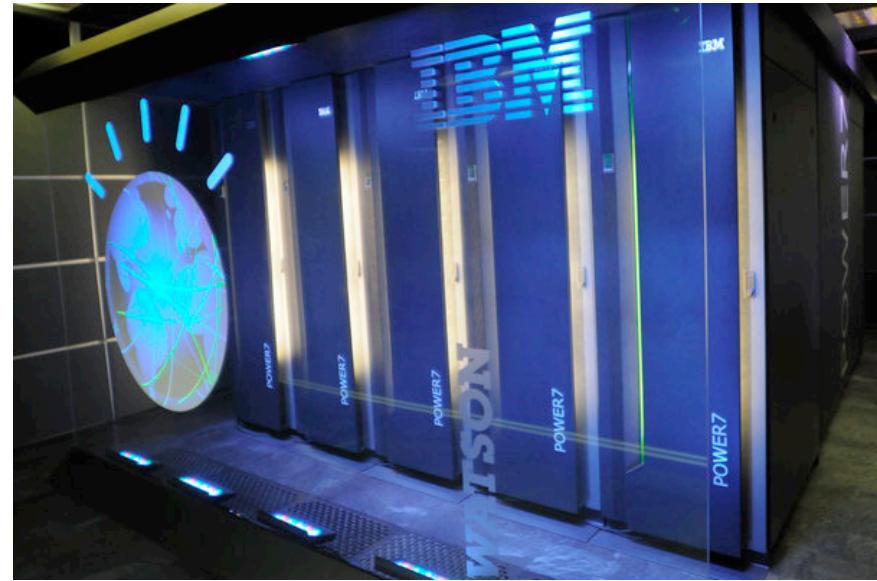


CS10: The Beauty and Joy of Computing

Artificial Intelligence

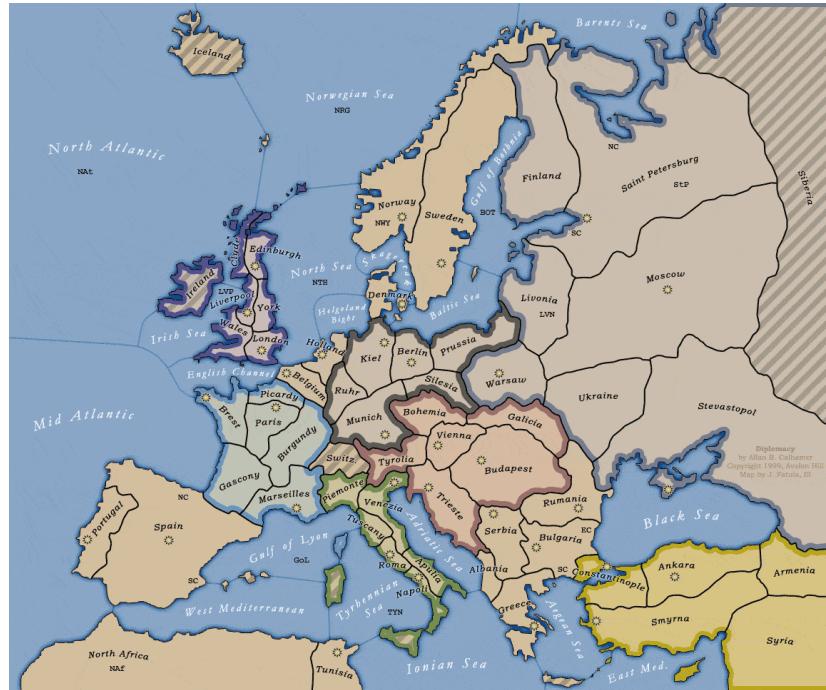


Jonathan Kummerfeld
(Slides adapted from Dan Garcia)
24 July 2014

What I Do...

