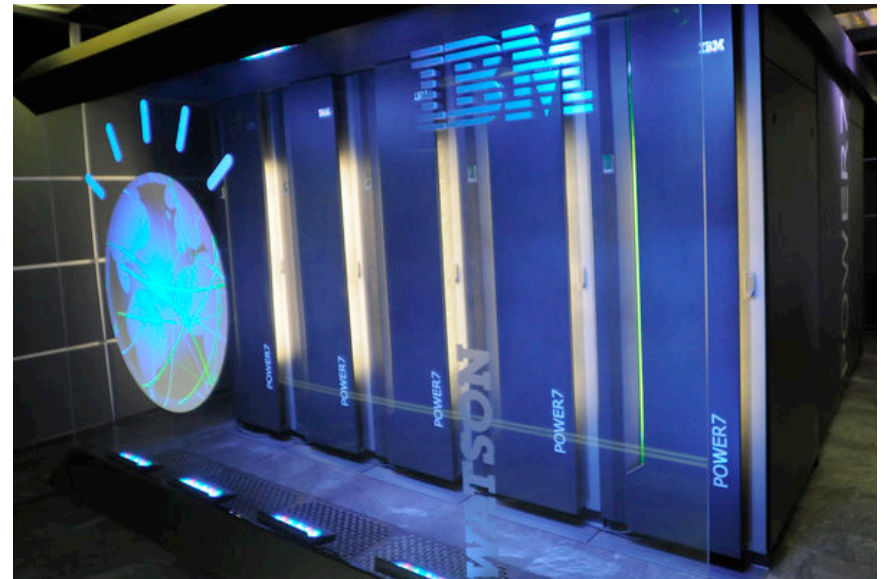


# CS10: The Beauty and Joy of Computing

## Artificial Intelligence



Anna Rafferty  
(Slides adapted from Dan Garcia)  
18 November 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

Chem vLab - Stoichiometry Activity 2 : Screen 11 of 19 - vLabBDilution

Activity 2: Sample 2 - Reported SDS value from Factory B

Solution Info

Name: 600mL Beaker  
Volume: 50.0 mL

log<sub>1</sub> Molarity

Species	Molarity
H <sup>+</sup>	1.005e-7
OH <sup>-</sup>	1.005e-7
C <sub>12</sub> H <sub>25</sub> SO <sub>4</sub> Na <sup>+</sup>	2.080e-3

You calculated that the reported output at the stream outside the factory was 0.0021 or 2.1e-3 M. The stream outside the factory flows into the river where the sample was taken. There is 2 times more water at the sample site than at the reporting site. The flask "Reported SDS Sample" has the reported concentration of SDS (C<sub>12</sub>H<sub>25</sub>SO<sub>4</sub>Na). Select a new beaker from the menu, and create a 1:2 dilution of the Reported SDS Sample. Add water to the sample until the concentration is diluted by a factor of 2. Use 2 significant figures in your response. The diluted concentration of SDS is:

[ ] M

Hint Next

Symbols Seen

Green Square	Blue Circle	Red Square
	Blue Circle	

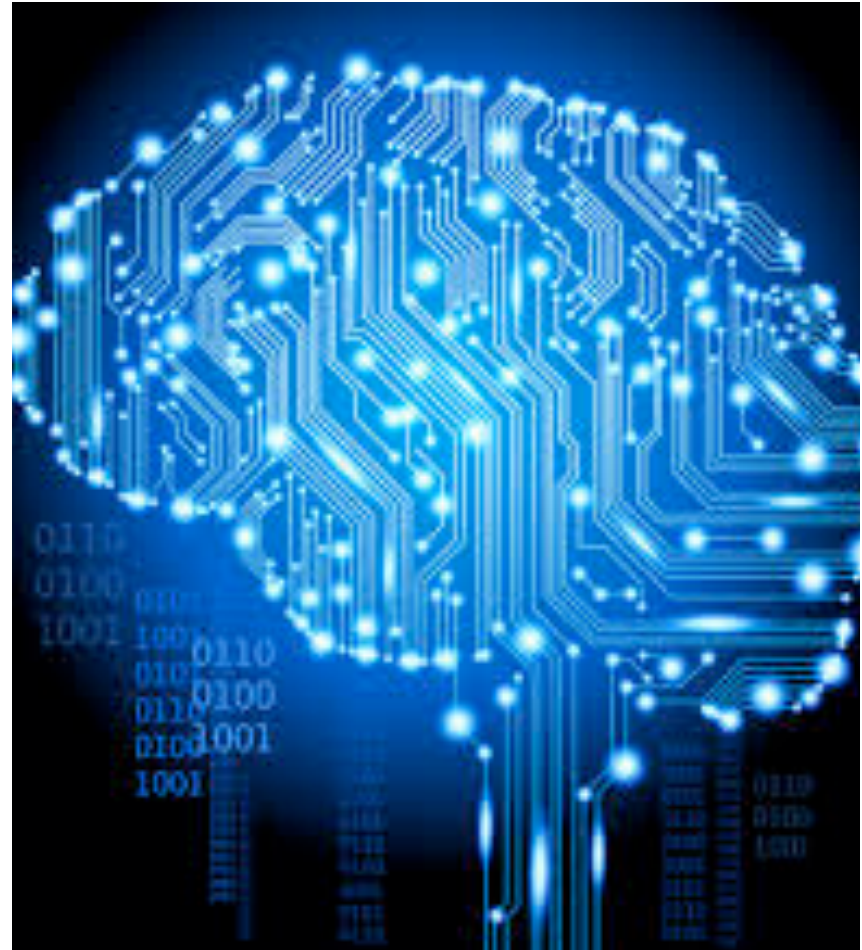
Energy: 17 Level: 1 Score: -2



# Lecture Overview

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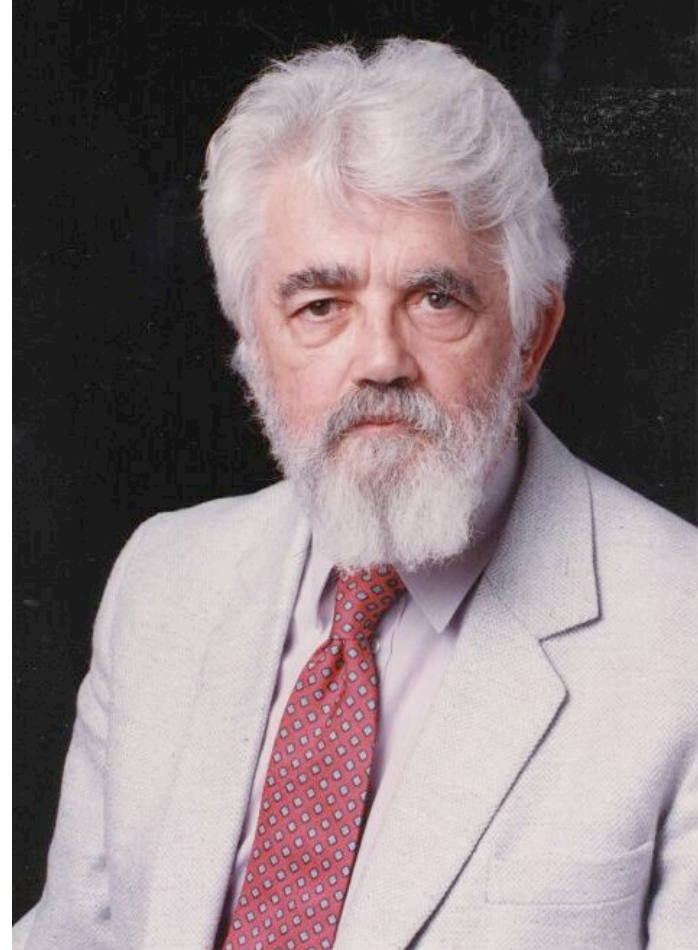
- What is AI?
- Some AI history: AI winter and the resurgence!
- Tour of areas of AI
- Philosophy: What would it mean for a program to be intelligent?



# AI Definition by John McCarthy

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- “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.

