CompSci 370

Artificial Intelligence
Introduction

Ron Parr
Duke University
Department of Computer Science

Course Staff
(Office Hours - See Class Web Page)

- Ron Parr – instructor
- Graduate TAs
  - Jack Goffinet
  - Dillon Sandhu

- Undergraduate TAs
  - Qiaoyi Fang
  - Ankit Jajoo
  - Ryan Krakower
  - Dev Seth
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 figure out how to use Python and the command line

• Other expectations
  – Ability to do short proofs
  – Basic probability concepts (though we will review all of this)
  – Basic algorithmic concepts
    • Complexity - O()
    • Analysis of algorithms
  – Math: Basic calculus, basic linear algebra
  – CompSci 230 is essential
  – CompSci 330 also helpful
How is 270 different from 370?

• It’s the same class
• Course numbering change to reflect difficulty of class, amount of CS experience expected
• Hope to avoid high attrition w/clear expectations

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: http://www.manifestation.com/neurotoys/eliza.php3
• (built in to emacs meta-x doctor)

• More recent efforts: http://chatbots.org/

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 – Siri, Alexa, Google Assistant
• Recommender systems – Netflix, amazon
• Handwriting recognition
• 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
• Consequences:
  – Pay fewer workers
  – Warehouses are packed more densely
  – Less space wasted on unpopular products
  – Combine to increase value per sq. unit of space
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

Original terminator movie poster
Image downloaded from wikipedia
Eye on the prize

- AI’s narrower focus has earned the field credibility and practical successes, yet
- Some senior researchers complain that we have taken our eye off the prize:
  - Too much focus on specific problems
  - Lack of interest in general intelligence

- Are we ready to tackle general intelligence?
- Not this semester 😊

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
Major Topics *Not* Covered

- Natural Language
- Vision, except as application of computer vision

Class Mechanics

- **Textbook:** *Artificial Intelligence, A Modern Approach*, Russell & Norvig (*third or fourth* edition)
  - Semi-required
  - On Amazon, electronic version (3rd edition) also available
  - Please don’t steal my advisor’s textbook!

- **Homework:** 40%
  - High level discussion OK, write-up, coding must be your own
    (see matrix on class web page)

- **Midterm:** 30%
  - On Sakai (75 continuous minutes in 24 window), no collaboration
  - Starts during class time

- **Final:** 30%
  - On Sakai (180 continuous minutes in 24 window), no collaboration
  - Starts during scheduled final exam time

- Homework will be a mix of short proofs, algorithm design/analysis, and programming projects
Grading

- I tend to give challenging problems, 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 $\geq 3.33$
  - Typically chosen to ensure median grade of B+ or A-

Attendance

- You are not required to attend class – though it’s a good idea
  - Videos and slides will be available
  - Everything in class is covered in readings
- You will not hurt my feelings if you skip class
- When you attend class:
  - Please be present in mind and body
  - Please don’t:
    - Text/email
    - Surf the web
    - Play games
- About multitasking:
  - You might think you can do this w/o cost, but you can’t
  - You aren’t fooling anybody
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
- Will aim to post materials and record sessions

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

• Recently ported to Python 3.x (may have issues with versions higher than 3.7)

• 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
- We will catch efforts to hide copying of code!

- 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
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!

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

• Let’s fasten our seatbelts and learn some AI!