Building a system that
understands player
communication in a game

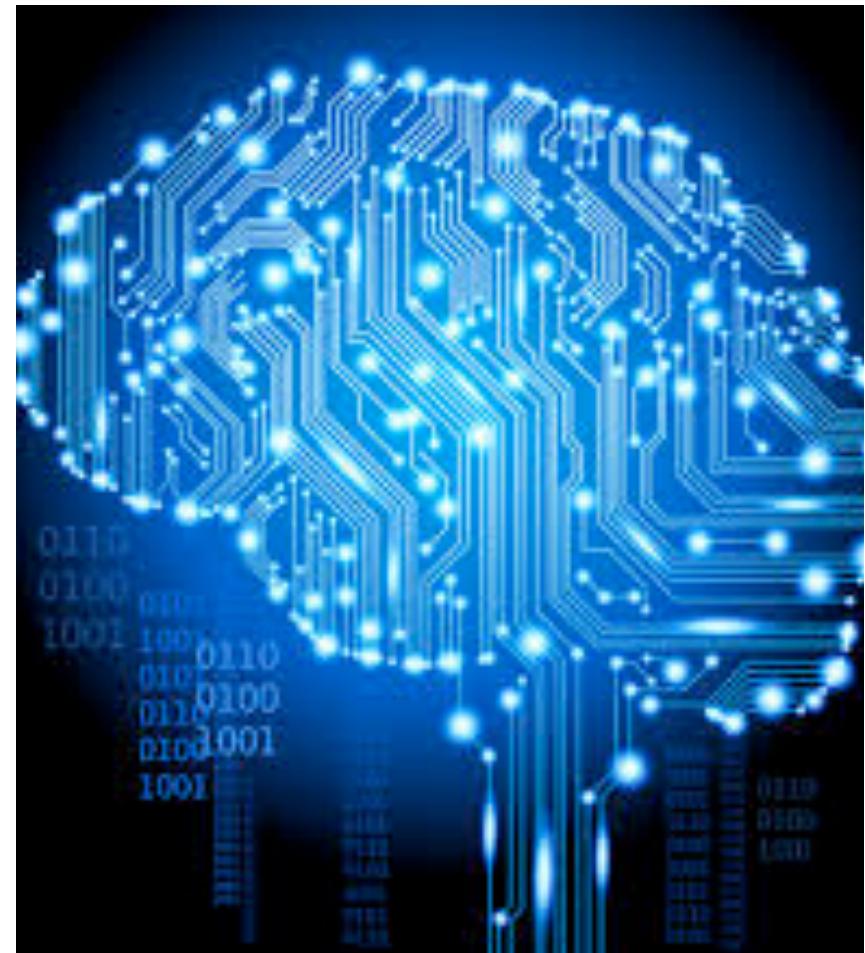
```
Sentence 13:  
8 Initial errors  
0 on fringe, 1 iterations  
8 Error:Clause Attachment  
Step:UNSET init  
{'classified_type': 'UNSET init', 'type': 'init'}  
CROOT  
  CS  
    CS  
      (NP We)  
      (VP  
        (MD would)  
        (VP  
          (VB have)  
          CS  
            (VP  
              (TO to)  
              (VP  
                (VB wait)  
                CSBAR CSBAR  
                (IN until)  
                CS CS  
                  (NP we)  
                  (VP (VP  
                    (VBP have)  
                    (VP  
                      (VP  
                        (VBN collected)  
                        (PP on those assets) VP S SBAR)  
                        (SBAR before we can move forward)))))))))))  
          (NP he)  
          (VP said)))
```



Building tools that work
out errors made by AI
systems for text

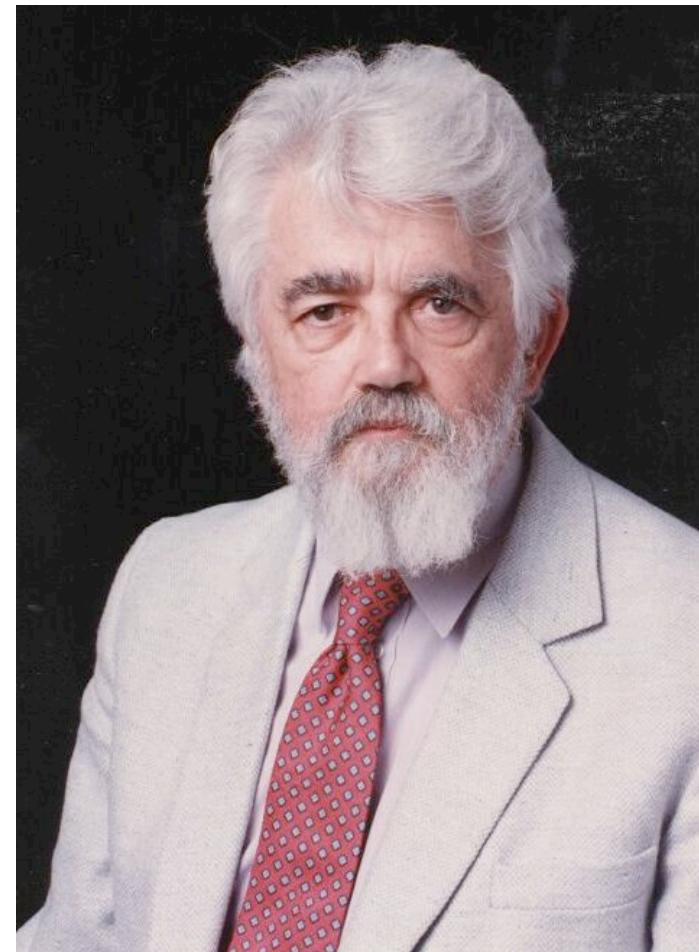
Lecture Overview

- What is AI?
- Some AI history: AI winter and the resurgence!
- Tour of areas of AI
- Philosophy: What would it mean for a program to be intelligent?



