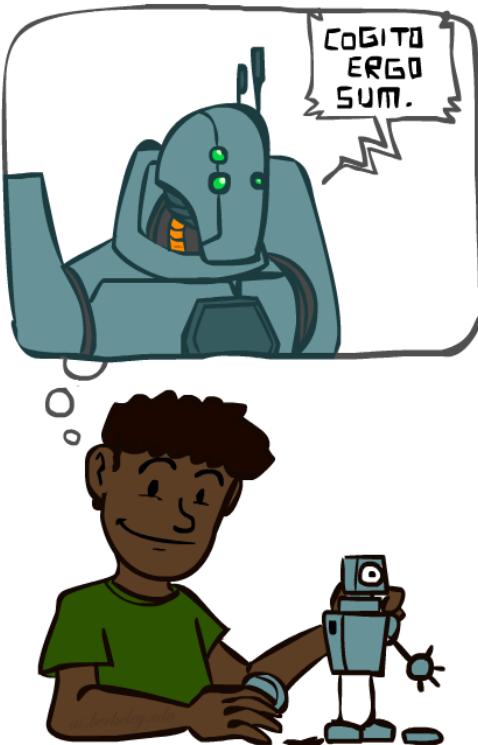


What About the Brain?

- 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

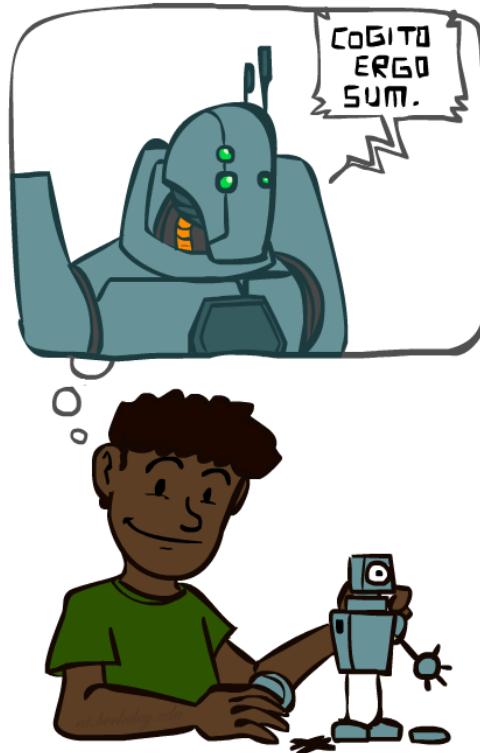


A (Short) History of AI



A (Short) History of AI

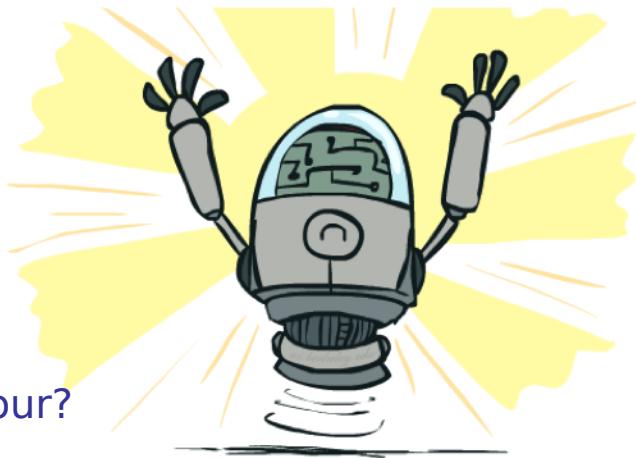
- **1940-1950: Early days**
 - 1943: McCulloch & Pitts: Boolean circuit model of brain
 - 1950: Turing's "Computing Machinery and Intelligence"
- **1950—70: Excitement: Look, Ma, no hands!**
 - 1950s: Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's 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, focus on uncertainty
 - General increase in technical depth
 - Agents and learning systems... "AI Spring"?
- **2000—: Where are we now?**



What Can AI Do?