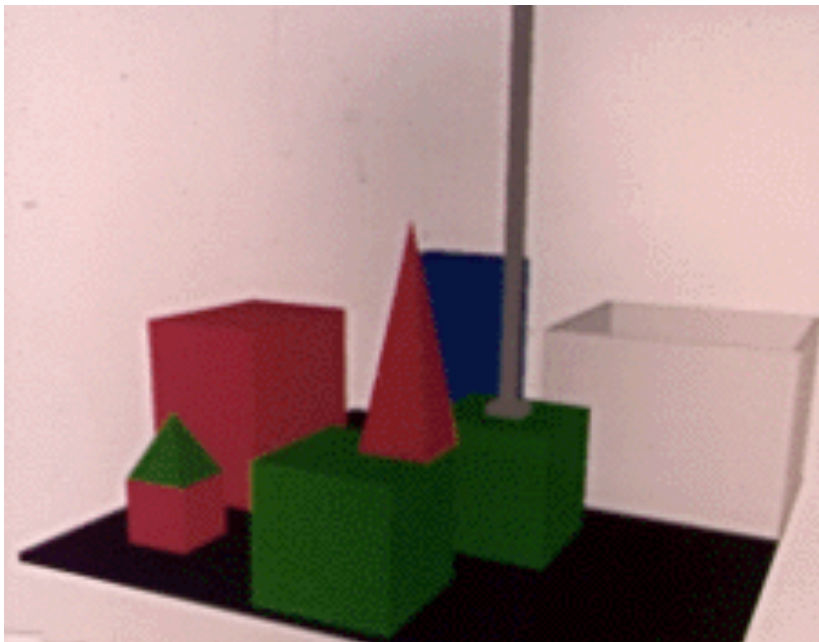




# A little history...

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- 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

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- 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](http://vision.stanford.edu/resources_links.html))

# Revival of AI: Big Ideas

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- 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

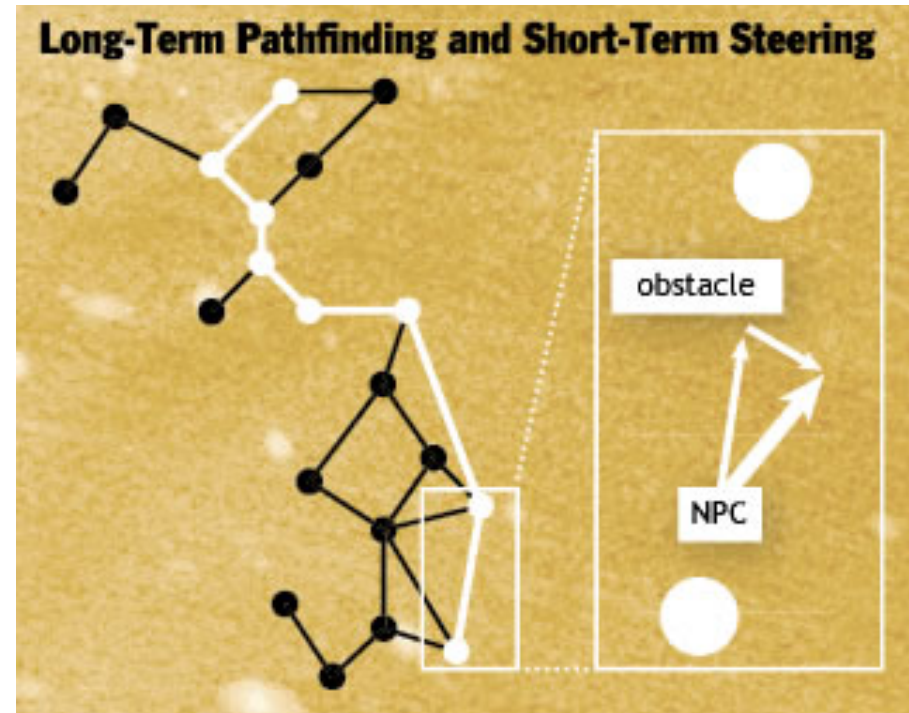
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- Questions to keep in mind:
  - How would you evaluate how well a machine performed on the tasks we talk about?
  - How can blending artificial and human intelligence make tasks simpler, even if the AI isn't perfect?



# 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](http://www.businessweek.com/innovate/content/aug2008/id20080820_123140.htm)

[en.wikipedia.org/wiki/Dynamic\\_game\\_difficulty\\_balancing](http://en.wikipedia.org/wiki/Dynamic_game_difficulty_balancing)

[en.wikipedia.org/wiki/Game\\_artificial\\_intelligence](http://en.wikipedia.org/wiki/Game_artificial_intelligence)

