CS 188: Artificial Intelligence

Introduction

Instructor: Anca Dragan
University of California, Berkeley
(slides adapted from Dan Klein, Pieter Abbeel)
AI
Course Staff

Professor

Anca Dragan

GSIs

Davis Foote
Anwar Baroudi
Francois Belletti
Xiang Cheng
Glen Chou
Ruoxi Jia

Alexandre Ku
Jacky Liang
Derrick Lin
Andrew Liu
Smith a Milli
Won Park

Taesung Park
Vitchyr Pong
Paria Rashidinejad
Nick Rose
Nikhil Sharma
Richard Zhang
Website and Piazza

- Website – sign up!
  - tentative schedule
  - homework, projects, lecture slides and notes, course policies, etc.

https://edge.edx.org/courses/course-v1:Berkeley+CS188+SP17/info

- Communication:
  - piazza – ask and answer questions; announcements
  - Staff email: cs188-staff@lists
  - Exceptions – email Davis (head GSI) at djfoote AT berkeley.edu
Course Format

- Lectures MW
  - I want for you to show up and actively engage
  - ‘12 and ‘16 videos available – good for recap, not a substitute
  - We’ll make lecture notes too

- Discussion Sections
  - 16; schedule soon on edge.edx
  - Pick 1 to go to; show up to it consistently -> bonus 1%
  - Videos posted at end of the week
  - No sections this week
Course Format (continued)

Homework

- Due Mondays at midnight (11:59pm)
- Exercises based on class material
- Solve together, submit alone
  - Academic integrity!
- Autograded, unlimited submissions!
- I expect you to get 100% on homework
Course Format (continued)

- Projects
  - Due Fridays at 5pm
    - 5 slip days, max 2 per project
  - 6 projects, groups of 1-2
    - Academic integrity!
  - Python, hands-on experience with the algorithms
  - Also autograded
  - I expect you to get 100% on projects
Course Format (continued)

- **Contests**
  - Submit your own agents and compete with each other!
  - Give your agents cool names!
    - AlphaGhost
    - PacLivesMatter
    - Mr. Silly and His Best Friend
    - myTeam.py
    - Twopac
    - extracredit plz try 2
    - Eh
    - Shotsandgoggles
    - Pieter <3 Anca 4 Life
Course Format (continued)

- Exams
  - Midterm: Wed, 3/15, 7-8:30PM
  - Final: Fri, 5/12, 3-6PM
  - No makeup exams
  - Exams are the main assessment tool, so they are hard

- Exam Practice Sessions
  - Extra sessions in the evenings
  - Schedule soon on edge.edx
  - Will start a week later than discussion sections
Course Format (continued)

- Office hours
  - General: concepts, homework, project help
  - No-project: concepts, homework
  - My office hours: concepts
Prerequisites

- 61A and 61B and 70
- Lots of math
  - There is a math self diagnostic test on edge.edx – take it! (not graded)
- Lots of programming
  - There is a 0th project (P0) which we will post today
  - Due Friday 5pm
  - Will have special office hours Thur and Fri
  - You get points for submitting it
  - Stay tuned via piazza
Laptops in Lecture

(starting next lecture)

0 I prefer if you don’t use laptops or phones in lecture.
0 If you really want to use a laptop, sit in the back.
0 I encourage you to sit in the front so that we can have an interaction.
Textbook

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

Important This Week

**Important this week:**

- **Register** for the class on edx
- **Register** for the class on piazza --- our main resource for discussion and communication
- **P0: Python tutorial** is out (due on Friday 1/23 at 5pm)
- **One-time (optional) P0 lab hours** this week: will post details on piazza
- **Math self-diagnostic** up on web page --- important to check your preparedness for second half
- **Mark exam dates in your calendars**

**Also important:**

- **Sections** start next week.
- **If you are wait-listed**, you might or might not get in depending on how many students drop. Contact Michael-David Sasson ([msasson@cs.berkeley.edu](mailto:msasson@cs.berkeley.edu)) with any questions on the process.
- **Regular Office Hours** start next week, this week there are the P0 labs
Today

0 What is artificial intelligence?
0 What can AI do?
0 What is this course?
Sci-Fi AI
AI in the News

Elon Musk: artificial intelligence is our biggest existential threat

The AI investor says that humanity risks ‘summoning a demon’ and calls for more regulatory oversight

Elon Musk has spoken out against artificial intelligence (AI), declaring it the most serious threat to the survival of the human race.

