CSE 571: Artificial Intelligence

Instructor: Dr. Yu (“Tony”) Zhang

Lecture: COOR L1-74, Tue/Thu, 4:30—5:45 PM

Office Hours: BYENG 594, Tue/Thu, 3:00—4:00PM

TURING TEST EXTRA CREDIT: CONVINCE THE EXAMINER THAT HE’S A COMPUTER.

YOU KNOW, YOU MAKE SOME REALLY GOOD POINTS.

I’M ... NOT EVEN SURE WHO I AM ANYMORE.
The current research focus of Cooperative Robotic Systems (CRS) Lab is on the theories and practices of areas within the broad fields of artificial intelligence and robotics, as well as emerging interdisciplinary research areas that integrate these two fields (e.g., humans in the loop of automated systems and cyber-physical systems). The goal of our research is to bring humans and automated systems seamlessly together to improve our everyday lives (e.g., in smart homes and for elderly care), and to achieve complex tasks that has never been achieved before (e.g., human-robot teaming in urban search and rescue and decision support systems). To accomplish this, new technologies must be developed to extend traditional Perception and Modeling, Decision Making, Learning and Adaptation and Communication capabilities of intelligent agents to allow them to work with humans in the loop (Check out CRS publications HERE):

http://www.public.asu.edu/~yzhan442/CRS.html
CSE 571: Artificial Intelligence

TAs:
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Office Hours:
BYENG M1-30
Ze: Wednesday 2:00-4:00PM
Akku: Monday 2:00-4:00PM

https://xkcd.com/329/
What is AI?
What is intelligence?

AI BOOK: The ability to perceive, understand, predict, and interact with a world

Artificial Intelligence
The science of making machines intelligent
What is AI?

Think like people

Think rationally

Act like people

Act rationally

from http://ai.berkeley.edu
Think like human

• Cognitive science

• Must understand human brain – necessarily based on experimental investigation

➢ Human is just an example of intelligent agent
➢ Human brains are too complex to study
Act like human: The Turing Test

from wiki
To pass the Turing Test, we need:

• natural language processing to communicate with humans successfully
• knowledge representation to store what it knows or hears
• automated reasoning to use the stored information to answer questions and draw new conclusions
• machine learning to adapt to new circumstances and detect and extrapolate patterns
• computer vision to perceive objects
• robotics to manipulate objects and move them about (Total Turing Test)

- Human is just an example of intelligent agent
  • humans are to intelligence as birds are to flight
- Human sometimes may not do intelligent things:
  • Make mistakes, etc.
- Computers can do better than human in many things
Think rationally

• Aristotle: right thinking

• logic reasoning, e.g., *Socrates is a man; all men are mortal* → *therefore, Socrates is mortal.*

➢ Intelligence may not require a brain (e.g., reflexes)!
Act rationally

• **Rational agent**
  
  Rational acting may not always be the result of rational thinking
  
  • Reflex may also be acting rationally
  
  • You may have to act even though you cannot be sure it is rational

More general than thinking rationally

➢ The view of AI taken in the textbook and this class
History of AI

1 AI in myth, fiction and speculation
2 Automatons
3 Formal reasoning
4 Computer science
5 The birth of artificial intelligence 1952–1956
   5.1 Cybernetics and early neural networks
   5.2 Turing's test
   5.3 Game AI
   5.4 Symbolic reasoning and the Logic Theorist
   5.5 Dartmouth Conference 1956: the birth of AI
6 The golden years 1956–1974
   6.1 The work
      6.1.1 Reasoning as search
      6.1.2 Natural language
      6.1.3 Micro-worlds
   6.2 The optimism
   6.3 The money
   6.4 Robotics
7 The first AI winter 1974–1980
   7.1 The problems
   7.2 The end of funding
   7.3 Critiques from across campus
   7.4 Perceptrons and the attack on connectionism
   7.5 Utilizing logic and symbolic reasoning
   7.6 Another approach: frames and scripts
8 Boom 1980–1987
   8.1 The rise of expert systems
   8.2 The knowledge revolution
   8.3 The money returns: the Fifth Generation project
   8.4 The revival of connectionism
9 Bust: the second AI winter 1987–1993
   9.1 A New and Different AI winter
   9.2 The importance of having a body: nouvelle AI and embodied reason
10 AI 1993–2011
   10.1 Milestones and Moore’s law
   10.2 Intelligent agents
   10.3 Implementation of Rigor
   10.4 AI behind the scenes
   10.5 Predictions
11 Deep learning, big data and artificial general intelligence: 2011–present
   11.1 Deep learning
   11.2 Big Data
   11.3 Artificial general intelligence
AI is booming!
AI in the Future

Reality

Haha that's adorable, the funny robot can do monkey tricks!

The fuck??

Intelligence

Time

EINSTEIN
DUMB HUMAN

CHIMP

AI INTELLIGENCE

BIRD

ANT

waitbutwhy.com
What can AI do now

Which of the following can be done at present?