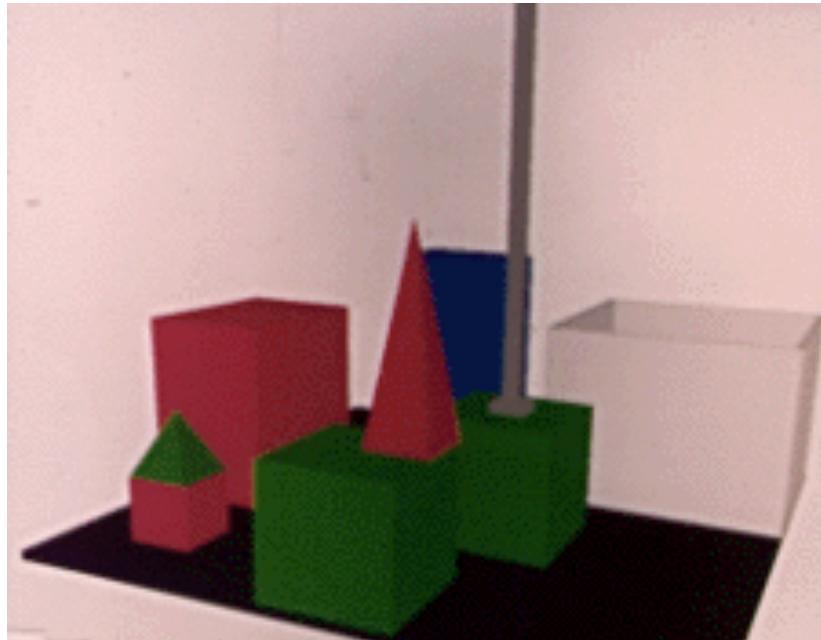
AI Definition by John McCarthy

- “Getting a computer to do things which, when done by people, are said to involve intelligence”
- Finesses the idea of whether a computer has consciousness, whether they have rights, etc.



A little history...

- Early AI (1956-early 1970s): symbolic reasoning and lots of optimism
- Neural nets (but very simple)



Person: PICK UP A BIG RED BLOCK.

Computer: OK. (does it)

Person: GRASP THE PYRAMID.

Computer: I DON'T UNDERSTAND WHICH PYRAMID YOU MEAN.

Person: FIND A BLOCK WHICH IS TALLER THAN THE ONE YOU ARE HOLDING AND PUT IT INTO THE BOX.

Computer: BY "IT", I ASSUME YOU MEAN THE BLOCK WHICH IS TALLER THAN THE ONE I AM HOLDING.

Computer: OK. (does it)



Clicker Question

- Which of these rules is true for all dogs?
 - (A) Has four legs
 - (B) Has fur
 - (C) Barks
 - (D) None of the above



(Image from: http://vision.stanford.edu/resources_links.html)

Revival of AI: Big Ideas

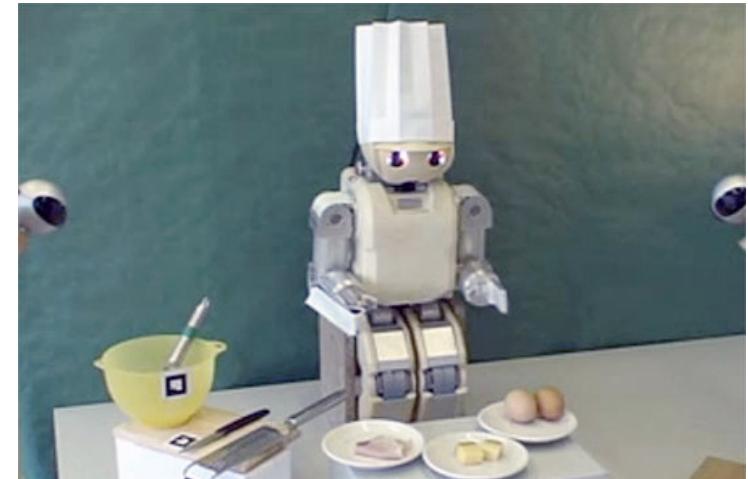
- Brittle rules break down in the real world
- Probability and uncertainty
- No “dog rule” – instead: what is the probability that the thing we’re seeing is a dog?
- Increased computational power and larger datasets



What intelligent things do people do?

