Who is Ron?

- Professor of Computer Science
- 22\textsuperscript{nd} year at Duke 😳
- A.B. in Philosophy (though I don’t use that much)
- Interests:
  - Robotics
  - MDPs & Reinforcement learning
  - Game theory
  - Sensing
- Office hours TBA by start of second week
Our Staff

- Chihui Shao

- Possibly +1 TA

- Office hours TBA

Take This Class If

- You have a strong CS and math background
- You are interested in AI, not just machine learning
- You are prepared to dig deep into some AI topics
- You would like to learn to read papers on AI, not just have it spoon-fed to you

- Take undergrad or ML classes if they are more appropriate for your interest/preparation
What This Class Is Not

• Not a machine learning class

• Not a “practical” or “job skills” class

• Not an intro to AI

• Not a balanced overview of AI

Am I Prepared?

• This is a **graduate computer science class**:  
  – We expect you to know undergraduate level computer science already  
  – Don’t think you can stumble into this and succeed without knowing CS

• Other expectations  
  – Ability to do short proofs  
  – Basic probability concepts (though we will review all of this)  
  – Basic algorithmic concepts  
    • Analysis of algorithms  
    • Complexity - O(I)  
    • NP-hardness and the complexity hierarchy  
  – Math: Calculus and linear algebra

• Every year, several people drop during the semester because they aren’t prepared for the intense math/CS. Take the above seriously!
## May I Get a Permission Number?

- **We will not** be increasing the cap
  (limited to 50 students)

- Waiting list appears to be broken because class was never opened up for non-majors

- There may be room for a few non-majors

- If you are not prepared, please drop to make room for those who are

## 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 CS AI faculty
  - Complement other related offerings at Duke
Learning Objectives

• Teach students to think outside the textbook

• Teach students to teach themselves from papers rather textbooks

• Expose students to classic topics in AI as well as leading edge research

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
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 quickly

• But...
  – You might be happier in 370
  – Make sure you’ve got enough background
  – We assume you know a lot of basic CS
  – Assume a certain level of sophistication

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 of a few topics
- Vision – object and activity recognition

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

Will the class be hybrid?

• The class will be live – no recordings
• We will go hybrid + recordings if COVID gets worse
• Why not hybrid + recordings now?
  – My experience after a couple of years of hybrid teaching: Students don’t engage if they have the option of passively watching the lecture later
  – I am a better lecturer when I get questions
  – I know lots of random, interesting stuff that you will only hear about if you tease it out of me
  – Your real-time feedback will shape lectures
  – But also: My slides are pretty good and missing a lecture here or there shouldn’t be a big deal
Illness and other COVID-19 Related Issues

- Please do not come to class if you are sick (with anything) or testing positive for COVID — missing live lecture or two shouldn’t be a big deal
- Undergrads:
  - If you need a short extension (up to 48 hours) because you are sick submit a STINF
  - If you need a longer extension, email me and your academic dean
- Grads:
  - If you need a short extension (up to 48 hours) because you are sick, send me an email.
  - If you need a longer extension, email me and your DGS

Discussion, Office Hours, etc.

- We will use Ed for asynchronous discussion and all announcements:
  - Please try logging in ASAP
  - Please set your preferences for prompt notifications

- Office hours will be announced next week

- Aim for 1 live + 1 zoom office hour per staff member per week
How To Get The Most Out Of Class

- Attend class if possible

- Stay caught up:
  - Read before lectures, come prepared
  - Ask questions
  - (Re)read after lectures
  - Start homework early
  - Go to office hours

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)

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!
Homework For Next Class  
(see class web page)

- Read Turing’s classic paper on machine intelligence
- Watch Russell’s Ted Talk on Safer AI
- Bookends on the AI story
- Be prepared to discuss/ask questions on Wednesday

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: iPhone unlock, MS seeing AI, image search (objects and faces)
- Automated logistics – UPS, 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

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