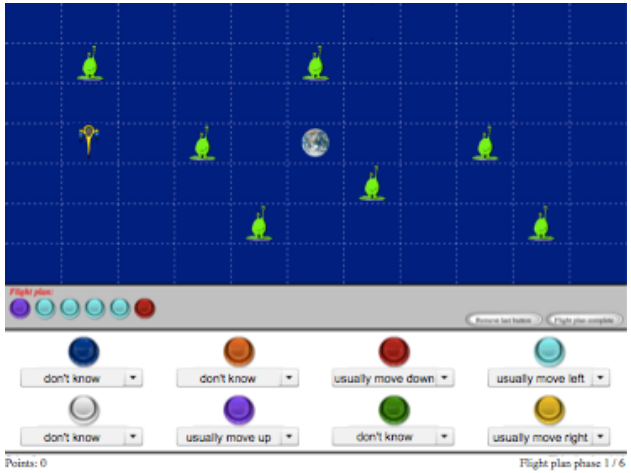
CS10: The Beauty and Joy of Computing

Artificial Intelligence

Anna Rafferty
(Slides adapted from Dan Garcia)
3 April 2013

What I Do…

- Model human learning using machine learning
- Adaptive instruction and feedback in computer-based educational environments
- E.g., diagnose a student's knowledge by watching her play a game



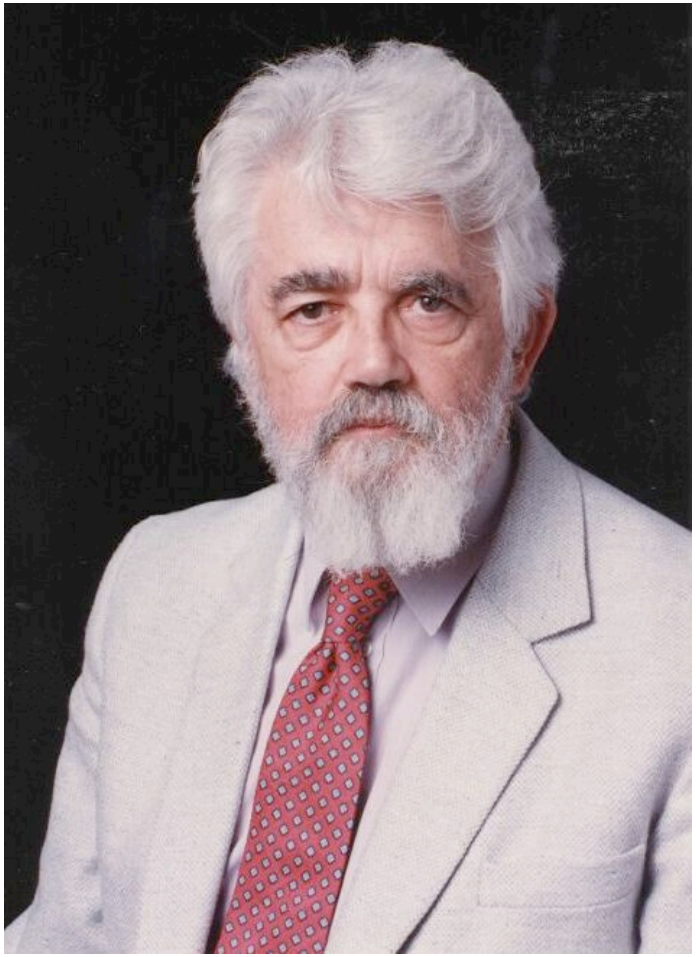
Lecture Overview

- Definition
- Some AI history
- Tour of areas of AI
- Turing Test and the Chinese room

