Introduction

CS 188: Artificial Intelligence

Course Information

Communication:
- Announcements on Piazza
- Questions? Discussion on Piazza
- Staff email: cs188@berkeley.edu

Course Technology:
- Website
- Piazza
- Gradescope
- This course is webcast (Fall 2018 videos)
- Edited videos from past semester

Prerequisites:
- (CS 61A or CS 61B) and (CS 70 or Math 55)
- Recommended: CS 361A and CS 61A and CS 70

Work and Grading:
- 5 programming projects: Python, groups of 1 or 2
- 5 late days for semester, maximum 2 per project
- 2 midterms, one final
- Written component: on paper, solve alone/together, submit alone
- Electronic component: online, interaction, groups allowed, submit alone
- Two homework assignments:
  - Two midterms, one final

Course Staff

Pieter Abbeel & Dan Klein

University of California, Berkeley

Professors

Alex Li
Daniel Ho
Aditya Baradwaj
Pieter Abbeel
David Gaddy
Ignasi Clavera
Jasmine Deng
Jonathan Ho
Katie Luo
Laura Smith
Mitchell Stern
Nikhil Sharma
Nikita Kitaev
Noah Golmant
Ronghang Hu
Wilson Yu
Yi Wu
Thanard Kurutach
(Head GSI)
Exam Dates

- Midterm 1: October 9th, 7:30 - 9:30pm
- Midterm 2: November 15th, 7:30 - 9:30pm
- Final Exam: December 11th, 8 - 11am

Discussion Section (Optional Attendance)

- Topic: Review / Warm-up Exercises
- Currently, no discussion sections are assigned to sections.
- Piazza survey later this week to help keep sections balanced.
- You are welcome to attend any section of your preference.
- Please consider sitting towards the back if using your laptop in lecture.

Laptops in Lecture

- Laptops can easily distract students behind you.
- Not necessarily follow the presentation in the book.

Not required, but for students who want to read more

Textbook

- Not a course textbook, so our presentation does not necessarily follow the presentation in the book.
- We recommend Russell & Norvig for students who want to read more.

Warning: There will be no alternate exams.

Exams

- There is no section in the current week (8/20-8/24).
- There will be webcasts of section.
- First two weeks of section, but then onwards section attendance will be lower and things will sort themselves out.
- From past semesters experience we know sections will be (over)crowded the first two weeks of section.

There will be no alternate exams.
Announcements This Week

• Important this week:
  • Check out website: https://inst.eecs.berkeley.edu/~cs188/fa18
  • Register on Gradescope and Piazza (check your email for links)
  • HW0: Math self-diagnostic is online now (due on Monday 8/27 at 11:59pm)
  • P0: Python tutorial is online now (due on Monday 8/27 at 11:59pm)
  • One-time (optional) P0 lab hours (Friday 3-6pm, 330 Soda Hall)

Instruction vs. Assessment

- Homework and projects: work alone/together, iterate/learn till you nailed it
- Exams: assessment

Suggestion: assess yourself by first spending some time working alone

Today

What is Artificial Intelligence?
- What is this course?
- What can AI do?
The science of making machines that:

**What is AI?**

- Think like people
- Act like people
- Think rationally
- Act rationally

**Rational Decisions**

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

1. **Rational**: maximally achieving your expected utility
2. Goals are expressed in terms of the utility of outcomes (not the thought process behind them)
3. Rationality only concerns what decisions are made
4. Rationality: maximizing achieving pre-defined goals

A better title for this course would be: **Computational Rationality**

**Computational Rationality**

A better title for this course would be:

- Being rational means maximizing your expected utility
- Goals are expressed in terms of the utility of outcomes (not the thought process behind them)
- Rationality only concerns what decisions are made
- Rational: maximally achieving pre-defined goals

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

**Sci-Fi AI?**

- They should slow
- We know it.
- A.I. can transform
- We can transform
- A: Should I read...
Maximize Your Expected Utility

Brains (human minds) are very good at making rational decisions, but not perfect. Brains are not as modular as software, so hard to reverse engineer. "Brains are to intelligence as wings are to flight." Lessons learned from the brain:

Course Topics

Part I: Intelligence from Computation

- Fast search / planning
- Constraint satisfaction
- Adversarial and uncertainty search

Part II: Intelligence from Data

- Bayes' nets
- Decision theory
- Machine learning

Throughout: Applications

- Natural language, vision, robotics, games...
- Decision theory
- Expert systems

A (Short) History of AI

What About the Brains?
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?
- Translate spoken Chinese into spoken English in real-time?
- Fold the laundry and put away the dishes?

Unintentionally Funny Stories

- 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.
- 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.

[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


§ 1990—2012: Statistical approaches + subfield expertise

§ 2012—: Excitement: Look, Ma, no hands again?

- Big data, big compute, neural networks
- Some re-unification of subfields
- AI used in many industries
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.

Vision (Perception)

- Face detection and recognition
- Semantic scene segmentation
- 3-D understanding

Source: Caesar et al. ECCV 2017
Robotics

Methods for control
Methods for planning
The human/mechanical agents
In this class:

Lidar
Camera
Laser
Sonar

Simulations
Real data
Robots

In this class:

We ignore mechanical aspects
Methods for planning
Methods for control

Images from UC Berkeley, RoboCup, Google/Waymo, Boston Dynamics
Game Playing

Open question: How does human cognition deal with the search space explosion of chess? Or: how can humans compete with computers at all? 2016: AlphaGo beats Lee Sedol – huge advance: sparse rollouts and self-play. Right now: OpenAI Five vs Team paiN (human pros) – some caveats! "The AI play was just something like completely different." – Austin Walsh.

Al is starting to be everywhere…

Applied AI automates all kinds of things.

AI vs.Humans

- Better at some things
- Generally better at others
- Can't do others (yet)

Rationality

- The ability to reason

Rational Agents

- An agent is a rational agent if it maximizes its (expected) utility

Designing Rational Agents

- What do we mean by "rational"?
- What do we mean by "utility"?

Classes

- Moral
- Practical

Consequences

- Actions have consequences

Logic

- Propositions
- Truth values
- Logical operators

Logical Systems

- Propositional logic
- First-order logic
- Second-order logic

Question answering

- Automated help desks
- Spam / fraud detection
- Product recommendations
- Medical diagnosis
- Smart home systems
- Search engines
- Route planning
- Traffic management
- ... Lots more!

Search

- Search algorithms
- Constraint satisfaction
- Satisfiability solvers (huge advances!)

Deduction systems

- Formal logic
- Natural language processing
- Expert systems

Constraint satisfaction

- CSPs
- SAT solvers
- SMT solvers

Question answering

- QA
- Information retrieval
- Natural language processing

Logic

- Propositional logic
- First-order logic
- Second-order logic
Pac-Man as an Agent

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