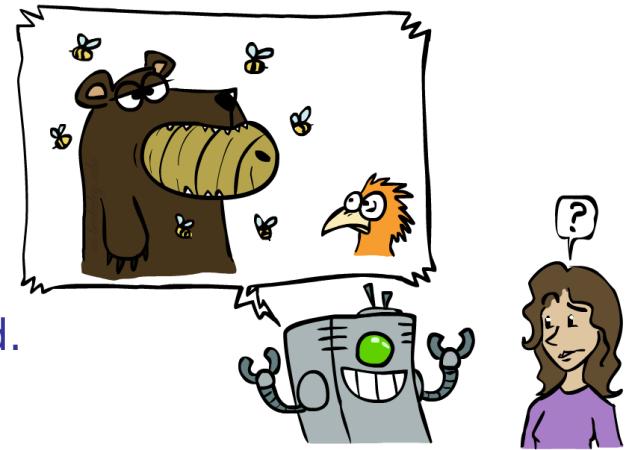
Quiz: Which of the following can be done at present?

- ✓ 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 Food City?
- ? 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 hungry. He asked his friend Irving Bird where some honey was. Irving told him there was a beehive in the 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 where his good friend Bill Bird was sitting. Henry slipped and fell in the river. Gravity drowned. The End.
- Once upon a time there was a dishonest fox and a vain crow. One day the crow was sitting in his tree, holding a piece of cheese in his mouth. He noticed that he was holding the piece of cheese. He became hungry, and swallowed the cheese. The fox walked over to the crow. The End.



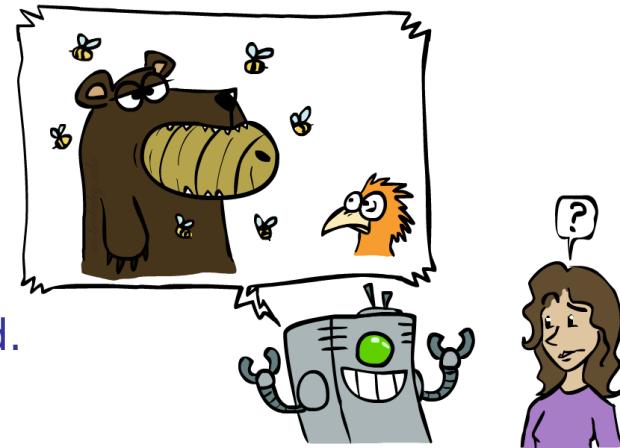
Unintentionally Funny Stories

- One day Joe Bear was hunting for food. He found Irving Bird where some bees were flying around him. There was a beehive in the oak tree. He ate the honey.
 - Henry Squirrel was thirsty. He was walking along the river bank where his good friend, Henry, lived. He slipped and fell into the water. The End.
 - Once upon a time there was a fox who was sitting in his tree, holding a piece of cheese. The fox walked up to the tree and said, "Good morning, Mr. Fox."



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End.

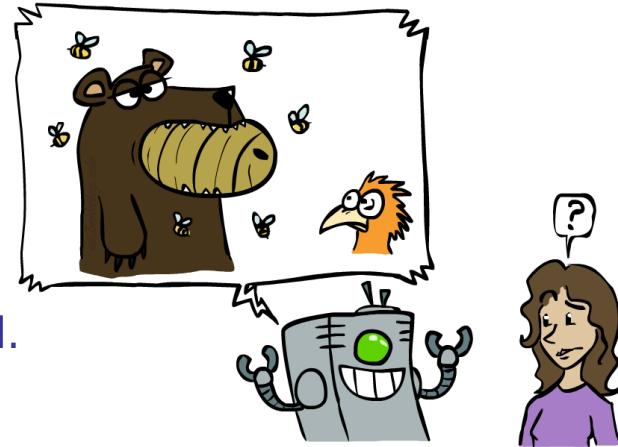
Unintentionally Funny Stories

- One day Joe Bear was hunting Irving Bird where some bees were there. There was a beehive in the oak tree. He ate the honey.
 - Henry Squirrel was thirsty. He was drinking water from a river bank where his good friend Henry Fox was fishing. Henry slipped and fell into the water. The End.
 - Once upon a time there was a fox who was sitting in his tree, holding a piece of cheese. A fox walked by.



end him
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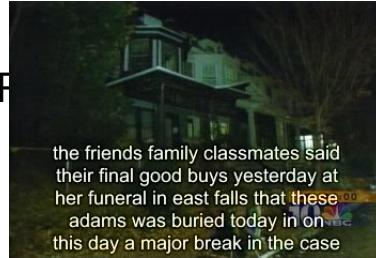
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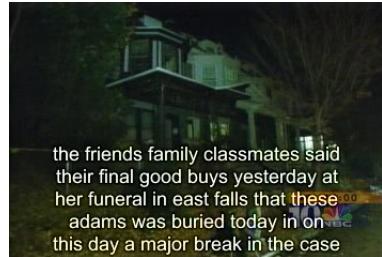
Natural Language

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



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'ilégalité".

