CS440 - Introduction to Artificial Intelligence

Course staff
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Course website
- Web Site: www.cs.colostate.edu/~cs440
- What you can find there:
  - All slides (hopefully before class so you can print and take notes on them)
  - All homework assignments
  - RAMCT: only grades
  - Piazza: discussion board and announcements

Textbook

Workload
- Programming/written assignments (~6)
  - Language: Python
- Project
- Exams (midterm/final): take home exams

Grading
- Assignments: 40%
- Project: 25%
- Exams: midterm: 15%
  - final: 20%
Course Outline

- Search: How to explore the space of potential solutions to a problem.
- Logic: How to make inferences from stored/learned knowledge.
- Learning: How can a computer learn from data.
- + brief discussion of other topics

CSU AI Faculty

- Darrell Whitley: Genetic algorithms, search problems
- Adele Howe: Planning
- Ross Beveridge: Computer vision (face recognition)
- Bruce Draper: Computer vision (biologically inspired vision, action recognition, face recognition)
- Charles Anderson: Machine learning/computational neuroscience
- Asa Ben-Hur: Machine learning in bioinformatics

What is Artificial Intelligence?

Press View

What is Artificial Intelligence?

Movie View

All images are movie posters taken from imdb.com.

What is Artificial Intelligence?

Let’s explore some possible definitions.
AI: Think Like Humans

- “The exciting new effort to make computers think … machines with minds, in the full and literal sense”
  Haugeland, 1985

AI: Act Like Humans

- “The art of creating machines that perform functions that require intelligence when performed by people” Kurzweil, 1990

The Turing Test

- When does a system behave intelligently?
  - Turing (1950) Computing Machinery and Intelligence
  - Operational test of intelligence

  - Requires the successful application of major fields of AI: knowledge representation, reasoning, natural language processing, machine learning

Role of the Turing Test

- To articulate a performance goal.
- To avoid defining intelligence.
- How significant is the Turing test?
  - How would you administer it?
  - What would you ask?
  - Would we all agree on the outcome?
- How close are we?
IBM’s Watson

AI: Think Rationally

“The study of the computations that make it possible to perceive, reason, and act.” Winston 1992

Thinking rationally

- Rationality as captured by logic.
- Problems:
  - Not all intelligent behavior is mediated by logical deliberation
  - What is the purpose of thinking? What thoughts should I (bother to) have?

AI: Acting Rationally

- “A field of study that seeks to explain and emulate intelligent behavior in terms of computation processes” Schalkoff, 1990
- “The branch of computer science that is concerned with the automation of intelligent behavior” Luger and Stubblefield
- Rational behavior: doing the right thing
  - The “right thing” is that which is expected to maximize goal given the available information.
- Our focus: rational agents, and how to construct them.

What is AI?

Definitions of artificial intelligence:

<table>
<thead>
<tr>
<th>Systems that think like humans</th>
<th>Systems that think rationally</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systems that act like humans</td>
<td>Systems that act rationally</td>
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- The definitions vary by:
  - Thought processes vs. action
  - Judged according to human standards vs. success according to an ideal concept of intelligence.

Tools

- Lisp
  - The traditional AI language
- Python
  - More common in AI research these days
- Prolog
  - Logic programming: fundamentally different!
Application areas

- Planning: What to do when.
- Computer vision: Seeing is knowing.
- Speech recognition: What words are spoken.
- Natural language processing (NLP): What do the words mean.

AI is pervasive in our everyday lives

1. Check email [spam filter, security agent]
2. Read news [personalized information agent]
3. Drive to work [traffic light control, collision avoidance, route planning]
4. Teach [search engine]
5. Work on research projects [search engine]
6. Go grocery shopping [market basket analysis, fraud detection]
7. Talk with customer service [voice recognition]
8. Have dinner [search engine]
9. Watch video [collaborative filtering]

AI Systems: Some Milestones

- Deep Blue: Defeats Kasparov, Chess Grand Master - IBM 1997
- DARPA grand challenge 2005: 130 mile race of driverless cars in the desert.
- Curiosity Mars rover 2012

The google driverless car


AI Technologies: Computer Vision

AI Technologies: Natural Language Understanding
AI Technologies: Robotics

Texas A&M
DARPA challenge

Search and rescue

MBARI Fish tracking

AI in Medicine

Mundane Versus Expert Tasks

Mundane
- Identifying objects in an image
- Answering a question
- Picking up an arbitrary object

Expert
- Chess
- Medical diagnosis
- Configuring computer hardware (circuit layout)
- Special purpose robots

Foundations of AI

- Philosophy: Logic, reasoning, rationality.
- Mathematics: Logic, computability, tractability
- Psychology: understanding how humans think and act.
- Neuroscience: how do brains process information?
- Economics: theory of rational decisions, game theory.
- Computer Engineering: building the hardware and software that make AI
- Linguistics: how to deal with language

Beware of combinatorics!

- "Solvable in Principle": little help in practice
- Beware of intractability…
  - Considering all possibilities often leads to correct, but intractable, algorithms.
  - Intractable means exponential time to solution.
- NP-Complete Problems
- Class of intractable problems

Foundations of AI: Neuroscience

Use ideas from neuroscience to design computer architectures that “learn”.

One View: AI proposes imperfect, but practical, algorithms to solve NP-Complete problems.

Artist's depiction of a neural network.
http://www.bing.com/images/search?q=neural+network
Abstraction as an artificial neural network.
http://en.wikipedia.org/wiki/Facet+network
Primary Areas of AI

- Knowledge Representation
- Automated Reasoning
- Game Playing
- Planning
- Machine Learning
- Search and Optimization
- Computer Vision
- Robotics
- Natural Language Processing