CompSci 370

Artificial Intelligence Introduction

Ron Parr
Duke University
Department of Computer Science

Course Staff (See Class Web Page)

- Ron Parr – instructor
- Graduate TAs
  - Vikram Aikat
  - Dillon Sandhu
- Undergraduate TAs
  - Angikar Ghosal
  - Justin Van De Graaf
  - Yuhao Zhou
  - (more may be added)

About me

- Learned to program on my 8-bit Atari computer
- Sent a print out of my Othello (reversi) playing code (in BASIC!) w/my college application
- Majored in Philosophy
- Switched to CS for graduate school
- Started at Duke in 2000
- Once taught this class to just 6 students

Am I Prepared?

- Good programming skills:
  - We assume that you can write, debug your own programs
    (If you need help programming, this class is **too hard** for you!)
  - We will use python for programming assignments
  - **We expect you to figure out** how to use Python and the command line
- Other expectations
  - Ability to do short proofs
  - Basic probability concepts (though we will review this)
  - Basic algorithmic concepts
    - Complexity - O()
    - Analysis of algorithms
  - Math: Basic calculus, basic linear algebra
  - CompSci 230 is essential
  - CompSci 330 also helpful

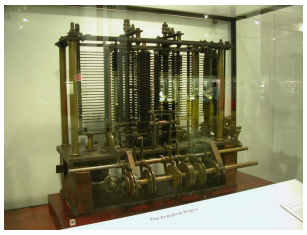
What is AI?

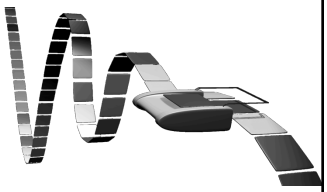
- For centuries, perhaps longer, people have wondered how to reproduce the smarts that people have…
- Even though we really have ***no idea*** how to define such things

- Defining intelligence has, itself, been a career-long endeavor for many scholars

Machine Intelligence Over the Centuries

- As long as people have had machines, they've wondered if they 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

Turing Test

- Computer must be indistinguishable from a human based upon written exchanges
  - Does this imply intelligence?
  - How could the computer cheat?
  - Does intelligence imply a certain type of computation?
  - Could an intelligent machine still fail the test?
- Does our notion of intelligence transcend our concept of humanity?

What Intelligence Isn't

- It's not about fooling people
- Fooling people is (in some cases) easy, e.g., eliza: https://web.njit.edu/~ronkowit/eliza.html
- (built in to emacs meta-x doctor)

- More recent efforts: http://chatbots.org/
- See also GPT3

AI after Turing

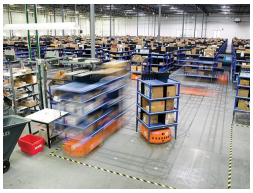
- Modern AI is ~60 years old
- "AI" term proposed at 1957, Dartmouth Conference
- Has been a subject of intense study since then
  - 1960's: Logic, search, theorem proving, perceptron
  - 70's: Robotic & perception
  - 80's: Expert systems, 1st industrial interest, neural nets
  - 90's: agents, uncertainty, "AI Winter"
  - 00's: growth of ML, NLP, usable AI systems
  - 10's: Deep learning, industrial/commodity AI, robotics
  - 20's: Up to you!

AI in Your Life

- Game playing - chess, Go, jeopardy, Starcraft
- Voice recognition and dialog – Siri, Alexa, Google Assistant
- Recommender systems – Netflix, amazon
- Scene, object, face recognition: Face ID, MS seeing AI, image search (objects and faces)
- Automated logistics – UPS, US military
- Space exploration
- Automated science & medicine
- Robotics & Autonomous Vehicles

Example: AI at Amazon Warehouses

- Amazon uses robots to move products within its warehouses (deploys 200,000 robots)
- Amazon uses AI to predict demand
- May use AI to deliver products
- Consequences:
  - Pay fewer workers
  - Warehouses are packed more densely
  - Less space wasted on unpopular products
  - Combine to **increase value per sq. unit** of space



Kiva systems photo
From IEEE Spectrum 7/2/08

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?

The sad (reassuring?) truth about modern AI

- Good news: Fears about the robot apocalypse are (for now) overblown

- Bad news:
  - Not because we're clever about preventing it
  - Because we aren't tackling:
    - Awareness
    - Deep understanding
    - High level reasoning
    - Robustness
  - Danger of deadly mistakes (if not intelligent ones) remains

Original terminator movie poster
Image downloaded from wikipedia

What is covered this semester?

