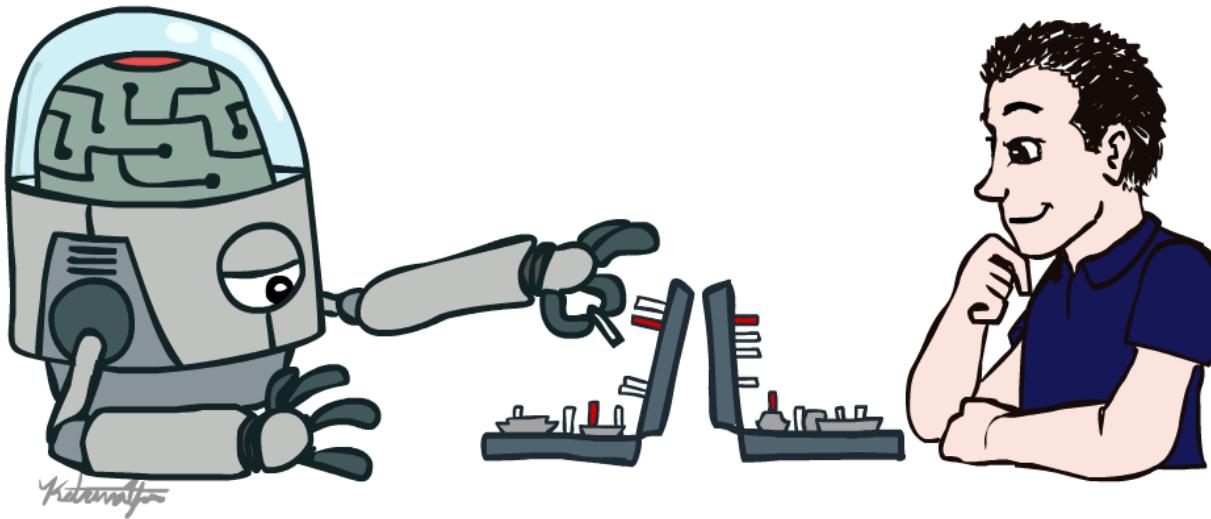


Candy Grab Game

1. Grab an Agent card and 1 pack of “game pieces”
2. Form groups of 2 (or 3 with an observer)
3. Play the game based on your Agent card!
 - A. 13 pieces on the table
 - B. Take turns taking either 1 or 2 pieces
 - C. Person forced to take the last pieces loses ☹
4. Think about how you might implement your Agent in code

