CS343: Artificial Intelligence

Introduction

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[Based on slides created by Dan Klein and Pieter Abbeel for CS188 Intro to AI at UC Berkeley. All materials available at http://ai.berkeley.edu.]
Course Staff

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A bit about me

Perception

Personal Autonomous Robotics Lab

Reinforcement learning

Robotic manipulation and learning from demonstration
Course Information

- **Communication:**
  - Announcements on webpage
  - Grades on Canvas / edX
  - Piazza for discussion

- **Course technology:**
  - edX for interactive homework (unlimited submissions!)
  - Autograded programming projects (submit via Canvas)
  - Make sure you have a CS Unix account IMMEDIATELY!
  - Create an edX account

Class website:

http://www.cs.utexas.edu/users/sniekum/classes/343-F18/desc.php

(or Google “Scott Niekum” and go to the Teaching tab)
Course Information

- **Prerequisites:**
  - Upper division standing
  - No formal class pre-reqs
  - There will be a lot of math (and programming)

- **Coursework**
  - Reading assignments
  - 8 homework assignments:
    - ~2 weeks for each, but overlapping
    - Online, autograded, solve and submit alone
    - No late submissions accepted
  - 6 programming projects
    - Python, groups of 1 or 2 (except Project 0)
    - ~2 weeks for each, non-overlapping
    - 5 late days for semester, maximum 2 per project
  - One midterm, one final
  - Final Contest
Warning: Not a course textbook, so our presentation does not necessarily follow the presentation in the book.


- After classes I’ll post slides
- There are also “step by step” videos posted for some topics
Homework Exercises

- Online on edX
- Autograded text boxes / multiple choice
- Try as many times as you want!
- Goal: self-assess and prepare for tests
- Can discuss at high-level, but work alone
- No spoilers on Piazza discussions!
Programming Assignments

Pacman domain

Projects include:

- path planning and search
- multi-agent game trees
- reinforcement learning
- state estimation
- classification
- final contest

Highly suggested: Pair programming
(switch “driver” and “observer” roles often)
Midterm and Final

- Midterm will cover roughly half the class material
- Final will be comprehensive
- One page of notes, but not open book
Grading

Plus/minus grading - adjustable scale, but no more harsh than:

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Grades will be weighted as follows:

- Homework Exercises (20%)
- Programming Assignments (30%)
- Midterm (20%)
- Final (30%)
Academic Honesty

READ THE STATEMENT IN THE SYLLABUS

• Discuss concepts, but don’t share solutions or written work with other students
• Don’t look for answers / code online or elsewhere
• Automated tools will be used to discover cheating
• If unsure, check departmental guidelines or ask — ignorance is not an excuse
• We will pursue the harshest penalties available, so please don’t cheat!
• To be clear: you will fail the class automatically and be reported to the university
Important This Week

• **Important this week:**
  • **Register** for the class on edX (Click on link for HW1 to register for class after making account)
  • **Be sure** that you have a usable CS Unix account - https://apps.cs.utexas.edu/udb/newaccount/
  • **P0: Python tutorial** is out (due on Tuesday 9/4 at 11:59 pm via Canvas)

• **Also important:**
  • **If you are wait-listed**, you might or might not get in depending on how many students drop. Be patient if possible — many students often drop early in the course.
  • **Office Hours** begin Monday
Today

- What is artificial intelligence?
- What can AI do?
- What is this course?
Sci-Fi AI?
AI in the news
A definition for AI

“Artificial Intelligence (AI) is a science and a set of computational technologies that are inspired by — but typically operate quite differently from — the ways people use their nervous systems and bodies to sense, learn, reason, and take action.”
Philosophical questions

- AI is one of the great intellectual adventures of the 20th and 21st centuries.
  - What is a mind?
  - How can a physical object have a mind?
  - Can we build a mind?
  - Can trying to build one teach us what a mind is?
What is AI?

The science of making machines that:

Think like people
Act like people
Think rationally
Act rationally
What is AI?

The science of making machines that:

Think like people
Thinking Like Humans?

- The cognitive science approach:
  - 1960s ``cognitive revolution'': information-processing psychology replaced prevailing orthodoxy of behaviorism (reflexive behaviors, classical conditioning, etc.)

- Scientific theories of internal activities of the brain
  - What level of abstraction? “Knowledge" or “circuits”?
  - **Cognitive science**: Predicting and testing behavior of human subjects (top-down)
  - **Cognitive neuroscience**: Direct identification from neurological data (bottom-up)

- Both approaches now distinct from AI
- Both share with AI the following characteristic:
  
  The available theories do not explain (or engender) anything resembling human-level general intelligence
What is AI?

The science of making machines that:

Think like people
What is AI?

The science of making machines that:

Think like people

Act like people
Acting Like Humans?

- Turing (1950) “Computing machinery and intelligence”
  - “Can machines think?” → “Can machines behave intelligently?”
  - Operational test for intelligent behavior: the Imitation Game

- Predicted by 2000, a 30% chance of fooling a lay person for 5 minutes
- Anticipated all major arguments against AI in following 50 years
- Suggested major components of AI: knowledge, reasoning, language understanding, learning

- Problem: Turing test is not amenable to mathematical analysis
What is AI?

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What is AI?

The science of making machines that:

- Think like people
- Act like people
- Think rationally
- Act rationally
Thinking Rationally?

- The “Laws of Thought” approach
  - What does it mean to “think rationally”?
  - Normative / prescriptive rather than descriptive

- Logicist tradition:
  - Logic: notation and rules of derivation for thoughts
  - Aristotle: what are correct arguments/thought processes?
  - Direct line through mathematics, philosophy, to modern AI

- Problems:
  - Not all intelligent behavior is mediated by logical deliberation
  - What is the purpose of thinking? What thoughts should I (bother to) have?
  - Logical systems tend to do the wrong thing in the presence of uncertainty
  - Why should we care about thought at all, when action is what matters?
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- Think rationally
- Act like people
- Act rationally
Acting Rationally

- **Rational behavior: doing the “right thing”**
  - The right thing: that which is expected to maximize goal achievement, given the available information
  - Doesn't necessarily involve thinking, e.g., blinking
  - Thinking can be in the service of rational action
  - Entirely dependent on goals!
  - Irrational ≠ insane, irrationality is sub-optimal action
  - Rational ≠ successful

- **Our focus here: rational agents**
  - Systems which make the best possible decisions given goals, evidence, and constraints
  - In the real world, usually lots of uncertainty
    - ... and lots of complexity
  - Usually, we’re just approximating rationality
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”
A (Short) History of AI
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

- **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 6th Street on a Friday night?
- ✔ Buy a week's worth of groceries on the web?
- ❔ Buy a week's worth of groceries at HEB?
- ❔ 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?