Les faits Le dalaï-lama dénonce l'"enfer" imposé au Tibet depuis sa fuite, en 1959
Vidéo Anniversaire de la rébellion tibétaine : la Chine sur une cascade



"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."

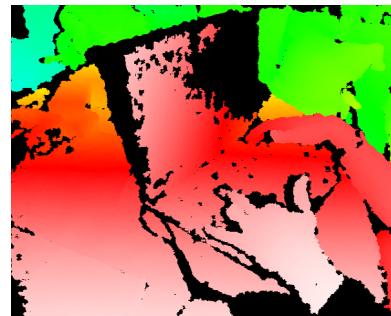
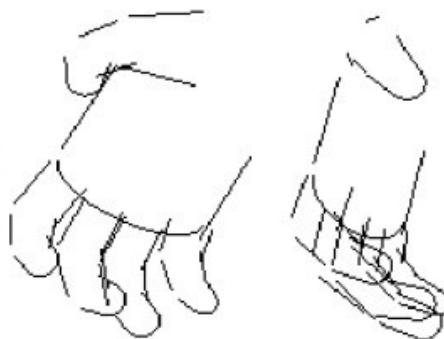
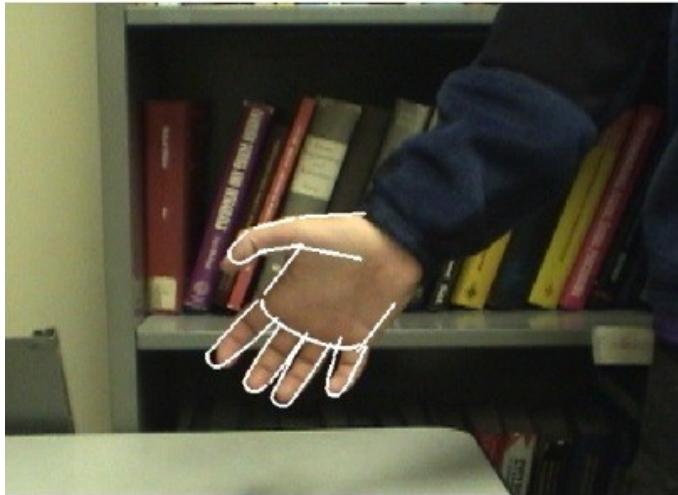
Facts The Dalai Lama denounces the "hell" imposed since he fled Tibet in 1959
Video Anniversary of the Tibetan rebellion: China on guard



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

Vision (Perception)

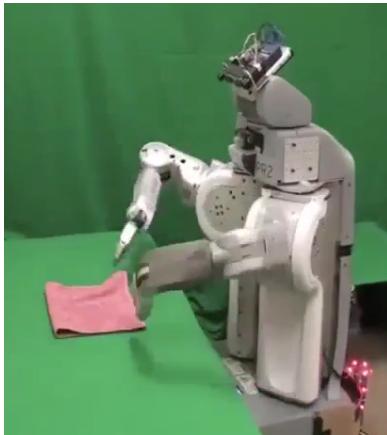
- Object and face recognition
- Scene segmentation
- Image classification



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

Robotics

- 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!)