CS10: The Beauty and Joy of Computing

Artificial Intelligence

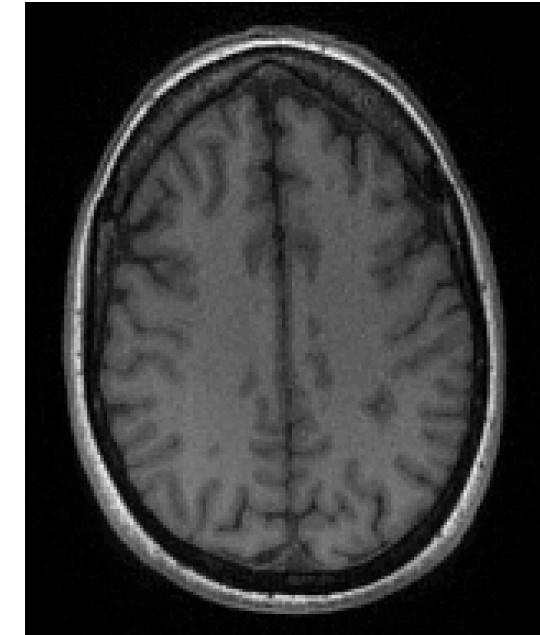
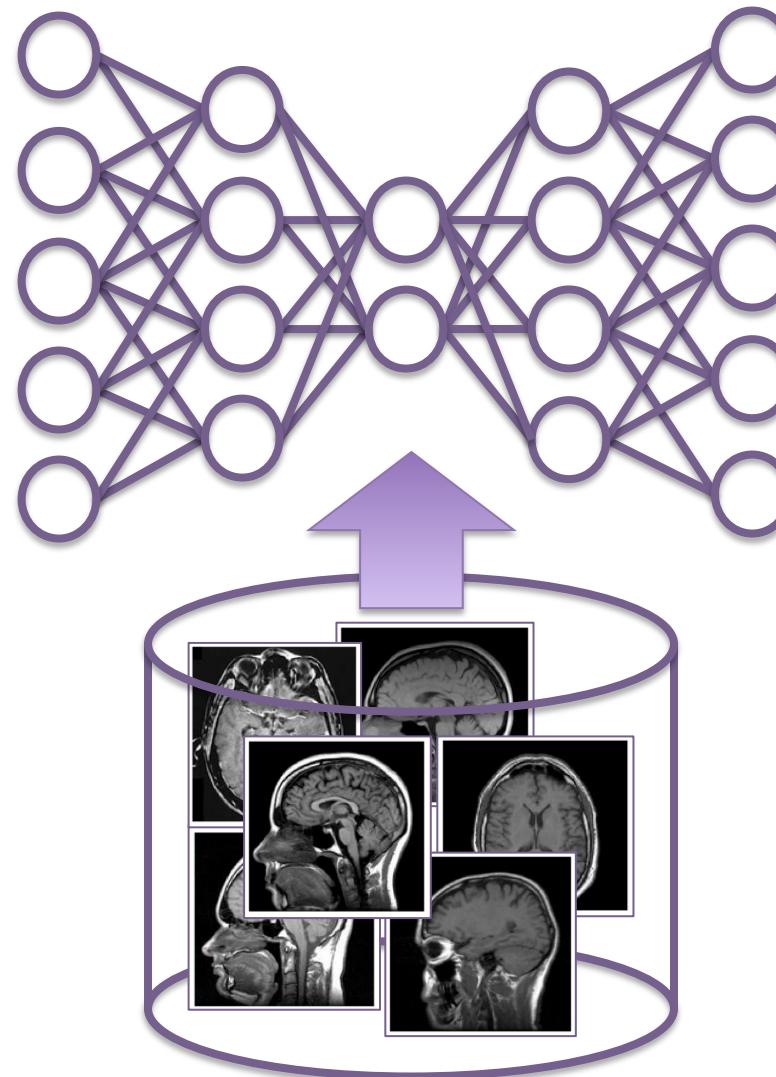
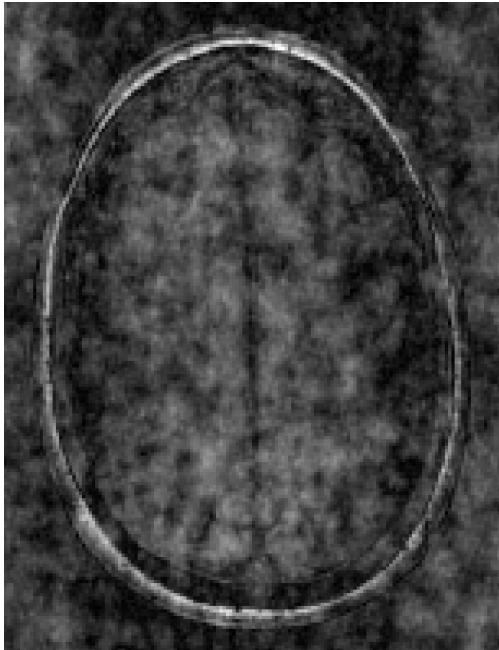


Pat Virtue

University of California, Berkeley

Slide credits: Dan Klein, Pieter Abbeel, Stuart Russell,
Anna Rafferty, Dan Garcia, Pat Virtue & [http://
csillustrated.berkeley.edu](http://csillustrated.berkeley.edu)

What I Do...