AI Definition by John McCarthy

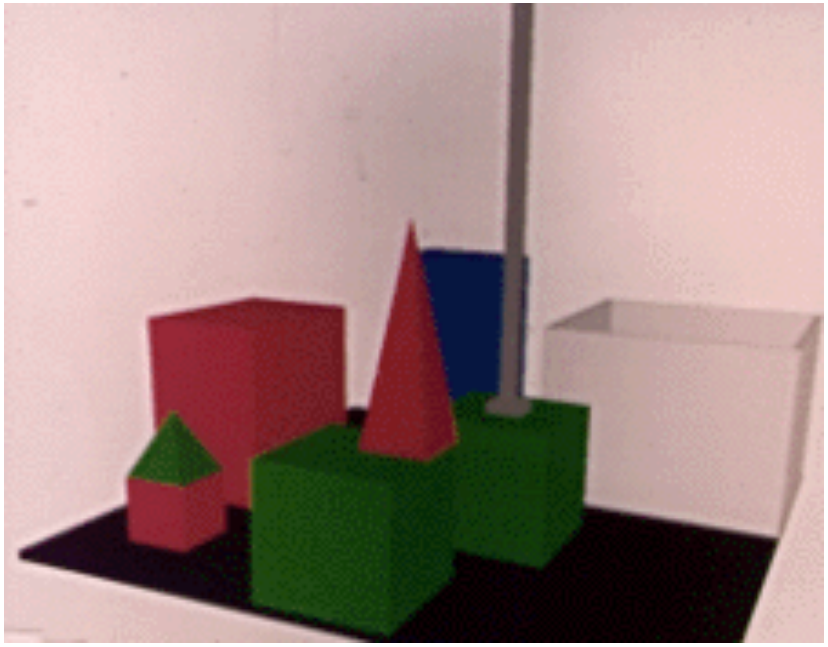
- "Getting a computer to do things which, when done by people, are said to involve intelligence"

- 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)

http://hci.stanford.edu/winograd/shrdlu/

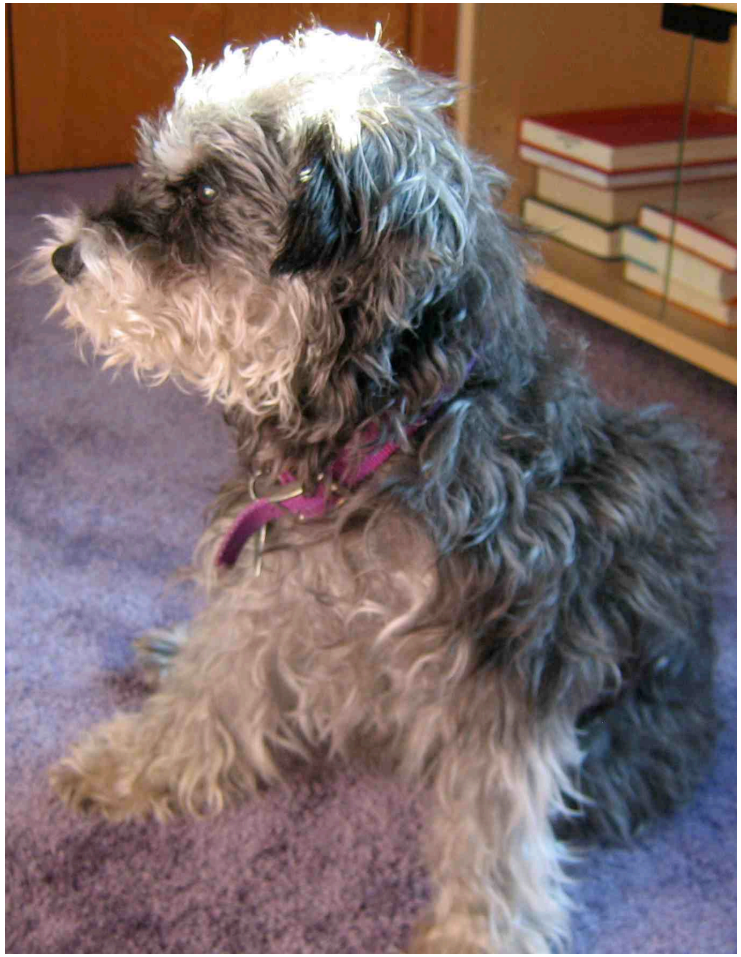
Clicker Question

- 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)

