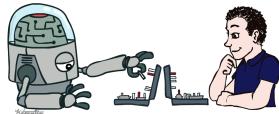


## CS 481: Artificial Intelligence

### Introduction



Instructor: Marco Alvarez  
University of Rhode Island

[These slides were created by Dan Klein and Pieter Abbeel for CS188 Intro to AI at UC Berkeley.  
All materials available at <http://ai.berkeley.edu>.]

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### Course Information

- Communication:
  - Announcements on edX edge
  - Questions? Discussion on piazza
  - Videos/Materials: [ai.berkeley.edu](http://ai.berkeley.edu)
  - Office Hours: F 3-4p Tyler 257
- Course technology:
  - Piazza, edge edX
  - Autograded projects, interactive homeworks (unlimited submissions!) + regular homework
- Prerequisites:
  - CSC 301, Python basics
  - expect a decent load of math and programming

Stay tuned on Piazza for edX signup

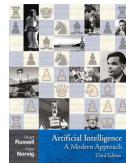
### Work and Grading

- -5 programming projects (25% total):
  - Python, groups of 1 or 2
- 10 homework assignments (15% total):
  - -6 are interactive edX homeworks (5% total)
  - -4 are written homeworks graded by real, organic humans (10% total)
  - Submit alone, your own work; may discuss with others
- One in-class midterm (25%), one final (35%)
  - closed-book w/ 1-page cheat sheet of your own devising
- Extra credit for contest participation and performance; extraordinary projects
- Participation can help on margins
- Academic integrity policy

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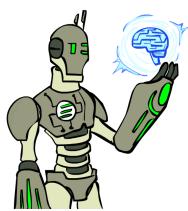
### Textbook

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

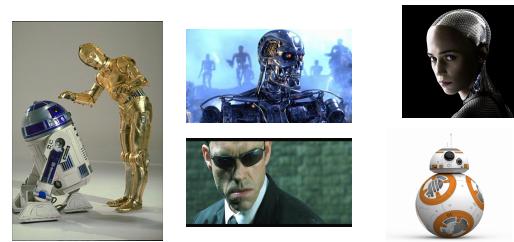


### Today

- What is artificial intelligence?
  - past, present, future
- What can AI do?
- What is this course?



### Sci-Fi AI?



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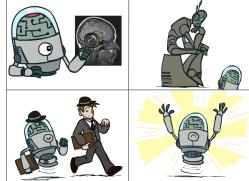
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### What is AI?

The science of making machines that:

Think like people



Think rationally

Act like people

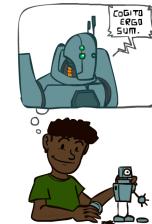
Act rationally

### 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 (Short) History of AI



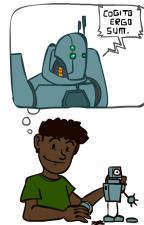
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## A (Short) History of AI

- 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?



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## 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?



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**Artificial Intelligence: Gods, gods and Ex Machina**

The Guardian - 7 hours ago  
Even with its flaws, last year's Ex Machina perfectly captured the existential chasm between artificial intelligence, God and love. A tiny change.

**Will Artificial Intelligence someday dominate humans?**

New York Daily News - Jan 25, 2016  
The term "Artificial Intelligence" is AI. It's a catch-all phrase for computers that can do things that normally require human intelligence. In other words, it's computers that think.

**Microsoft Open-Sourc... Microsoft's 3-hour video on AI**

Microsoft - 3 hours ago  
Microsoft is following Google's lead by publishing a massive open-source project. Microsoft posts AI tools, Ingvoldur, Ingvoldur, Explor... In Depth - 2 hours ago

**Glaze Inside The Mind**

Information Week - 3 hours ago  
Even aside from the fact that it's a video, this is a really cool look at how AI sees the world. It's a bit like looking through a camera lens.

**Harvard is trying to build a supercomputer that can... Harvard is trying to build a supercomputer that can... Even though it's still in the planning stages, the team at Harvard University has already made some progress.**

**Marvin Minsky dies**

Information Week - 3 hours ago  
In a field where most people ignore the threat to humanity, Marvin Minsky was one of the few who didn't. He was a pioneer in the field of artificial intelligence and helped found the MIT Media Lab. Now he's gone.

**Sophia: scientists worry that runaway artificial intelligence could pose an existential threat to humanity**

Washington Post - Dec 27, 2015  
Of all the people worried about runaway artificial intelligence, and human-like robots, Sophia is the first to escape human control and pose an existential threat to humanity.

**The AI anxiety**

Washington Post - Dec 27, 2015  
Exploring the fears of AI experts about the future of AI.

**AI Threats to Big Law**

Information Week - 3 hours ago  
It's not just the threat to humanity that's causing concern. It's also the threat to law firms. Recent advances in AI have led to a new generation of legal software that can analyze contracts and identify potential legal issues.

**Marvin Minsky: A Greater Risk To IP Than H... Marvin Minsky: A Greater Risk To IP Than H...**

Information Week - 3 hours ago  
In almost entirely ignored: the threat to intellectual property (IP). Existing laws are insufficient to protect IP rights from AI.

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## Natural Language

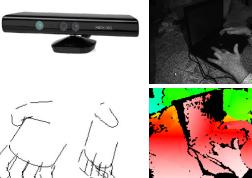
- Speech technologies (e.g. Siri)
  - Automatic speech recognition (ASR)
  - Text-to-speech synthesis (TTS)
  - Dialog systems
- Language processing technologies
  - Question answering
  - Machine translation
- Web search
- Text classification, spam filtering, etc...



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## Vision (Perception)

- Object and face recognition
- Scene segmentation
- Image classification



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

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## 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

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## Logic

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

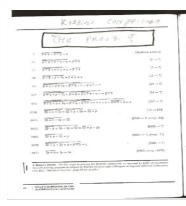


Image from Bart Selman

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## Game Playing

- Classic Moment: May, 97: Deep Blue vs. Kasparov
  - First match won against world champion
  - Intelligent creation plan
  - 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!

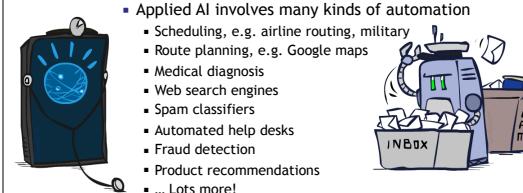


Text from Bart Selman, image from IBM's Deep Blue pages

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## Decision Making

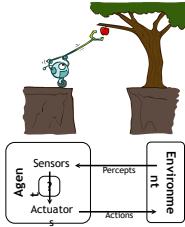
- Applied AI involves many kinds of automation
  - Scheduling, e.g. airline routing, military
  - Route planning, e.g. Google maps
  - Medical diagnosis
  - Web search engines
  - Spam classifiers
  - Automated help desks
  - Fraud detection
  - Product recommendations
  - ... Lots more!



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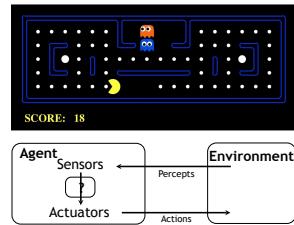
## Designing Rational Agents

- 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



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## Pac-Man as an Agent



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## 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, ...



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