Instructor: George Konidaris

HTAs: Rachel Ma and Jinwoo Choi

TAs:
Bowen He
Edward Tan
Jason Crowley
Jason Gong
Kevin Lu
Kunj Padh
Neil Ramaswamy
Paul Krupski
Rena Jiang
Thien Nguyen
Major Topics Covered

Syllabus:
1. Agents and Agenthood
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
Required Text

*Artificial Intelligence, A Modern Approach*
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.
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 EdStem Discussion

**Make sure to sign up!**
Questions

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

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

Six assignments
  • 75% of grade.
  • Python programming + report
  • Generally 1-2 weeks long

Extended project: 25%.

Note: basic numpy/Python workshop on Monday from 5-6pm in Motorola.
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

Connectionism I

GOFAI

Reinforcement Learning

Connectionism II

AI Winter

Deep Learning (C III)

Bayes

Probabilistic Reasoning in Intelligent Systems

Hinton

Reinforcement Learning

Modern AI

Subject of intense study:
• Nearly every CS department has at least 1 AI researcher.
• ~ 3000 PhDs a year in the US
• Tens of 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>
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<th>thinking</th>
<th>thinking</th>
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<tbody>
<tr>
<td>humanly</td>
<td>acting humanly</td>
<td>acting rationally</td>
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<tr>
<td>rationally</td>
<td></td>
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</tbody>
</table>
What is AI?

cognitive science

thinking humanly

thinking rationally

acting humanly

acting rationally

“emulation”

laws of thought

rational agents
What is a Rational Agent?

- Agent
- Program
- Sensors
- Actuators

Performance measure.
A rational agent:
- acts in its environment
- according to what is has perceived
- in order to maximize
- its expected performance measure.
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)
Mars Rover

The Mars Rover environment is:

- Partially observable.
- Stochastic.
- Continuing.
- Dynamic.
- Continuous.
- Partially known.
Are We Making Progress?

Specific vs. General

![Chessboard](image1.png)  ![Vitruvian Man](image2.png)
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
• Occasionally: vividly illustrative applications.
• Arduous and slow

• Huge opportunity