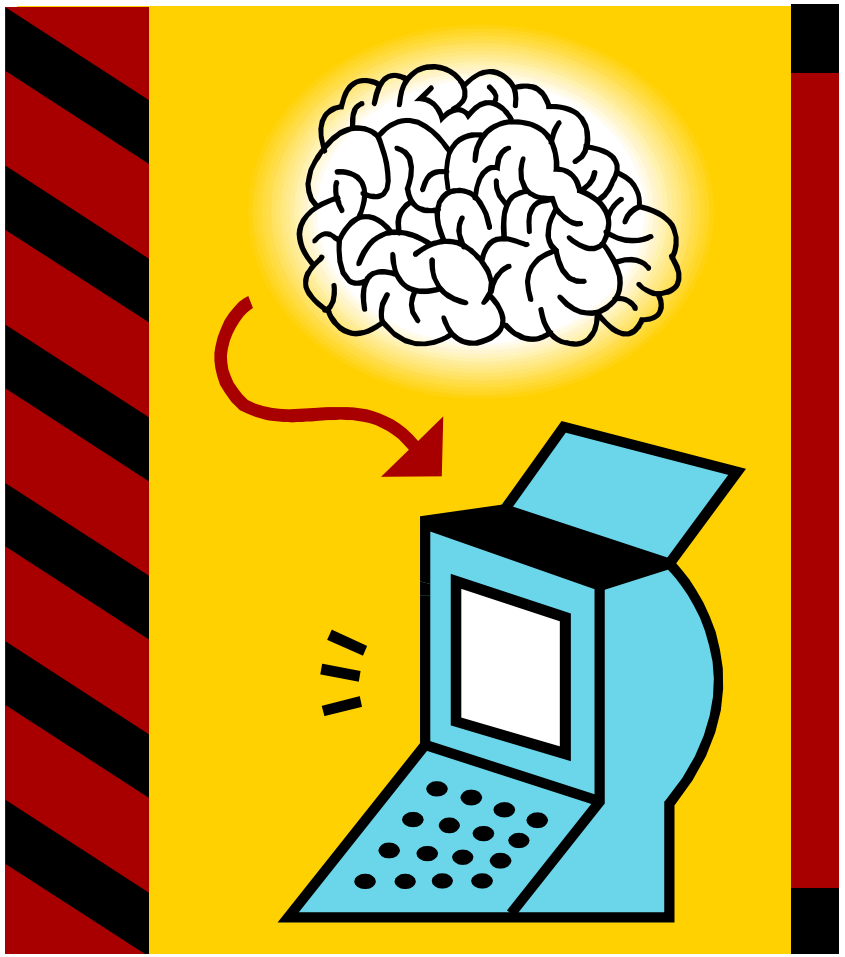
Revival of AI

- Brittle rules break down with complexity of real world
- Probability and uncertainty
- No “dog rule” – instead: what is the probability that the thing we’re seeing is a dog?



What intelligent things do people do?

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



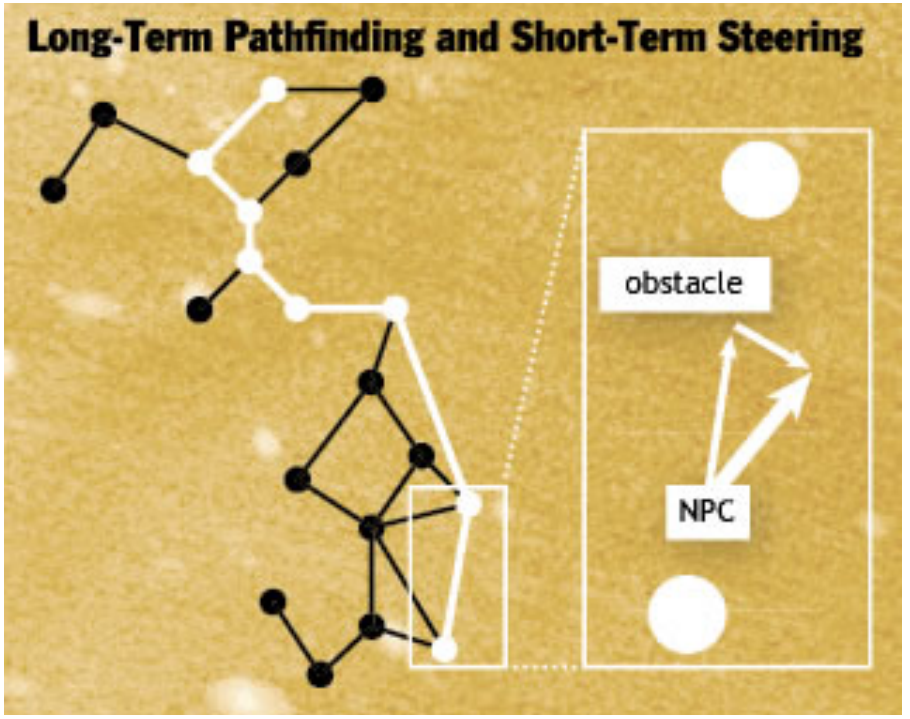
en.wikipedia.org/wiki/Artificial_intelligence

