What is AI?

http://xkcd.com/329/
COMPUTER SCIENCE DEPARTMENT PICNIC

Welcome to the 2019-2020 Academic year!

Meet your faculty, department staff, and fellow students in a social setting. Food and drink will be provided.

When: Saturday, August 31st
Time: 1pm-4pm
Where: City Park Shelter #7
Course staff

- Instructor: Asa Ben-Hur
  - Office: 448
  - Office Hours: TBD
  - Email: asa at cs dot colostate dot edu

- Teaching Assistants:
  - Sadaf Ghaffari
  - Ameni Trabelsi
Course website

- Web Site: [www.cs.colostate.edu/~cs440](http://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
- Canvas: only grades
- Piazza: discussion board and announcements
Workload

- Programming/written assignments (~6)
  Language: Python
- Project
- Midterm exam
- Canvas quizzes
Grading

- Assignments: 45%
- Project: 25%
- Midterm: 20%
- Canvas quizzes: 10%
AI in popular culture

All images are movie posters taken from imdb.com.
Should we be worried about AI?

Within thirty years, we will have the technological means to create superhuman intelligence. Shortly after, the human era will be ended

—"The Coming Technological Singularity" by Vernor Vinge, 1993
Issues in the prevalence of AI systems

- Is the system safe?

- Can we hold the system accountable? (The role of explainable AI)

- Is the system fair?
What is AI?

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: Think Like Humans

- How do humans think?
  - Requires understanding of brain activity (cognitive model).

- The available theories do not explain anything resembling human intelligence!
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 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?
The Turing Test

CAPTCHA: Acronym for: "Completely Automated Public Turing test to tell Computers and Humans Apart"

http://xkcd.com/632/
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?

<table>
<thead>
<tr>
<th>Systems that <strong>think like humans</strong></th>
<th>Systems that <strong>think rationally</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Systems that <strong>act like humans</strong></td>
<td>Systems that <strong>act rationally</strong></td>
</tr>
</tbody>
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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.
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

http://www.grandchallenge.org/

The Curiosity rover
The google driverless car

AI Technologies:
Natural Language Understanding

Now ask even more of Siri.

With iOS 6, Siri understands more languages and works in more countries. So you can get more things done in more places around the world. Want to know the latest scores and stats for your favorite teams and players? Thanks to iOS 6, Siri knows the answers. Or maybe it’s movie night. Siri can show you the latest reviews and showtimes. Find the best restaurants in town and make reservations. Even have Siri open your apps for you — no tapping required. Say "Launch Flight Tracker" or "Open Angry Birds" and Siri does just that. You can also use Siri to post Facebook updates and tweet for you. Learn more about Siri.
AI Technologies: Robotics

Boston Dynamics
DARPA challenge

Texas A&M
Search and rescue

MBARI Fish tracking
AI in Medicine

- Disease diagnosis
- Patient monitoring
- Detection of disease using imaging modalities such as CT, X-rays etc.
- Analysis of electronic health records
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

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

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

Artist’s depiction of a neural network
http://www.bitspin.net/images/neuron.jpg

Abstraction as an artificial neural network
http://en.wikipedia.org/wiki/Neural_network
Show a demo of google translate
Areas of AI

- Search: Find a solution.
- 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.
- Machine learning
- Game playing
- Robotics
## CSU AI Faculty

- **Darrell Whitley**  
optimization, genetic algorithms, ML
- **Ross Beveridge**  
Computer vision
- **Bruce Draper**  
Computer vision
- **Nathaniel Blanchard**  
Computer vision
- **Charles Anderson**  
Machine learning / computational neuroscience
- **Asa Ben-Hur**  
Machine learning in bioinformatics
- **Hamid Chitsaz**  
Machine learning in bioinformatics
Show blocks world video

http://www.cs.colostate.edu/~draper/home_research.php
Tools

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