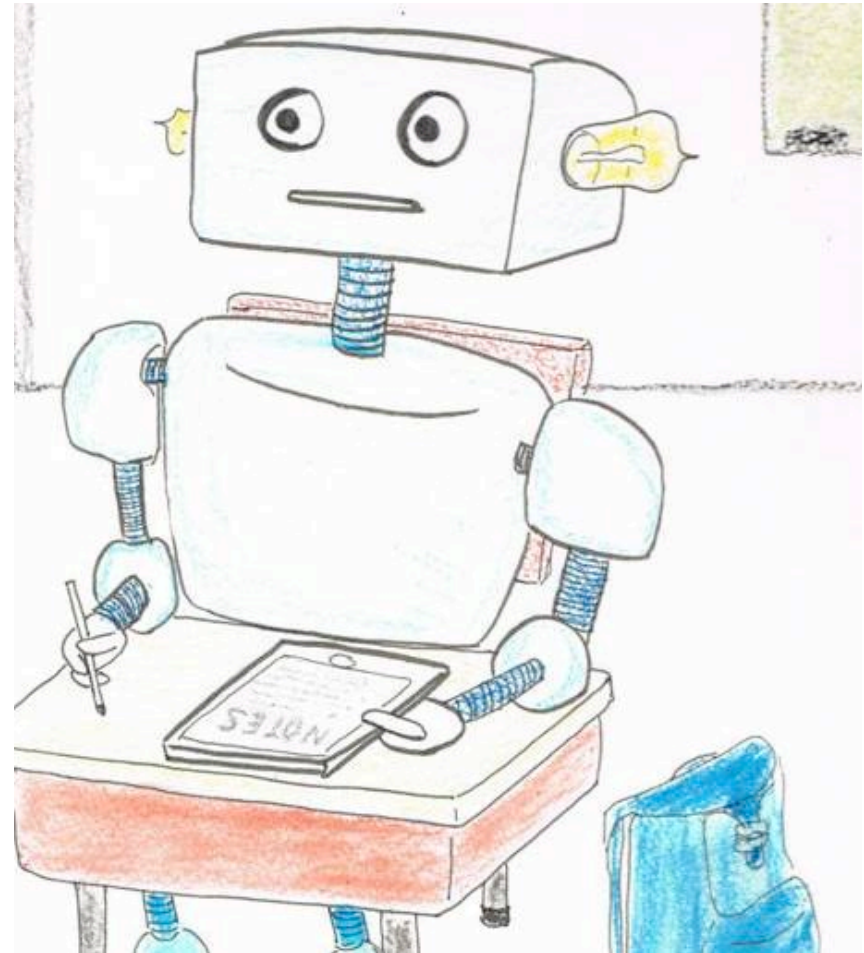
[queue.acm.org/detail.cfm?id=971593](http://queue.acm.org/detail.cfm?id=971593)



# Machine Learning

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- “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

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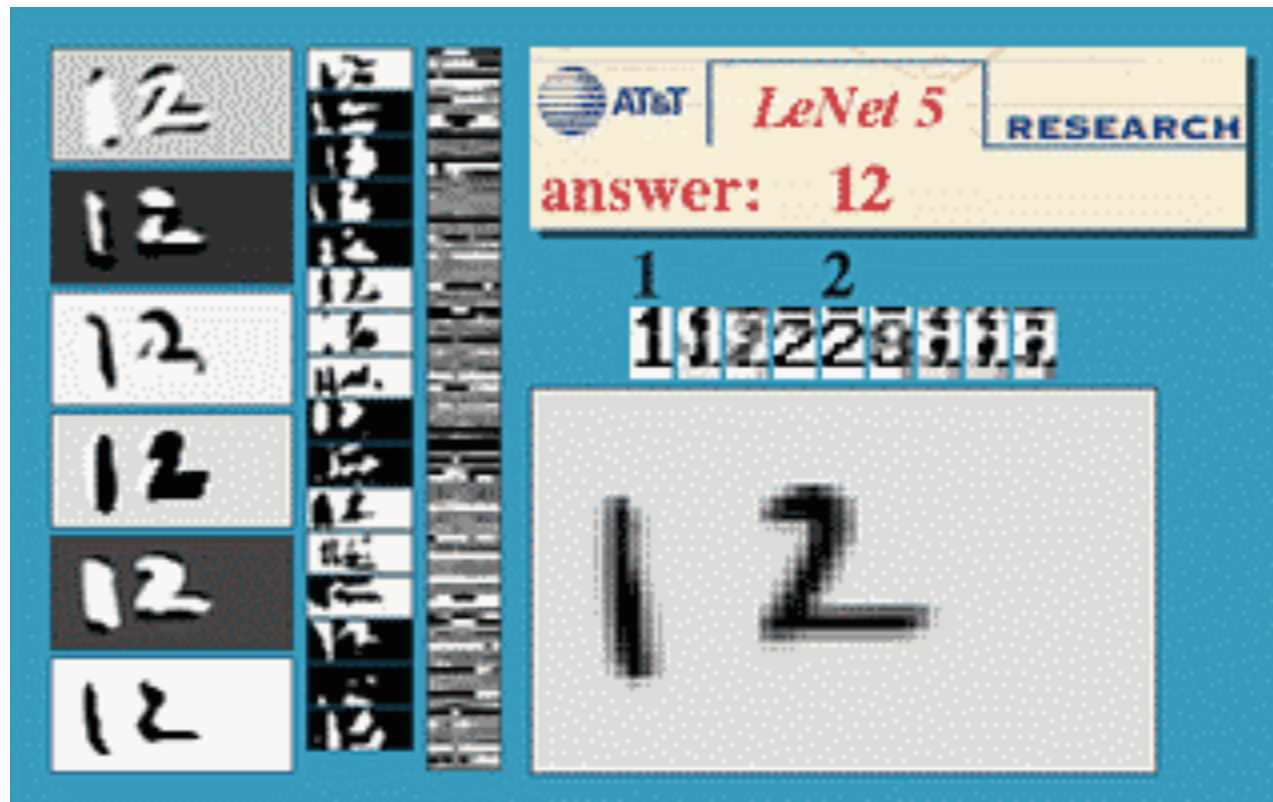
You want to make a spam filter that can tell you if an email is spam or not. What might be some good features for your algorithm?