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 heuristics
  - 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

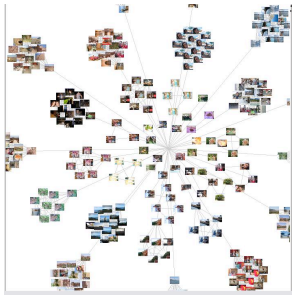
Machine Learning

- "A program learns if, after an experience, it performs better"
- What are the right generalizations to make given the data you've seen and the task you're completing?

en.wikipedia.org/wiki/Machine_learning

Machine Learning

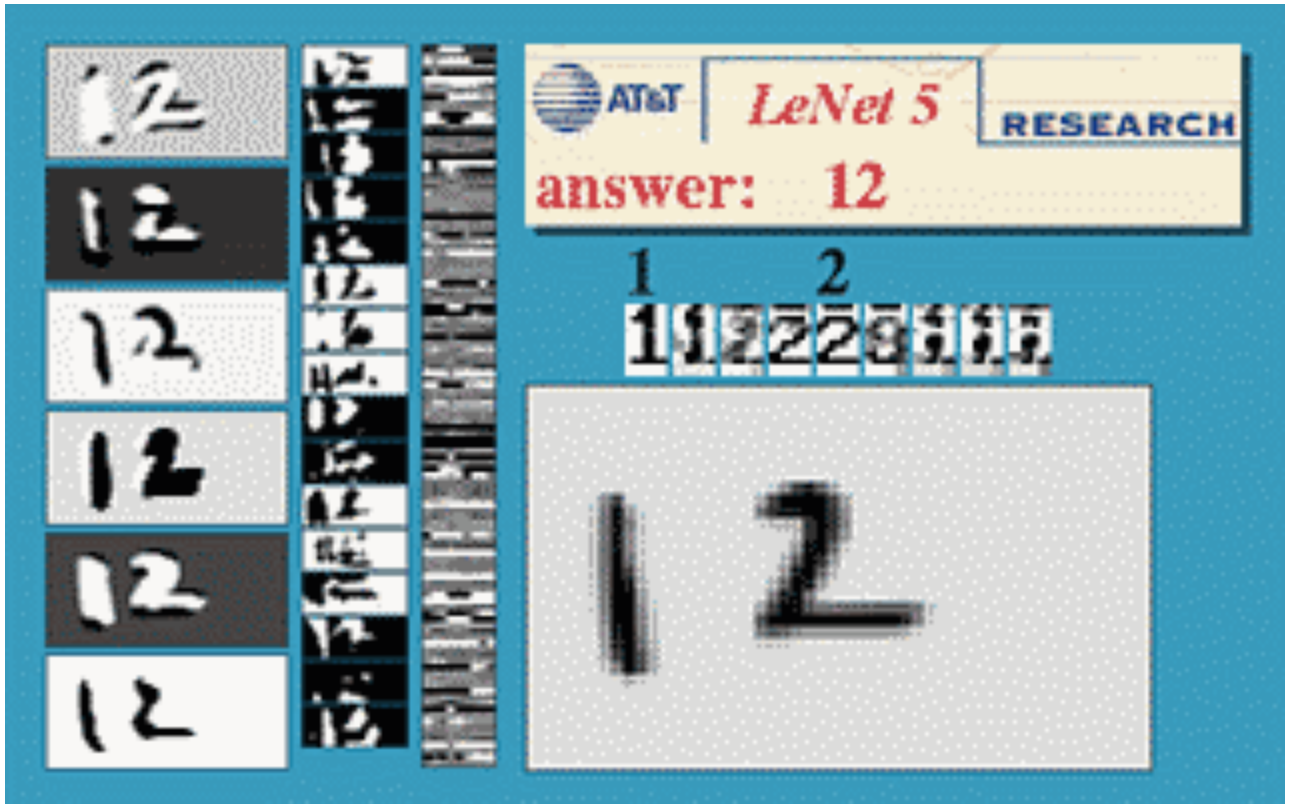
- Algorithm Types
  - Supervised learning
    - Give a system input & output training data, and it produces a classifier
  - Unsupervised learning
    - Determine how data is organized or clustered
  - Reinforcement learning
    - No training data, real-time corrections adjust behavior