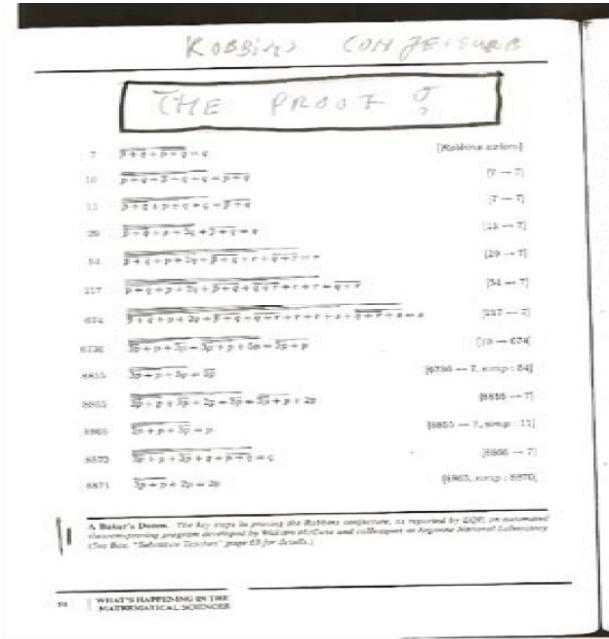


Image from Bart
Selman

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!**



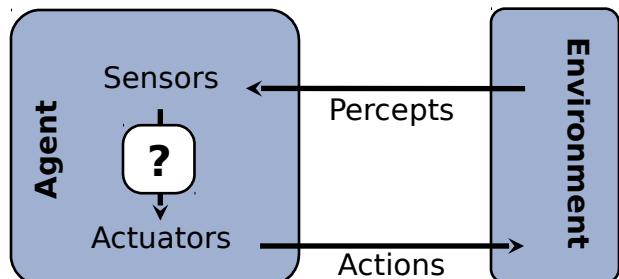
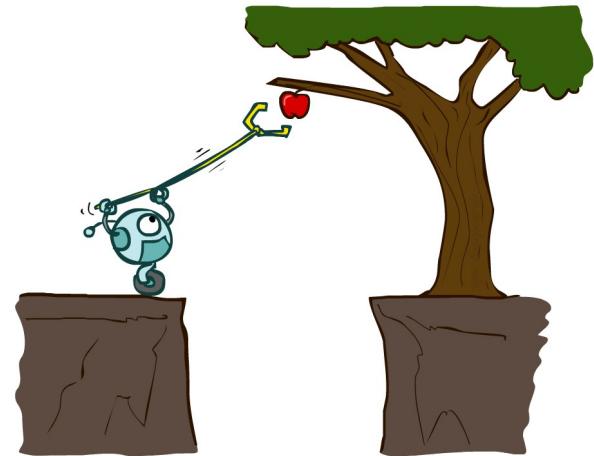
Decision Making

- 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!

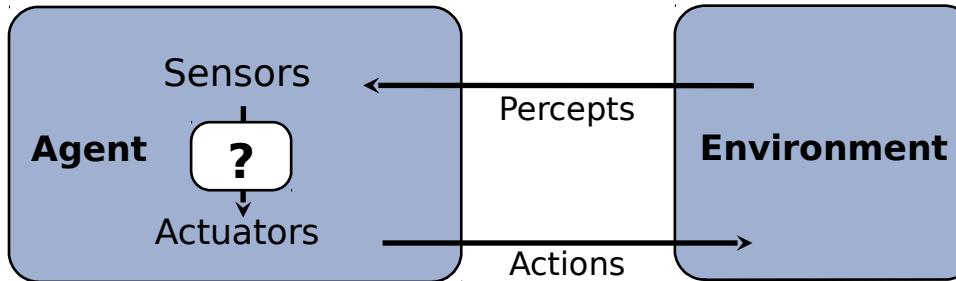
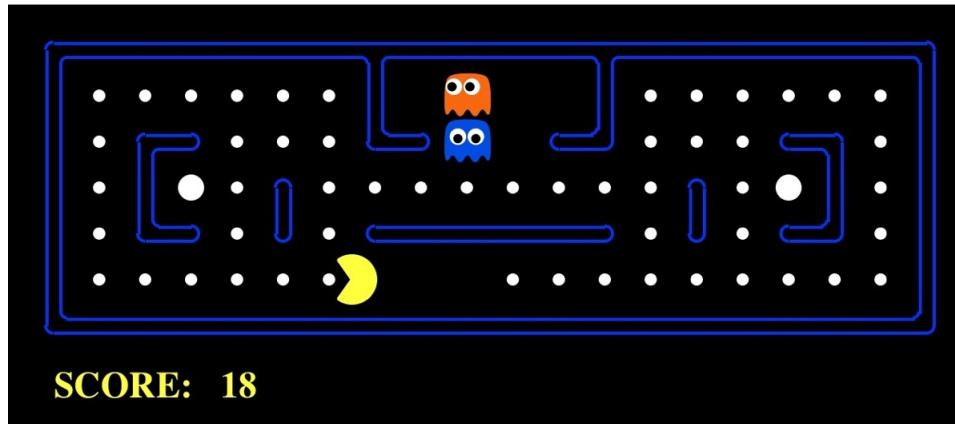


Designing Rational Agents

- 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



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
 - Neural Networks
- **Throughout: Applications**
 - Robotics, vision, natural language processing, games, ...