Outline

- What is AI?
- Some AI history: AI winter and the resurgence!
- AI Techniques:
 - Logic
 - Search & Planning
 - Probability & Statistics (Machine Learning)
- AI Applications
 - Natural Language
 - Vision / Perception
 - Robotics
 - Much, much more

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- **What is AI?**
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Candy Grab Game

```
function takeTurn(numPiecesAvailable)  
    return ?
```

Candy Grab Game

Agent 001 – Always choose 1

```
function takeTurn(numPiecesAvailable)
```

```
return 1
```

Candy Grab Game

Agent 002 – Always choose 2

```
function takeTurn(numPiecesAvailable)
```

```
return 2
```

Candy Grab Game

Agent 004 – Choose the opposite of opponent

```
function takeTurn(numPiecesAvailable)
```

```
return ?
```

Candy Grab Game

Agent 007 – Whatever you think is best

```
function takeTurn(numPiecesAvailable)
```

```
return ?
```

Candy Grab Game

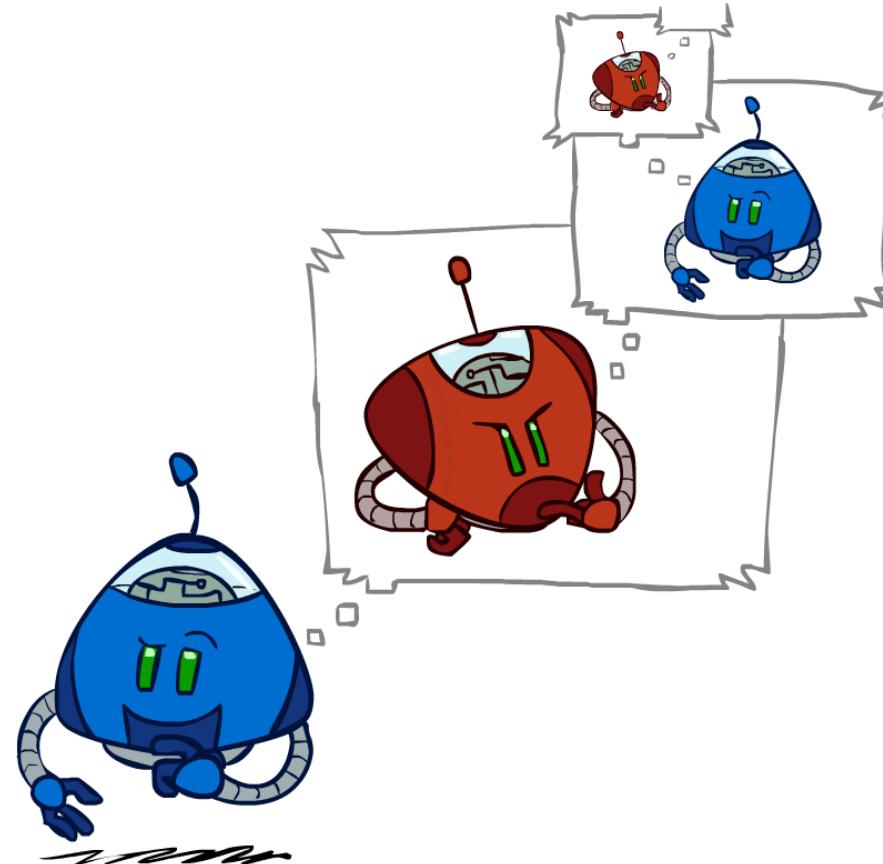
Agent 007 – Whatever you think is best

```
function takeTurn(numPiecesAvailable)  
if multipleOf3(numPiecesAvailable)  
    return 2  
else  
    return 1
```

Candy Grab Game

Agent 007 – Whatever you think is best

```
function takeTurn(numPiecesAvailable)
```



Candy Grab Game

Agent 007 – Whatever you think is best

function **takeTurn**(numPiecesAvailable)

Keep track of win % statistics from past games

Pieces Available	Take 1	Take 2
2	100%	0%
3	2%	100%
4	3%	2%
5	90%	5%
6	7%	88%

AI Games in the News

The New Yorker website header features the magazine's iconic blue cover with a building and the text "THE NEW YORKER". To the right are buttons for "READ SOMETHING THAT MEANS SOMETHING.", "SUBSCRIBE", "RENEW", "GIVE A GIFT", and "NON-U.S. ORDERS". On the far right are links for "Sign in", "Link your subscription", and "TNY Store", along with social media icons for Facebook, Twitter, and Google+.