✓ Play a decent game of table tennis?
What can AI do now

Which of the following can be done at present?

✔️ Play a decent game of table tennis?
✔️ Play a decent game of Jeopardy?
What can AI do now

Which of the following can be done at present?

✓ Play a decent game of table tennis?
✓ Play a decent game of Jeopardy?
✓ Drive safely in Tempe (always)?
What can AI do now

Which of the following can be done at present?

✔ Play a decent game of table tennis?
✔ Play a decent game of Jeopardy?
✔ Drive safely in Tempe (always)?
✔ Discover and prove a new (and useful) mathematical theorem?
What can AI do now

Which of the following can be done at present?

✓ Play a decent game of table tennis?
✓ Play a decent game of Jeopardy?
✓ Drive safely in Tempe (always)?
✓ Discover and prove a new (and useful) mathematical theorem?
✓ Converse successfully with another person? For an hour?

images from online
What can AI do now

Which of the following can be done at present?

- ✔ Play a decent game of table tennis?
- ✔ Play a decent game of Jeopardy?
- ✔ Drive safely in Tempe (always)?
- ✔ Discover and prove a new (and useful) mathematical theorem?
- ✔ Converse successfully with another person? For an hour?
- ✗ Perform a surgical operation?
What can AI do now

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- Play a decent game of table tennis?
- Play a decent game of Jeopardy?
- Drive safely in Tempe (always)?
- Discover and prove a new (and useful) mathematical theorem?
- Converse successfully with another person? For an hour?
- Perform a surgical operation?
- Put away the dishes and fold the laundry (if not sped up)?
What can AI do now

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- Discover and prove a new (and useful) mathematical theorem?
- Converse successfully with another person? For an hour?
- Perform a surgical operation?
- Put away the dishes and fold the laundry (if not sped up)?
- Translate spoken Chinese into spoken English in real time?
What can AI do now

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✓ Play a decent game of table tennis?
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✓ Drive safely in Tempe (always)?
✓ Discover and prove a new (and useful) mathematical theorem?
✓ Converse successfully with another person? For an hour?
✓ Perform a surgical operation?
✓ Put away the dishes and fold the laundry (if not sped up)?
✓ Translate spoken Chinese into spoken English in real time?
✓ Tell an intentionally funny story?
Natural language understanding

- **Speech technologies**
  - Automatic speech recognition
  - Text-to-speech synthesis
  - Dialog systems

- **Language processing technologies**
  - Question answering
  - Machine translation

- **Web searches**
Autonomous driving

Stanley: 132 miles
2005 DARPA Grand Challenge

Google: 1,725,911 miles, June 2016

Based on Google's own accident reports, their test cars have been involved in 14 collisions, of which human drivers were at fault 13 times. It was not until 2016 that the car's software caused a crash.
Game playing

- Classic Moment: May, '97: Deep Blue vs. Kasparov
  - First match won against world champion
  - “Intelligent creative” play
  - 200 million board positions per second
  - Humans understood 99.9 of Deep Blue's moves
  - Can do about the same now with a PC cluster

- Open question:
  - How does human cognition deal with the search space explosion of chess? $\sim 10^{47}$
  - Or: how can humans compete with computers at all??

- 1996: Kasparov Beats Deep Blue
  “I could feel --- I could smell --- a new kind of intelligence across the table.”

- 1997: Deep Blue Beats Kasparov
  “Deep Blue hasn't proven anything.”

- Huge game-playing advances recently, e.g. in Go! $\sim 10^{170}$
Decision making

- Scheduling, e.g. airline routing, military
- Route planning, e.g. Google maps
- Medical diagnosis, e.g., IBM Watson health
- Spam classifiers
- Fraud detection
- Product recommendations
- … Lots more!
Vision

- Object and face recognition
- Scene segmentation
- Image classification

https://www.youtube.com/watch?v=uG2UOasIx2I
Robotics

• Robotics
  • Manufacturing Factory
  • Warehouse
  • Rescue (not yet)
  • ...

DARPA Robotics Challenge

The first DARPA challenge was held in 2004

https://www.youtube.com/watch?v=fRj34o4hN4I

Images from online
Designing an intelligent agent

Action rationally!

- An agent is an entity that *perceives* and *acts*; a rational agent selects actions (via reasoning or reflex) to maximize its performance.

- Characteristics of the performance (expected utility), environment, actuators and sensors dictate techniques for selecting rational actions.

- This course is about:
  - How rational agents act/behave in different settings to maximize its performance.
Topics

• Problem solving

• Knowledge and reasoning

• Reasoning under uncertainty

• Decision making under uncertainty

• Learning
Syllabus

It's in the syllabus.

This message brought to you by every instructor that ever lived.

www.phdcomics.com
Outline for today

• Introduction to AI
• Views of AI
• AI history, now and future
• Popular AI applications
• Discussion of Syllabus

• Recommended reading:
  o R&N: Chapter 1