Imagine cooking a meal with your roommates...

- Planning
- (Machine) Learning
- Natural Language Processing
- Motion and manipulation
- Perception
- Creativity



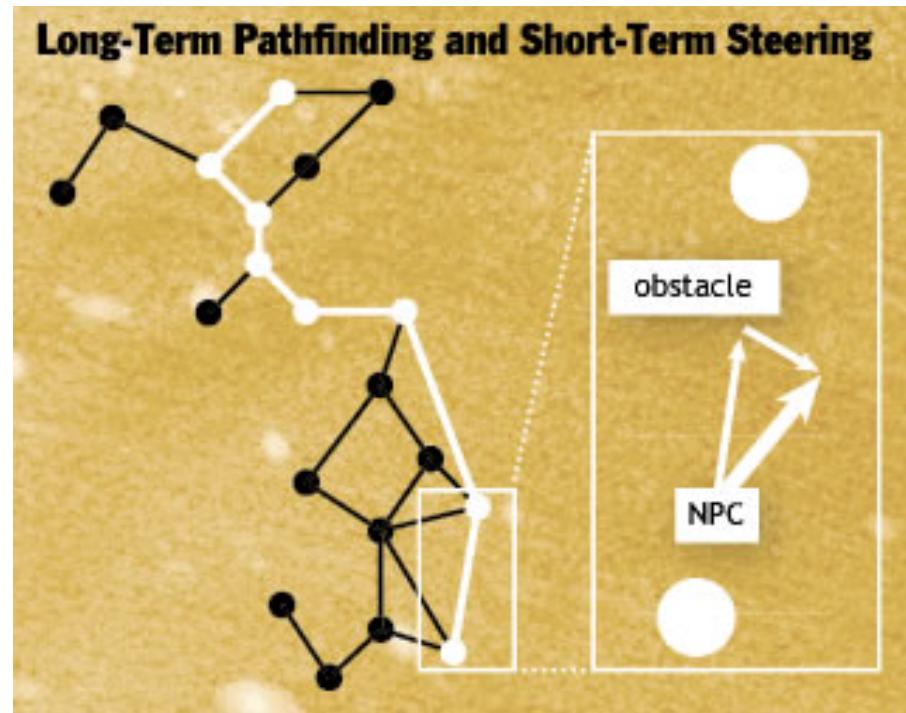
Tour of AI Applications

- Questions to keep in mind:
 - How would you evaluate how well a machine performed on the tasks we talk about?
 - How can blending artificial and human intelligence make tasks simpler, even if the AI isn't perfect?



Planning

- Range of intelligence
 - Low: simple rules
 - Medium: pathfinding
 - High: Learns from player
- Dynamic difficulty - adjust to player's skill
- Allocation of resources
 - E.g., choose what land resources to give to which conservation projects