THE NEW YORKER

NEWS CULTURE BOOKS & FICTION SCIENCE & TECH BUSINESS HUMOR MAGAZINE VIDEO ARCHIVE SUBSCRIBE

FEBRUARY 25, 2015

ARTIFICIAL INTELLIGENCE GOES TO THE ARCADE

BY NICOLA TWILLEY

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A shaky video, recorded with a mobile phone and smuggled out of the inaugural First Day of Tomorrow technology conference, in April, 2014, shows an artificially intelligent computer program in its first encounter with Breakout, the classic Atari

SIGN UP FOR NEWSLETTERS

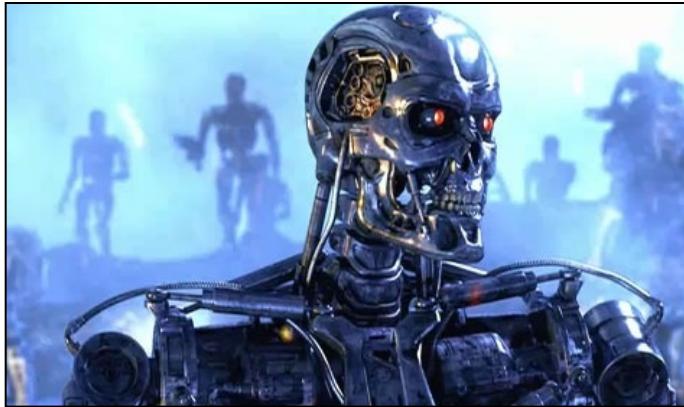
E-mail address

ADVERTISEMENT

<https://www.youtube.com/watch?v=EfGD2qveGdQ>

So what is AI?

Sci-Fi AI?

