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.]
Course Information

- **Communication:**
  - Announcements on edX edge
  - Questions? Discussion on piazza
  - Videos/Materials: 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
Textbook

- Not required, but for students who want to read more we recommend
Today

- What is artificial intelligence?
  - past, present, future

- What can AI do?

- What is this course?
Sci-Fi AI?
What is AI?

The science of making machines that:

Think like people

Think rationally

Act like people

Act rationally
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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- **1940-1950: Early days**
  - 1943: McCulloch & Pitts: Boolean circuit model of brain
  - 1950: Turing’s “Computing Machinery and Intelligence”
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- 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
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- **1970–90: Knowledge-based approaches**
  - 1969–79: Early development of knowledge-based systems
  - 1980–88: Expert systems industry booms
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- **1990—: Statistical approaches**
  - Resurgence of probability, focus on uncertainty
  - General increase in technical depth
  - Agents and learning systems... “AI Spring”?
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- **2000–: Where are we now?**
What Can AI Do?

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

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- Drive safely along a curving mountain road?
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  - Converse successfully with another person for an hour?
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  - ❏ Perform a surgical operation?
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- ✔ Put away the dishes and fold the laundry?
- ✔ Translate spoken Chinese into spoken English in real time
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  - Write an intentionally funny story?
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Artificial Intelligence: Gods, egos and Ex Machina
The Guardian - 7 hours ago
Even with its flaws, last year’s Ex Machina perfectly captured the curious relationship between artificial intelligence, God and ego. A tiny change ...

Will Artificial Intelligence someday dominate humans?
The term “Artificial Intelligence,” or AI, suggests a category of computer technology that challenges humans. Some very smart people like Elon ...

The Rise of the Artificially Intelligent Hedge Fund
Highly Cited - WIRED - Jan 25, 2016
Explore in depth (4 more articles)

Microsoft Open Sources Artificial Intelligence Toolkit
PC Magazine - 3 hours ago
Microsoft is following Google’s lead and making its deep learning tools a whole lot more accessible. The software giant has open sourced its ...

Microsoft posts AI toolkit on GitHub
Highly Cited - InfoWorld - Jan 25, 2016
Explore in depth (39 more articles)

Gaze Inside The Mind Of Artificial Intelligence With This...
Popular Science - 21 hours ago
Even aside from the fear that evil A.I.s will take over the world, the field of artificial intelligence can be daunting to outsiders. Facebook’s director ...

Harvard is trying to build an AI as fast as the human brain
Wired.co.uk - Jan 25, 2016
... Information than artificial intelligence. The award, from the Intelligence Advanced Projects Activity (IARPA), could help make AI systems faster ...

Thanks to a $28 million grant, Harvard is heavily researching ...
Digital Trends - Jan 25, 2016
Explore in depth (9 more articles)
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Natural Language

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

"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 condemns the "false" imposed since he fled Tibet in 1959.

Video: Anniversary of the Tibetan rebellion: China on guard
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  - 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)
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!)
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

Text from Bart Selman, image from IBM’s Deep Blue pages
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- Huge game-playing advances recently, e.g. in Go!

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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

![Diagram of a robot agent with sensors, actuator, and environment](image-url)
Pac-Man as an Agent

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