1410 Team

Instructor: George Konidaris

Hours: Wed 4-5pm, CIT 447

HTAs: Leon Lei and Aansh Shah

TAs:
- Alex Liu
- Ariel Rotter-Aboyoun
- Berkan Hiziroglu
- Chris Zamarripa
- Daniel de Castro
- Deniz Bayazit
- Elizabeth Zhao
- Fawn Tong
- Husam Salhab
- Jesus Contreras
- Kaiqi Kiang
- Katie Scholl
- Maulik Dang
- Megan Gessner
- Nikhil Pant
- Roelle Thorpe
- Spencer Greene
- Troy Moo Penn
Major Topics Covered

Syllabus:

1. Agents and Agencyhood
2. Search
   (a) Uninformed
   (b) Informed
   (c) Game Theory and Adversarial Search
3. Knowledge Representation and Reasoning
   (a) Logical Representations: Reasoning and Inference
   (b) Uncertain Knowledge
      i. Bayes’ Rule
      ii. Probabilistic Reasoning
      iii. Bayes Nets
      iv. Hidden Markov Models
4. Planning
   (a) Classical Planning
   (b) Robot Motion Planning
   (c) Planning Under Uncertainty: Markov Decision Processes
5. Learning
   (a) Reinforcement Learning
   (b) Supervised Learning
   (c) Unsupervised Learning
6. Advanced Topics
   (a) Natural Language Processing
   (b) Machine Vision
   (c) Robot Learning
   (d) Algorithmic Game Theory
7. Philosophy of AI
8. Social and Ethical Issues
On Lectures

The textbook contains everything you need to know.

Lectures contain everything you need to know.

Lecture notes **do not contain everything you need to know**.

Suggested approach:

- Come to lectures and pay attention.
- Revise via textbook (immediately).
- Clarify at office hours.
Required Text

*Artificial Intelligence, A Modern Approach*
Logistics

Course webpage:
http://cs.brown.edu/courses/cs141/
  • Syllabus
  • Calendar - **office hours**!
  • Assignments etc.

Written assignments and grades etc. via Gradescope
Comms (Q&A, announcements) via Piazza
**Make sure to sign up!**
Questions

**Piazza**: Quick question, or question many people may want to know the answer to.

**UTA Hours**: Assignment and coding questions, material covered in lectures.

**GTA / Professor Hours**: Conceptual questions, or questions beyond the coursework.
Exams:
• Midterm: 15%, in class.
• Final: 15%, finals week.
• Closed book.

Six assignments
• 50% of grade.
• Python programming + report
• Generally 1-2 weeks long
• First assignment already available.

Extended project: 20%. 
Academic Honesty

I expect all Brown students to conduct themselves with the highest integrity, according to the Brown Academic Code.

It is OK to:
• Have high-level discussions.
• Google for definitions and background.

It is NOT OK TO:
• Hand in anyone else’s code, or work, in part or in whole.
• Google for solutions.

ALWAYS HAND IN YOUR OWN WORK.
Academic Honesty

Consequences of cheating:
• Your case will be reported.
• Possible consequences include zeros on the assignment, suspension, failure to graduate, retraction of job offers.

If I catch you I will refer you to the Office of Student Conduct, and I will push for a hearing with the Standing Committee.

DO NOT CHEAT.
AI
AI: The Very Idea

For as long as people have made machines, they have wondered whether machines could be made intelligent.

(pictures: Wikipedia)
(pictures: Wikipedia)
Turing


“Can machines think?”

(picture: Wikipedia)
Dartmouth, 1956
Trends
Trends
Trends

Connectionism I
Trends

Connectionism I
Trends

1940
1950
1960
1970
1980
1990
2000
2010
2020

Connectionism I

GOFAI
Trends

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Connectionism I

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Al Winter
Trends

Connectionism I

GOFAI

Connectionism II

Al Winter

Trends

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2000
2010
2020

Connectionism I

GOFAI

Connectionism II

AI Winter

Bayes

Probabilistic Reasoning in Intelligent Systems
Networks of Plausible Inference

Perceptrons

Hinton
Trends


Connectionism I

GOFAI

AI Winter

Connectionism II

Bayes
Trends


Connectionism I

GOFAI

Al Winter

Connectionism II

Bayes
Modern AI

Subject of intense study:
- Nearly every CS department has at least 1 AI researcher.
- ~ 700 PhDs a year in the US
- Thousands of research papers written every year.

- Heavily funded (NSF, DARPA, EU, etc.).
  - Pays itself back fast (e.g., DART).

- Most major companies have efforts in this direction
  - Google,
  - Amazon
  - Microsoft, etc.
Modern AI

(picture: Wikipedia)
What is AI?
Fundamental Assumption

The brain is a computer.

(picture: Wikipedia)
What is AI?

This turns out to be a hard question!

Two dimensions:

• “Humanly” vs “Rationally”
• “Thinking” vs. “Acting”.

<table>
<thead>
<tr>
<th>thinking humanly</th>
<th>thinking rationally</th>
</tr>
</thead>
<tbody>
<tr>
<td>acting humanly</td>
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What is AI?

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What is AI?

cognitive science

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What is AI?

cognitive science

thinking humanly  thinking rationally

acting humanly  acting rationally

“emulation”
What is AI?

- Cognitive science
  - Thinking humanly
  - Acting humanly
- Laws of thought
  - Thinking rationally
  - Acting rationally

“Emulation”
What is AI?

- thinking humanly
- thinking rationally
- acting humanly
- acting rationally

- cognitive science
- "emulation"
- laws of thought
- rational agents
What is a Rational Agent?

Performance measure.
What is a Rational Agent?

Performance measure.
Rational Agents

A rational agent:

• acts in its environment
• according to what is has perceived
• in order to maximize
• its expected performance measure.
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Example: Chess

Performance measure?
Environment?
Prior knowledge?
Sensing?
Actions?

(picture: Wikipedia)
Chess

The chess environment is:

- Fully observable.
- Deterministic.
- Episodic.
- Static.
- Discrete.
- “Known”.

(picture: Wikipedia)
Example: Mars Rover

Performance measure?
Environment?
Prior knowledge?
Sensing?
Actions?

(picture: Wikipedia)
The Mars Rover environment is:
  • Partially observable.
  • Stochastic.
  • Continuing.
  • Dynamic.
  • Continuous.
  • Partially known.
Are We Making Progress?

Specific vs. General
Starting out - 10 minutes of training

The algorithm tries to hit the ball back, but it is yet too clumsy to manage.

[Mnih et al., 2015]  video: Two Minute Papers
Progress

Starting out - 10 minutes of training

The algorithm tries to hit the ball back, but it is yet too clumsy to manage.

[Mnih et al., 2015]
Atari

[Mnih et al., 2015]
Structure of the Field

AI is fragmented:

- Learning
- Planning
- Vision
- Language
- Robotics
- Reasoning
- Knowledge Representation
- Search
Progress

Progress in AI:

• Clear, precise models of a class of problems
• Powerful, general-purpose tools

• A clear understanding of what each model and tool can and cannot do
Progress

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• Occasionally: vividly illustrative applications.
• Arduous and slow
Progress in AI:

- Clear, precise models of a class of problems
- Powerful, general-purpose tools
- A clear understanding of what each model and tool can and cannot do
- Occasionally: vividly illustrative applications.
- Arduous and slow
- Huge opportunity