www.businessweek.com/innovate/content/aug2008/id20080820_123140.htm

en.wikipedia.org/wiki/Dynamic_game_difficulty_balancing

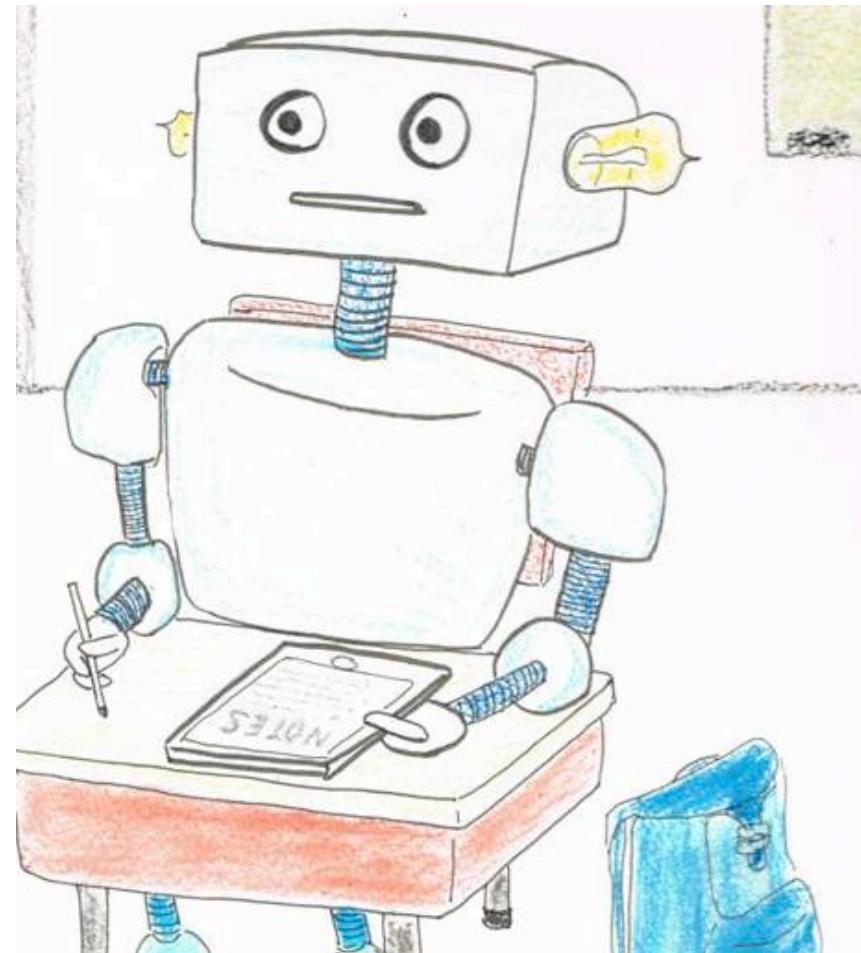
en.wikipedia.org/wiki/Game_artificial_intelligence

queue.acm.org/detail.cfm?id=971593



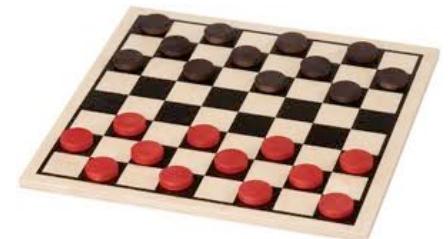
Machine Learning

- “A program learns if, after an experience, it performs better”
- Machine learning enables a program to act without behavior being explicitly programmed.
- Need to discover the right generalizations



Machine Learning

- Algorithm Types
 - Supervised learning
 - Give a system input & output training data, and it produces a classifier
 - Unsupervised learning
 - Determine how data is organized or clustered
 - Reinforcement learning
 - No training data, real-time corrections adjust behavior



Clicker question

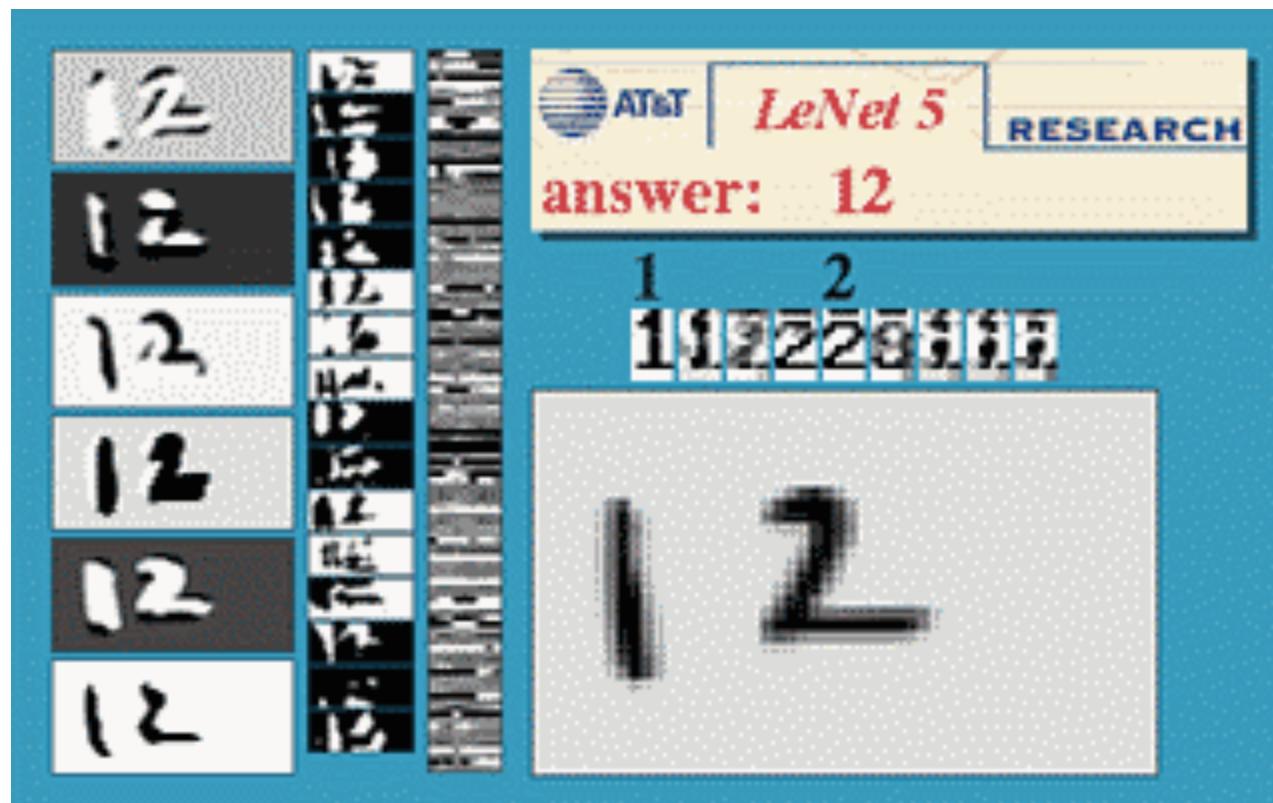
You want to make a spam filter that can tell you if an email is spam or not. What might be some good features for your algorithm?

