CPS 570
Artificial Intelligence

Introduction

Ron Parr

Who is Ron?

- Professor of Computer Science & Chair
- Starting my 17th year at Duke
- A.B. in Philosophy (though I don't use that much)
- Interests:
  - Robotics
  - MDPs & Reinforcement learning
  - Game theory
  - Sensing

More AI at Duke

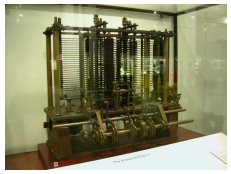
- In CS: Vince Conitzer (Computational Economics), Bruce Donald, Raluca Gordan & Alex Hartemink (Computational Biology), Cynthia Rudin (machine learning), & Carlo Tomasi (vision)
- In Engineering: Larry Carin (Machine Learning), Guillermo Sapiro (Vision)
- In Statistics: Katherine Heller & Sayan Mukherjee (Machine Learning)
- (With apologies to those I left out…)

What is AI?

- For centuries, perhaps longer, people have wondered how to reproduce the smarts that people have…
- Even though we really have no idea how to define such things
- The task of defining intelligence has, itself, been a career long endeavor for many scholars

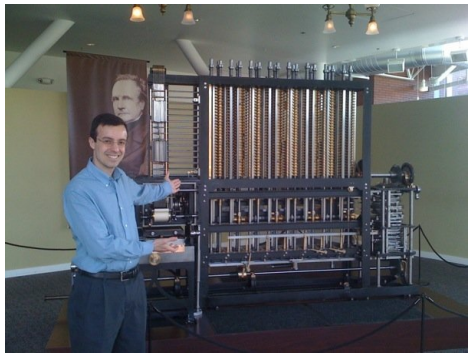
Machine Intelligence

- For as long as people have made machines, they have wondered if these machines could exhibit human-like intelligence
- von Kempelen's (fraudulent) Turk (1700s), Babbage's analytical and difference engines (1800s), Turing's Turing machine (1900s)


Images from Wikipedia

Exhibit at the Computer History Museum in Santa Clara



AI after Turing

- Modern AI is almost 60 years old
- "AI" term proposed at the famous "Dartmouth Conference" in 1957, when computers were slow, room-sized monstrosities
- Has been a subject of intense study since then
  - Most CS departments have at least one AI expert
  - Defense department, national science foundation, industry invest heavily in AI every year
  - Google, amazon, Microsoft, etc. all have robust AI groups – often machine learning

Are We Making Progress? (AI in your life)

- Game playing - chess, jeopardy
- Voice recognition – siri, Google Now, Cortana
- Recommendation systems – netflix, amazon
- Handwriting recognition
- Automated logistics – UPS, US military
- Space exploration

But Where's the General Intelligence?

- AI didn't get traction until it focused on more specific problems
- Hard to provide "general intelligence" if you don't know what it is
- Are we mimicking intelligence or getting closer to it by focusing on specific problems?

What This Class Is Not

- A Balanced Introduction to AI
- Easy

How This Differs from Undergraduate AI

- Undergrad AI:
  - Covers most of AI
  - Covers things at a shallow level
  - Uses an encyclopedic textbook
  - Emphasizes programming, basic algorithms
- This course:
  - Focuses on fewer topics
  - Goes into depth
  - Uses no textbook – lectures and papers
  - Emphasizes theory, research papers
  - Insights from using algorithms

Goals for Graduate AI

- Graduate students now encouraged to pass qualifying exams to demonstrate undergraduate-level mastery of breadth topics
- Graduate AI should:
  - be a more exciting class for people who are genuinely interested in more advanced material
  - prepare students for further study in AI
  - help students become effective researchers/computer scientists even if they aren't focusing on AI
  - Reflect interests and expertise of Duke AI faculty

Learning Objectives

- Teach students to think outside the textbook
- Teach students to teach themselves:
  - Reading papers in the field
  - Trying, discussing
- Expose students to classic topics in AI as well as leading edge research

What If I'm not an AI student?

- AI papers tend to mix theory and application
- AI has been a source of interesting questions for theoreticians
- AI has useful applications across CS, engineering, biology, etc.
- Learning to read AI papers will help develop useful skills that transfer to other disciplines

What if I'm not a Graduate Student?

- Hopefully you will be one some day
- Even if you don't go to graduate school:
  - There is no textbook for the real world
  - Much of what is in your textbooks now will be outdated in a few years
- But…
  - You might be happier in 270
  - Make sure you've got enough background
  - We assume you know a lot of basic CS
  - Assume a certain level of sophistication "teach yourself Matlab"

Requirements

- Familiarity with programming
- Ability to do short proofs
- Basic probability concepts
- Basic algorithmic concepts
  - Complexity - O()
  - Analysis of algorithms
- Math
  - Basic calculus (partial derivatives)
  - Basic linear algebra

Major Topics Covered

See Syllabus on Class Web Page

Major Topics *Not* Covered

- Search – single player and games
- Constraint Satisfaction
- Natural Language – written, spoken language
- Logic and Knowledge Representation
- Machine Learning in depth – we only scratch the surface
- Vision – object and activity recognition

Active Learning

- I will attempt to engage student in active learning experiences whenever possible
  - Discussion
  - Running/Writing code in class
- Will be challenging given class size!

Class Mechanics

See Grading Section of Class Web Page

Grading Scale

- This is a graduate course
- Grades are typically A's and B's
- Lower grades are rare, but they do occur

- If you are a young Ph.D. student, you probably need to rethink the importance of grades in your life

Academic Honesty

- You are encouraged to discuss papers and high level concepts with your friends
- Specific answers to questions must be your own
- You may ***not***
  - ask your friends for specific answers to questions
  - use code from other sources without permission
  - search the internet for answers to questions
- Don't push it; we take these things seriously here.

- More details in a separate presentation & academic honesty matrix on assignments section of web page

Things That Might Go Wrong

- Sometimes papers will be confusing
  - This may be the fault of the authors
  - This may be because the paper assumes something you don't know yet

- Active learning could flop in a class this big
- I love to meet with students, but have very little time to do so because I am dept. chair ☹