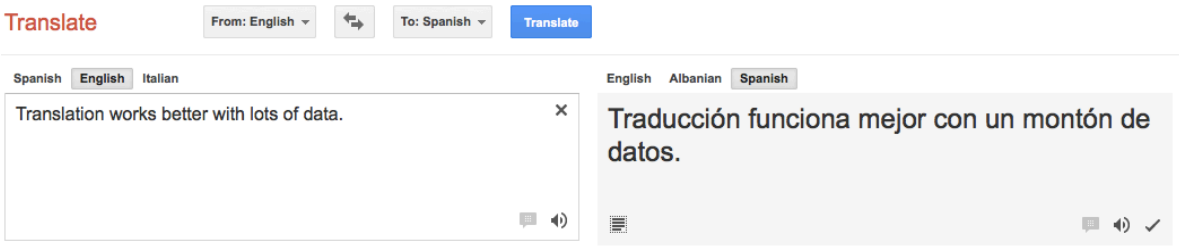
en.wikipedia.org/wiki/Machine_learning

Example: Deep Learning

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

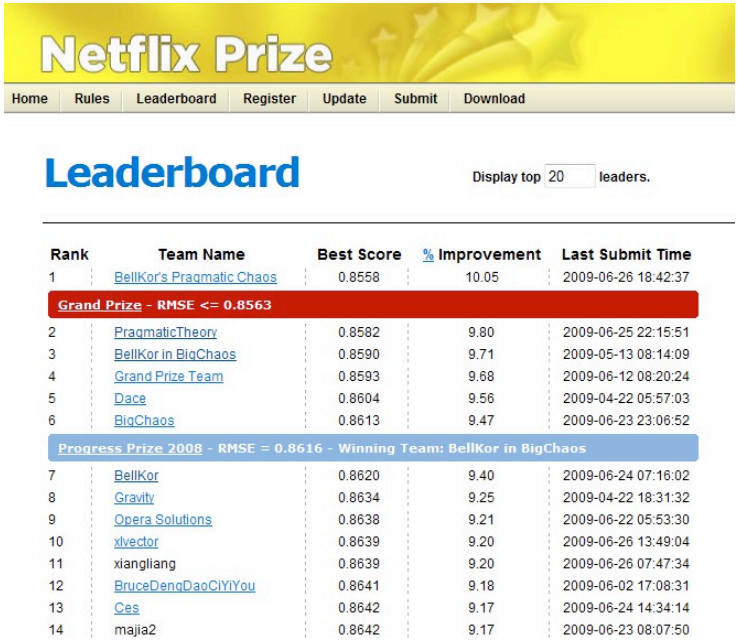


Benefiting from Big Data



Translation

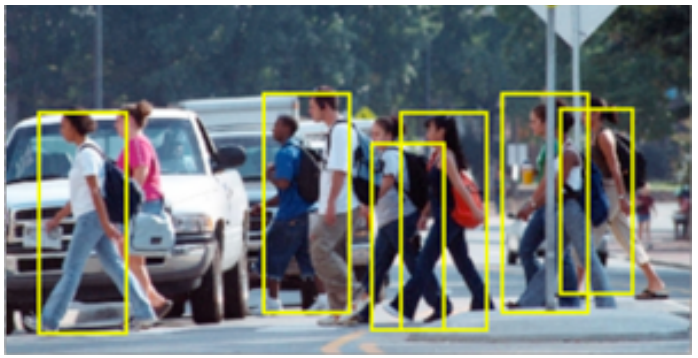