- (a) The full text of each email you've marked as spam
- (b) Individual sentences from emails marked as spam or not spam
- (c) Character counts (e.g., \$ seen 54 times in spam emails, A seen 85 times in spam email)
- (d) Words from emails marked as spam or not spam



Example: Deep Learning

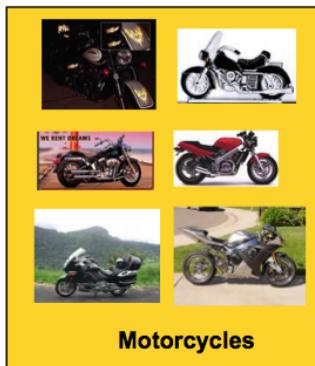
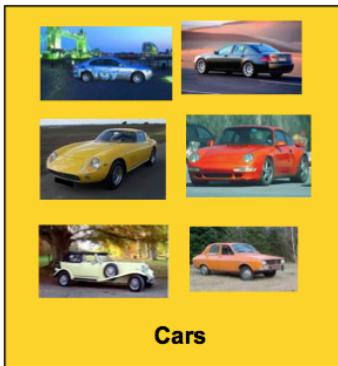
- Combines supervised and unsupervised learning:
Learn the right *representations* for input -> output



Benefiting from Big Data

A screenshot of a web-based translation tool. At the top, there's a "Translate" button with dropdown menus for "From: English" and "To: Spanish". Below the button is a text input field containing the English sentence "Translation works better with lots of data.". To the right of the input field is the translated Spanish sentence "Traducción funciona mejor con un montón de datos.". The interface includes language selection buttons for Spanish, English, and Italian, and a toolbar with icons for copy, paste, and other functions.

Translation



Computer vision

A screenshot of the Netflix Prize Leaderboard. The page has a yellow header with the text "Netflix Prize". Below the header, there are navigation links for Home, Rules, Leaderboard, Register, Update, Submit, and Download. The main content area is titled "Leaderboard" and shows a table of results. A filter "Display top 20 leaders." is visible above the table. The table columns include Rank, Team Name, Best Score, Improvement, and Last Submit Time. The top entry is "BellKor's Pragmatic Chaos" with a Best Score of 0.8558 and an Improvement of 10.05.