Musk made the comments to students from Massachusetts Institute of Technology (MIT) during an interview at the AeroAstro Centennial Symposium, talking about computer science, AI, space exploration and the colonisation of Mars.

Source: The Guardian, 10/27/2014
Elon Musk Funds 1 Billion-Dollar Project To Save Mankind From Artificial Intelligence
The rise of robots: forget evil AI – the real risk is far more insidious

It’s far more likely that robots would inadvertently harm or frustrate humans while carrying out our orders than they would rise up against us
AI Booming in Industry

HAL 9000 Is Coming
Newly funded artificial intelligence startups, by year

Artificial Intelligence, Real Money
Total venture capital money for pure AI startups, by year

Source: CB Insights
What is AI?

The science of making machines that:

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

Rational Agents [decisions]

Robots [physically embodied]

Machine Learning [learning decisions; sometimes independent]

Human-AI Interaction

NLP

Computer Vision
A (Short) History of AI
“the thinking machine”
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—: Statistical approaches
- Resurgence of probability, focus on uncertainty
- General increase in technical depth
- Agents and learning systems... “AI Spring”?
What Can AI Do?

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

- ✓ Play a decent game of Jeopardy?
- ✓ Win against any human at chess?
- ✓ Win against the best humans at Go?
- ✓ Play a decent game of tennis?
- ✓ Grab a particular cup and put it on a shelf?
- ✓ Unload any dishwasher in any home?
- ✓ Drive safely along the highway?
- ✓ 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?
- ✓ Perform a surgical operation?
- ✓ Unload a know dishwasher in collaboration with a person?
- ✓ Translate spoken Chinese into spoken English in real time?
- ✓ Write an intentionally funny story?
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 into the river. He 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 cheese. He became hungry, and swallowed the cheese. He offered a piece of cheese to the crow. The End.
Natural Language

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

0 Language processing technologies
  o Question answering
  o 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'illegalité".
Les faits Le dalai-lama dénonce l'"exil" imposé au Tibet depuis sa fuite, en 1959
Video Anniversaire de la rébellion

"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 "exile" imposed since he fled Tibet in 1959
Video Anniversary of the Tibetan rebellion: China on guard
Computer Vision

Karpathy & Fei-Fei, 2015; Donahue et al., 2015; Xu et al, 2015; many more
Game Agents

- 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

- 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."

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

- Reinforcement learning

- Pong
- Enduro
- Beamrider
- Q*bert
Game Agents

[Duan, Schulman, Chen, Bartlett, Sutskever & Abbeel, 2016]
Game Agents

Reinforcement learning
Simulated Agents

Iteration 20

[Schulman, Moritz, Levine, Jordan, Abbeel, ICLR 2016]
Robotics

- Robotics
  - Part mech. eng.
  - Part AI
  - Reality much harder than simulations!

- Technologies
  - Vehicles
  - Rescue
  - Help in the home
  - Lots of automation…

- In this class:
  - We ignore mechanical aspects
  - Methods for planning
  - Methods for control

Images from UC Berkeley, Boston Dynamics, RoboCup, Google

Demo 1: ROBOTICS – soccer.avi
Demo 2: ROBOTICS – soccer2.avi
Demo 3: ROBOTICS – gcar.avi
Demo 4: ROBOTICS – laundry.avi
Demo 5: ROBOTICS – petman.avi
Robots
Robots

[Levine*, Finn*, Darrell, Abbeel, JMLR 2016]
Interacting with AI: Very Open
Interacting with AI: Very Open
Interacting with AI: Very Open

Why did it decide to do that?
Interacting with AI: Very Open

Clear utility function

Not so clear utility function
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!
CS 188: Artificial Intelligence

Introduction

Instructor: Anca Dragan
University of California, Berkeley
(slides adapted from Dan Klein, Pieter Abbeel)