Computer vision



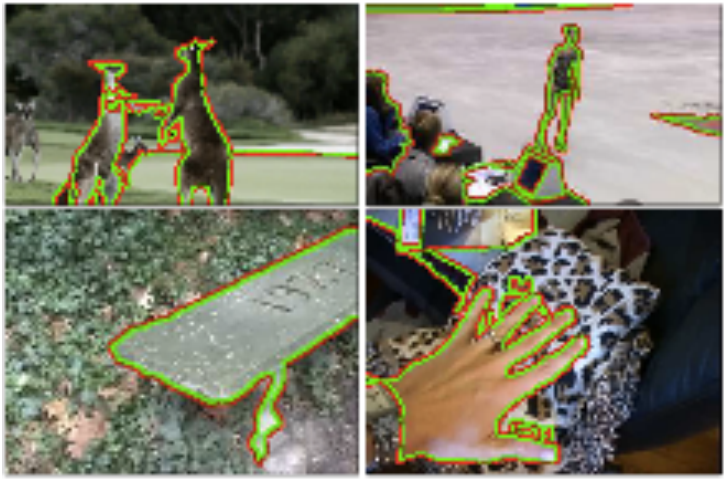
Recommendation

Vision

- Tasks related to understanding images/camera input



Pedestrian detection



Figure/ground segmentation

Action recognition

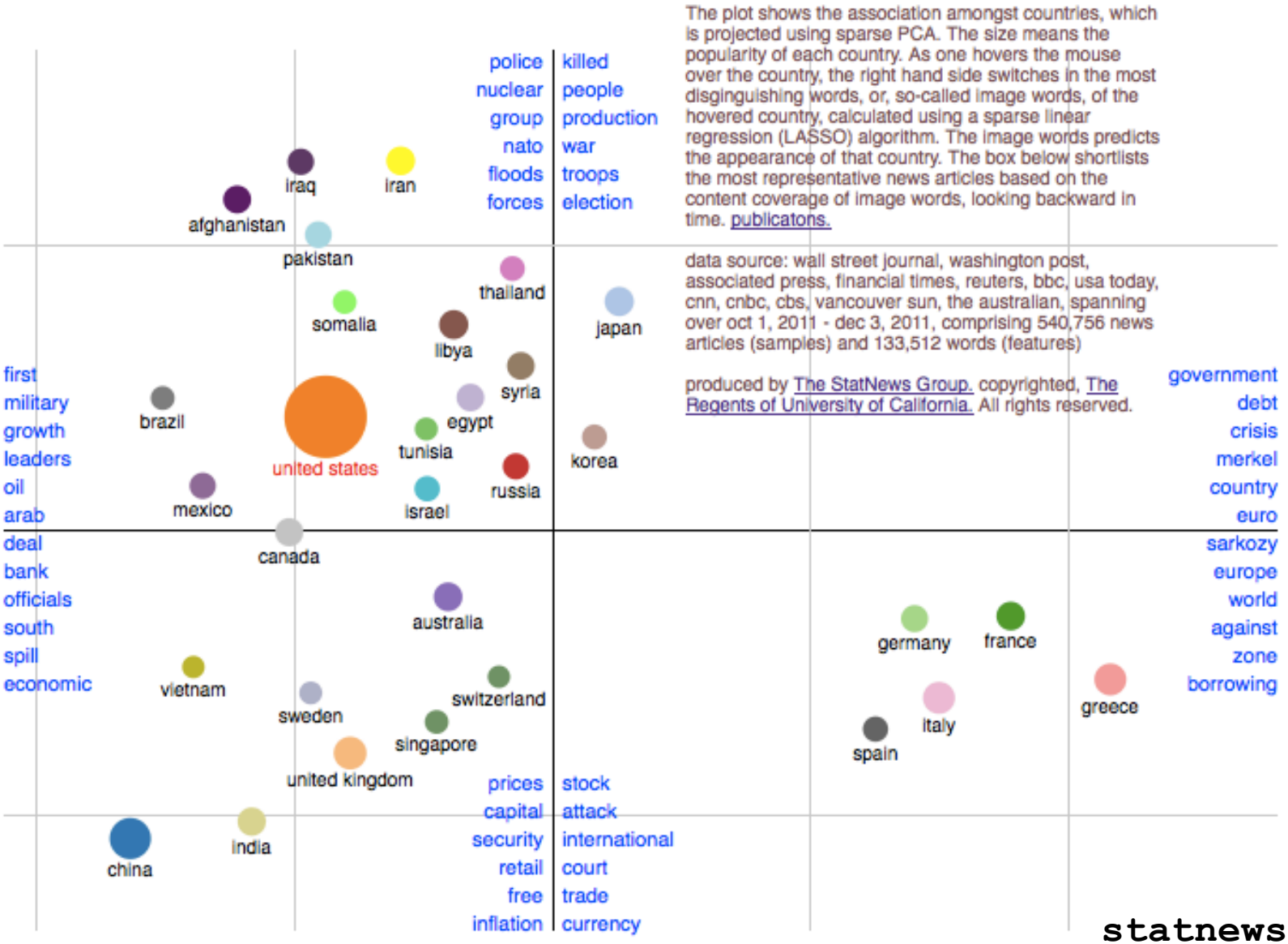
(Some images from Berkeley vision group)