- (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

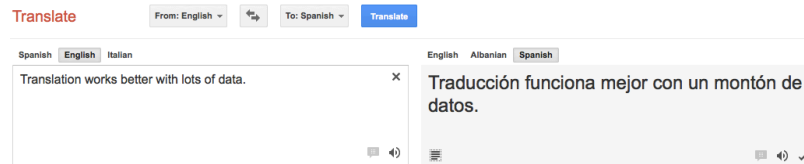


# Example: Deep Learning

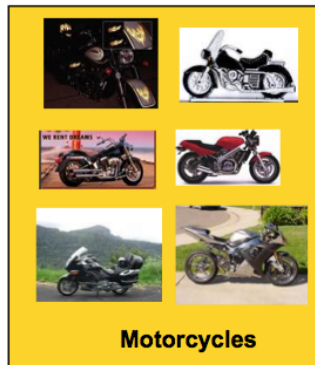
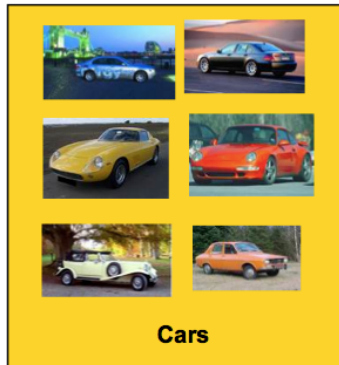
- Combines supervised and unsupervised learning:  
Learn the right *representations* for input -> output



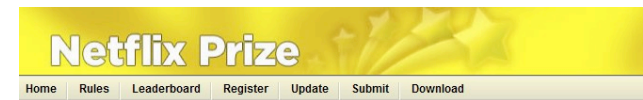
# Benefiting from Big Data



## Translation



## Computer vision



## Leaderboard

Display top 20 leaders.

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

## Recommendation

More examples help algorithms recognize trends and similarities across instances.