Leaderboard

| Rank | Team Name | Best Score | Improvement | Last Submit Time |
|--|---|------------|-------------|---------------------|
| 1 | BellKor's Pragmatic Chaos | 0.8558 | 10.05 | 2009-06-26 18:42:37 |
| Grand Prize - RMSE <= 0.8563 | | | | |
| 2 | PragmaticTheory | 0.8582 | 9.80 | 2009-06-25 22:15:51 |
| 3 | BellKor in BigChaos | 0.8590 | 9.71 | 2009-05-13 08:14:09 |
| 4 | Grand Prize Team | 0.8593 | 9.68 | 2009-06-12 08:20:24 |
| 5 | Dace | 0.8604 | 9.56 | 2009-04-22 05:57:03 |
| 6 | BigChaos | 0.8613 | 9.47 | 2009-06-23 23:06:52 |
| Progress Prize 2008 - RMSE = 0.8616 - Winning Team: BellKor in BigChaos | | | | |
| 7 | BellKor | 0.8620 | 9.40 | 2009-06-24 07:16:02 |
| 8 | Gravity | 0.8634 | 9.25 | 2009-04-22 18:31:32 |
| 9 | Opera Solutions | 0.8638 | 9.21 | 2009-06-22 05:53:30 |
| 10 | xvector | 0.8639 | 9.20 | 2009-06-26 13:49:04 |
| 11 | xiangliang | 0.8639 | 9.20 | 2009-06-26 07:47:34 |
| 12 | BruceDengDiaoCiYiYou | 0.8641 | 9.18 | 2009-06-02 17:08:31 |
| 13 | Ces | 0.8642 | 9.17 | 2009-06-24 14:34:14 |
| 14 | majia2 | 0.8642 | 9.17 | 2009-06-23 08:07:50 |

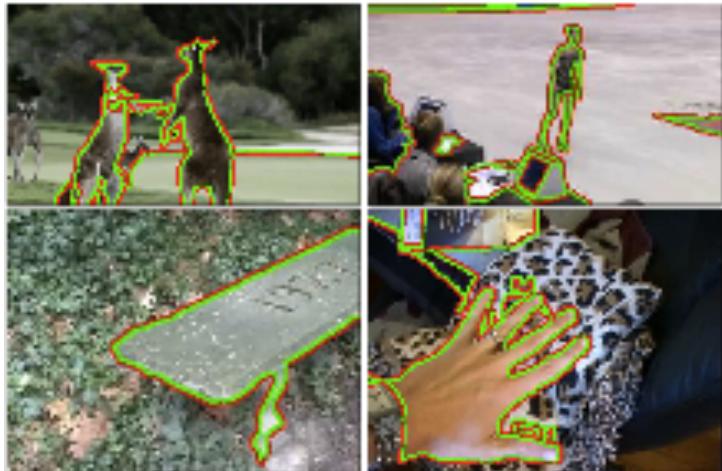
Recommendation

More examples help algorithms recognize trends and similarities across instances.

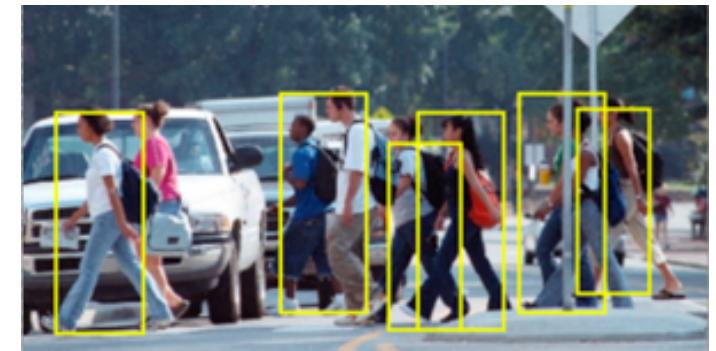


Vision

- Tasks related to understanding images/camera input



Figure/ground
segmentation



Pedestrian detection



Action
recognition

phoning



(Some images from Berkeley vision group)

Natural Language Processing

- Known as “AI-complete” problem
 - (Often) requires extensive knowledge of world
- Statistical NLP
 - Correcting/guessing text
 - Suggesting news stories
 - Finding articles that are similar to one another
 - Translate or paraphrase texts



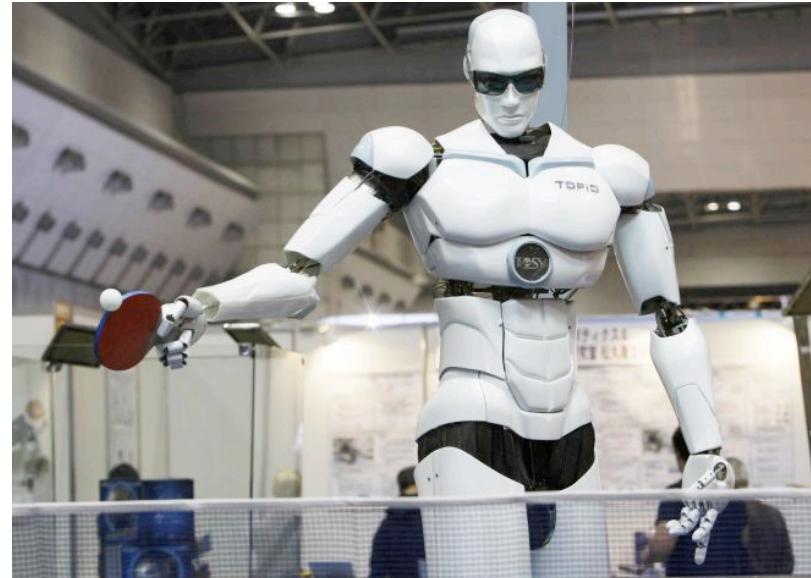
Robotics

- For many, the coolest and scariest part of AI
- Combines fields of AI/CS
 - Speech recognition
 - Synthetic voice
 - Machine vision
 - Planning
 - HCI