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

en.wikipedia.org/wiki/Natural_language_processing

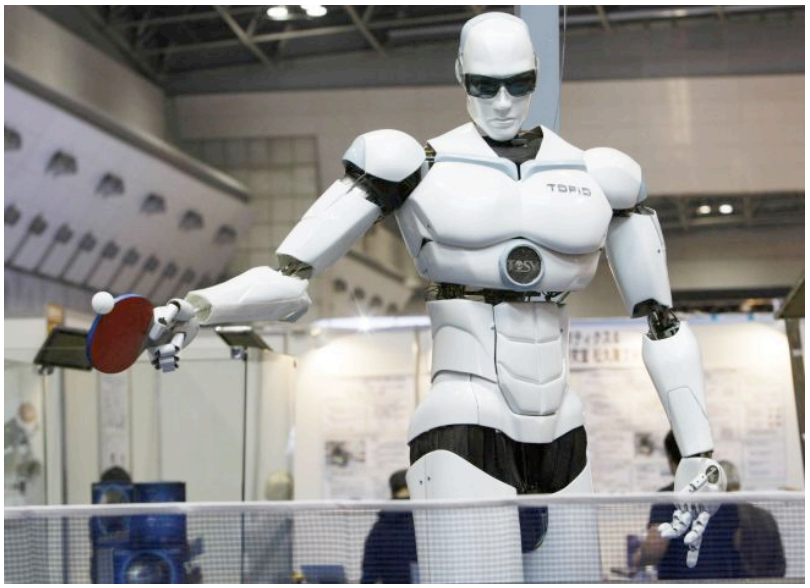
Unsupervised Learning Example



statnews.org

Robotics

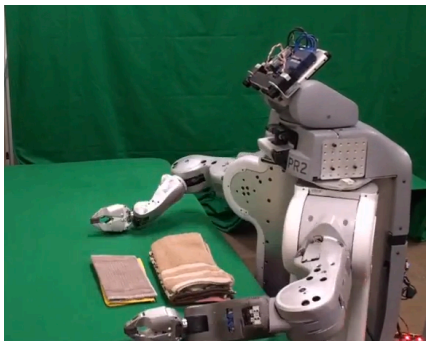
- For many, the coolest and scariest part of AI
- Combines fields of AI/CS
  - Speech recognition
  - Synthetic voice
  - Machine vision
  - Planning
  - HCI