# Natural Language Processing

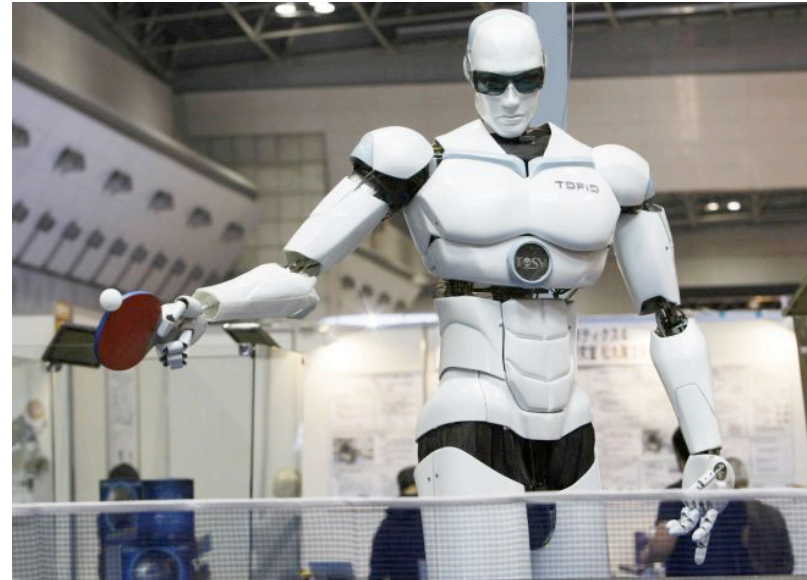
- Known as “AI-complete” problem
  - (Often) requires extensive knowledge of world
- Statistical NLP
  - Correcting/guessing text
  - Suggesting news stories
  - Finding articles that are similar to one another
  - Translate or paraphrase texts





# Robotics

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

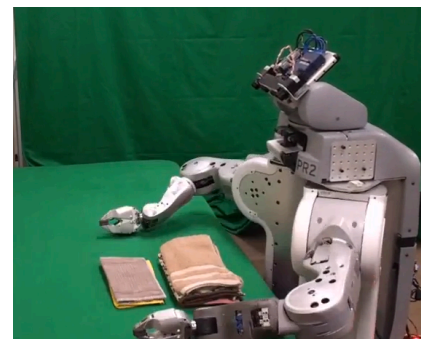


TOPIO, the ping-pong playing robot



Assistive robots

Surgical robots



UC Berkeley's towel-folder



Autonomous helicopter



# Recap

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- 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

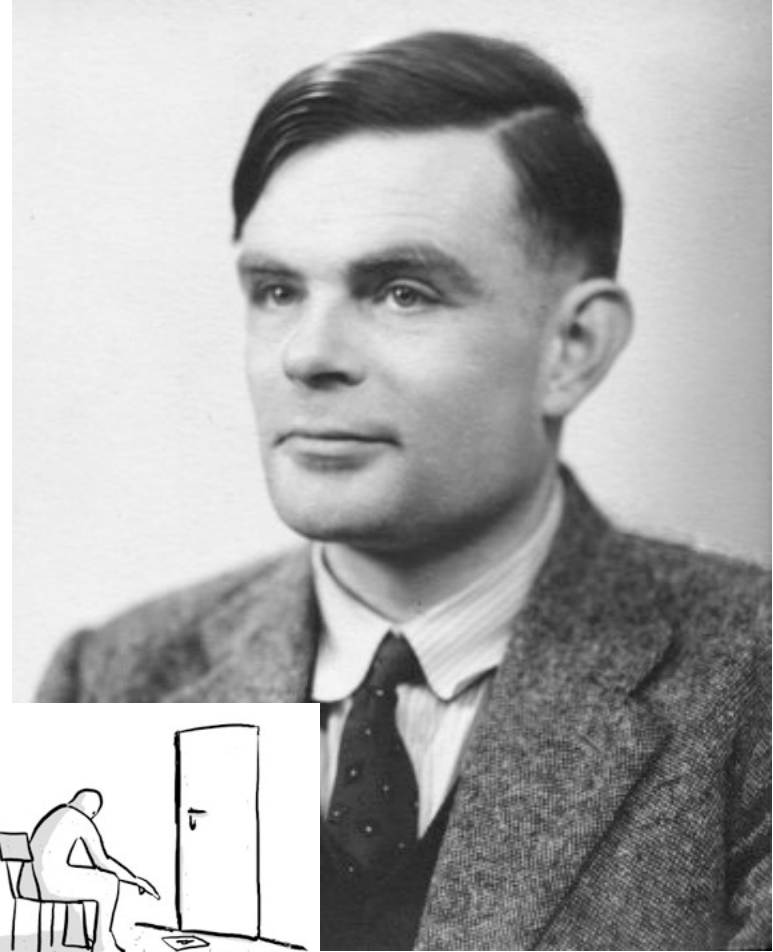
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- What would a “truly intelligent” AI system look like?
  - (A) Behaves in an optimal or rational manner
  - (B) Behaves similarly to people – when it makes errors, those errors are similar to people’s errors
  - (C) Carries out the same type of processing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





# Clicker Question

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- 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](mailto:rafferty@cs.berkeley.edu)