- Search
  - Uninformed search, informed search, CSPs, classical planning
- Game Playing
  - minimax, alpha-beta search
- Logic and Knowledge Representation
  - Propositional logic, first order logic, theorem proving
- Reasoning under uncertainty
  - probability, Bayes nets, HMMs & tracking
- Probabilistic planning and reinforcement learning
- Introduction to machine learning
- Introduction to game theory (time permitting)

Major Topics *Not* Covered

- Natural Language
- Vision, except as application of machine learning

Class Mechanics

- Textbook: ***Artificial Intelligence, A Modern Approach***, Russell & Norvig (*fourth* edition – third is probably OK)
  - Semi-required
  - On Amazon, electronic version also available
  - Please don't steal my advisor's textbook!
- Homework: 40%
  - mix of short proofs, algorithm design/analysis, and programming projects
  - High level discussion OK, write-up, coding must be your own (see matrix on class web page)
- Midterm: 30%
  - Conceptual questions
  - Hopefully in person, no collaboration
  - Scheduled during class time
- Final: 30%
  - Conceptual questions
  - Hopefully in person, no collaboration
  - Scheduled according to registrar's final exam schedule

Grading

- I tend to give challenging conceptual questions, and not everybody will get them
- More important for you to be ***challenged*** than to have a score that you can put on your refrigerator

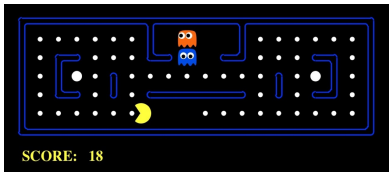
- Don't obsess over raw scores
- At end of semester, I will decide how many points correspond to 1/3 of a letter grade
  - Will always be >= 3.33
  - Typically chosen to ensure median grade of B+ or A-

Discussion Sections

- Staffed by (U)Tas
- Attendance optional
- No new material covered
- Goals:
  - Work through common issues, e.g., "Help me fix my python installation!"
  - Work through problems/examples that wouldn't fit in lecture
- We will usually post questions for discussions before discussion, and post solutions after discussion

Programming Assignments

- Based on the Berkeley Pacman framework



- Why?
  - It's *really* well-done
  - Seeing ***your own code*** run AI algorithms is fun, motivating, and develops your intuitions
  - Even debugging is instructive

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

Pacman Limitations

- Works with Python 3.7, may not work with higher versions
- Not all algorithms make sense in this framework (life isn't a Pacman game)
- Has been around for a while
  - Pacman was new when RP was a kid
  - Temptation to cheat

Academic Honesty

- Brainstorming with friends is encouraged, but answer write up and coding must be your own work
- Don't confuse brainstorming with letting your smart friends tell you the answers
- Don't Google for answers!!!
- Don't troll for answers from previous semesters
- You may Google for definitions

- What you turn in must be your own work!!!

Examples of Cheating

- Simply reading solutions to similar problems found by searching
- Submitting code written by others
- Refactoring or cosmetically modifying code written by others (this is much easier to catch than you think!)
- "Borrowing" a friend's laptop and finding answers

- Note: **Uploading** to a code sharing site **is also cheating**

Consequences of Cheating

- One year, 8 people were caught submitting code from the internet as their own code
  - All cases were reported
  - Consequences included:
    - Zeroes on assignments
    - Suspension
    - Failure to graduate
    - Retraction of job offers
- Three students were caught cheating in Spring 2021!

Consequences of Cheating This Year

- All cases will be reported
- A grade of zero will be given for any assignment on which cheating is detected
- At least 1/3 letter grade will be deducted from the final grade for each instance of cheating in addition to any other penalties
- Other penalties may apply, at the discretion of the instructor and/or dean

Just don't do it!

Should I worry about getting falsely accused?

- No!

- I have never had a false positive accusation
- How do I know this?
  - I don't make frivolous accusations
  - Cheating is surprisingly obvious when it happens
  - When presented with evidence, **students have always owned up**

On a More Positive Note

- This class will be **hard and a lot of work**, but I have taught versions of it for many years and most who are *prepared and stick with it*:
  - Earn a reasonable grade in the end
  - Have fun with projects
  - Learn a lot

- We are here to help!
- We do not want to be your adversaries in this process
- Let us be your partners in learning by allowing us to help you