TOPIO, the ping-pong playing robot

Assistive robots

Surgical robots



UC Berkeley's towel-folder

Autonomous helicopter

en.wikipedia.org/wiki/Robotics

Recap

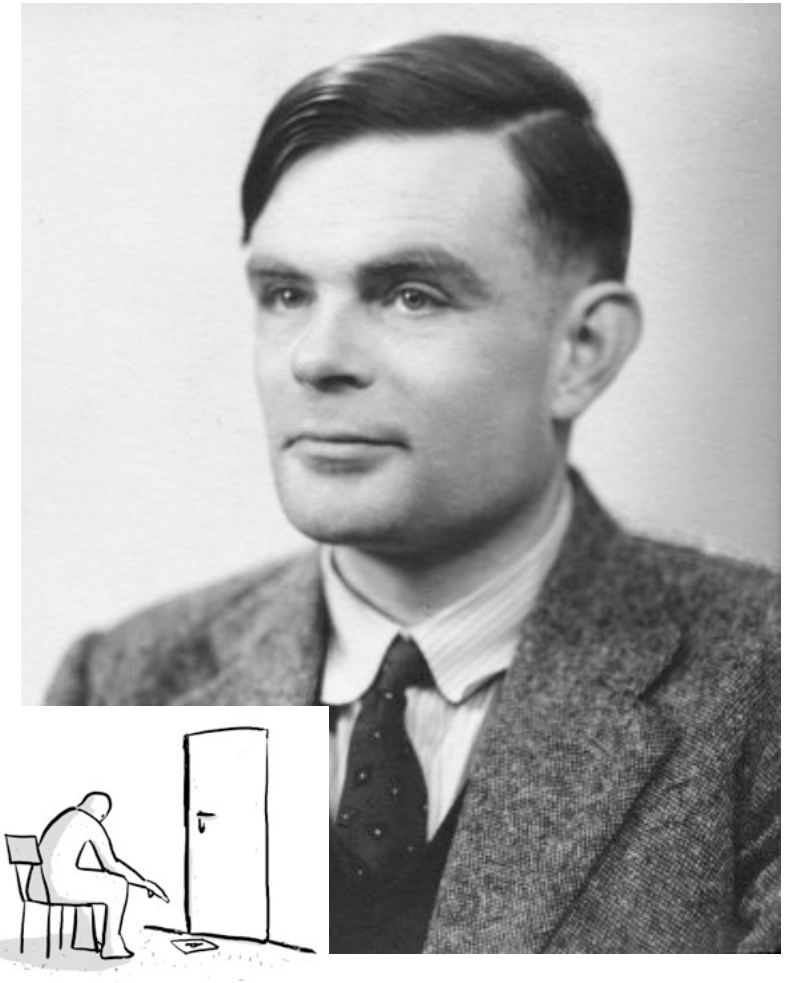
- All of these applications are tough because they require:
  - Knowing about context
  - Uncertainty about input
  - Intensive computations
- But AI has been relatively successful at making progress (and ir some cases, better thar people!)

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?



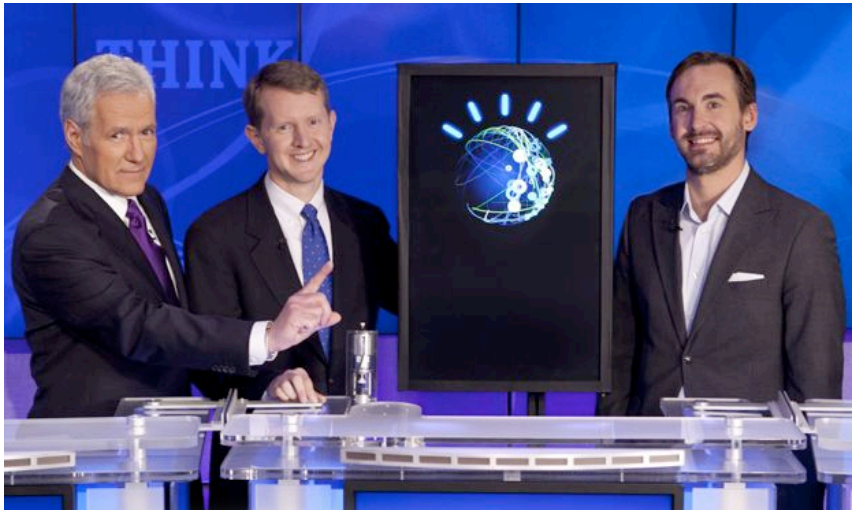
en.wikipedia.org/wiki/Turing_test

Clicker Question

- How would you respond to Searle's Chinese room experiment?
  - (A) The system as a whole understands Chinese
  - (B) The man doesn't understand Chinese, but if he had a way to connect with the outside world (rather than just receiving strings of symbols), he could understand Chinese
  - (C) We must be missing something about "understanding" since the argument implies that brains, which are collections of neurons, cannot understand

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 rafferty@cs.berkeley.edu