Assistive robots

Surgical robots



TOPIO, the ping-pong playing robot



UC Berkeley's
towel-folder



Autonomous
helicopter



Recap

- All of these applications are tough because they require:
 - Knowing about context
 - Uncertainty about input
 - Intensive computations
- But AI has been relatively successful at making progress (and in some cases, better than people!)



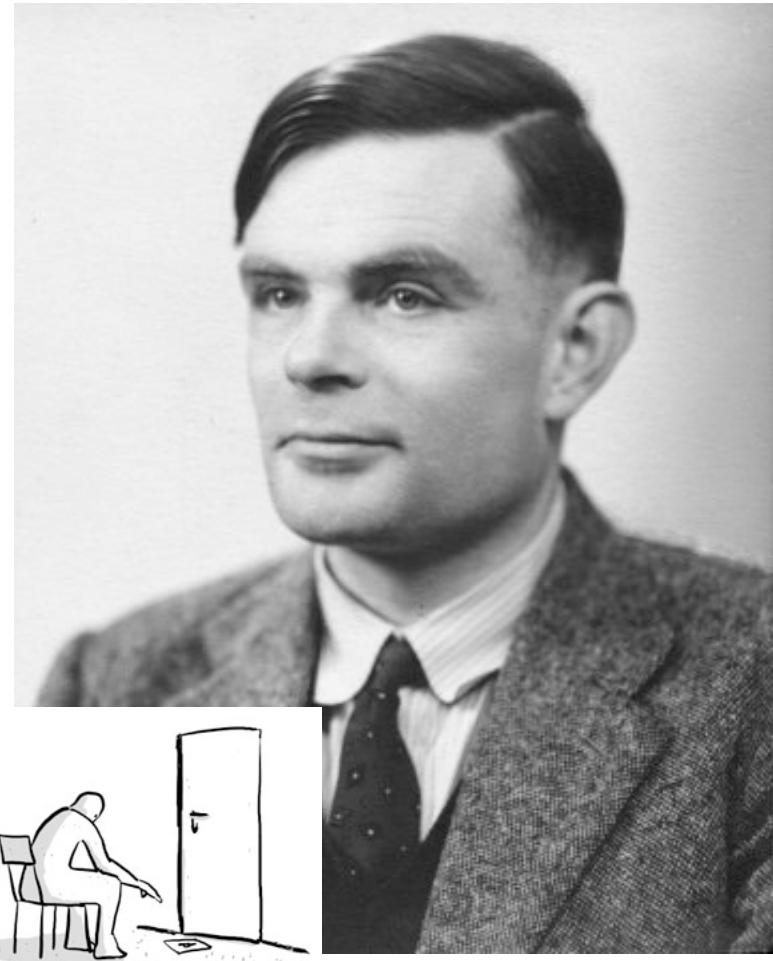
Clicker Question

- What would a “truly intelligent” AI system look like?
 - (A) Behaves in an optimal or rational manner
 - (B) Behaves similarly to people – when it makes errors, those errors are similar to people’s errors
 - (C) Carries out the same type of processing (mental representations) people do – i.e., thinks like people



Turing Test for Intelligence

- In 1950, Turing defined a test of whether a machine could “think”
- “A human judge engages in a natural language conversation with one human and one machine, each of which tries to appear human. If judge can’t tell, machine passes the Turing test”
- John Searle argued against the test via the Chinese room experiment, in which someone carries on a conversation by looking up phrases in a book. Does that person understand Chinese?



en.wikipedia.org/wiki/Turing_test



Summary

- AI systems excel in things computers are good at
 - Big data (using web to parse language)
 - Constrained worlds (chess, math)
- It's getting better at...
 - Language understanding
 - Real-time robotics
- Lots more applications that I didn't have time to talk about!
- CS188: Artificial Intelligence
 - One of the most popular courses on campus!
- CogSci131: Computational Models of Cognition



Thanks! Feel free to email me with questions at jkk@cs.berkeley.edu

