CPS 270

Artificial Intelligence
Introduction

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Course Staff
(Office Hours TBA)

- Ron Parr – instructor
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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

Can I Get a Permission Number?

• We will not be increasing the cap

• Some students will drop

• If you are not prepared, please drop to make room for those who are
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 not required but recommended – may be required in future
  - 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

- 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)

Exhibit at the Computer History Museum in Santa Clara
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/
The Moving Target

• What is human intelligence?
  – At one time, calculating ability was prized
    • Now it is deprecated
    • Calculators permitted earlier and earlier in school
  – Chess was once viewed as an intelligent task
    • Massively parallel computers used not very intelligent search procedures to beat best human players
    • Some say Deep Blue wasn’t AI
  – Learning once thought uniquely human
    • Now it’s a well-developed theory
    • Best backgammon, chess, go players are learning programs
  – Vagaries of natural language once considered impenetrable
    • Now Watson wins at Jeopardy
    • Siri understands a lot of what you say
• Biological chauvinism at work?

Artificial Flight

• Even seemingly unambiguous terms such as “flight” were subject to biological chauvinism.
• Problem: Flight was largely irreducible (no easier subproblems)
  
  • Demonstrable, unambiguous success ended chauvinism – could the same be true for AI?
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
- Voice recognition – siri, Alex, Google Now
- Recommender systems – netflix, amazon
- Handwriting recognition
- Scene, object, face recognition: iPhone X, MS seeing AI, image search (objects and faces)
- Automated logistics – UPS, US military
- Space exploration
- Automated science & medicine
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 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
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 😊

Paths To Scaling Up

- Some have proposed “grand challenges” as a way to build on our successes with smaller problems
- DARPA grand challenge, CALO (precursor to Siri), Watson challenge researchers to integrate, build bigger systems

- Pros:
  - Some impressive successes
  - Some useful lessons learned about integration

- Cons:
  - Some non-general solutions
  - Siphons off a lot of resources, talent
Class Mechanics

• Textbook: *Artificial Intelligence, A Modern Approach*, Russell & Norvig (third edition)
  – On Amazon, Kindle edition no longer available 🙁
  – Book store on 1/25

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

• Midterm: 30%
  – Closed book, in class, no collaboration

• Final: 30%
  – Closed book, finals week, no collaboration

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

Major Topics Covered

• 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 an application of machine learning

Attendance

• You are not required to attend class – though it’s a good idea
  – Notes will be posted
  – 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
Grading

• Unless there is widespread goofing off, most students will get A’s and B’s
• I tend to give challenging problems, and not everybody will get them
• Don’t obsess over raw scores
• More important for you to be *challenged* than to have a score that you can put on your refrigerator

Learning Objectives

• Course material – students should:
  – Have a clue about the algorithms behind common AI techniques, such as search, game playing, or simple machine learning
  – Understand probabilistic reasoning
  – Have a toolbox of techniques that can be used to make more “intelligent” programs

• General computer science - acquire:
  – Greater facility with computational complexity
  – Greater facility with probability
  – More sophisticated understanding of optimization
  – Better proof skills
Academic Honesty

- High level discussions clarify question, what is required, general approach that is expected
- High level discussions do not drill down into implementation/proof details
- Don’t confuse brainstorming with letting your smart friends tell you the answers
- Don’t Google for answers!!!
- You may Google for definitions
- What you turn in must be your own work!!!

Examples of Cheating

- Reading solutions to similar problems found by searching
- Submitting code written by others
- Refactoring, 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
• Other penalties may apply, at the discretion of the instructor and/or dean

Just don’t do it!