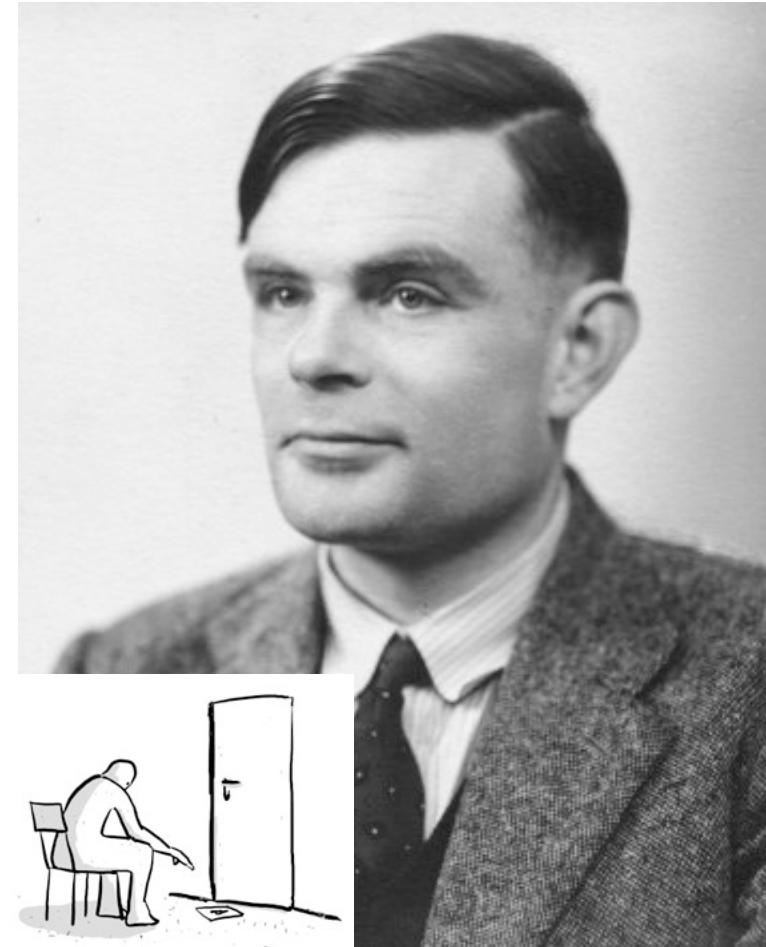


So what is AI?

The science of making machines that:

Turing Test for Intelligence

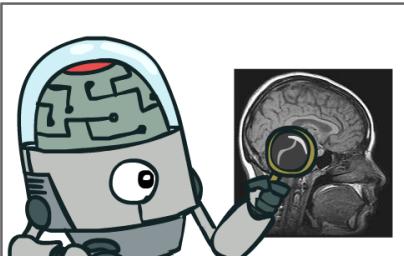
- In 1950, Turing defined a test of whether a machine could “think”
- “A human judge engages in a natural language conversation with one human and one machine, each of which tries to appear human. If judge can’t tell, machine passes the Turing test”



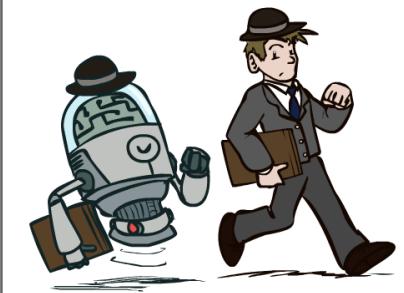
So what is AI?

The science of making machines that:

Think like people

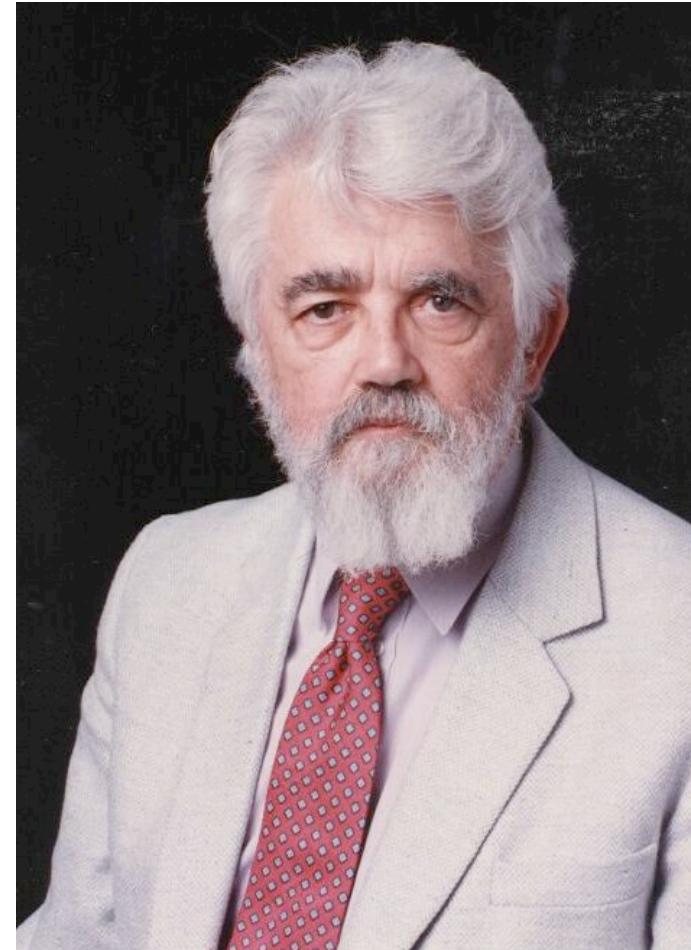


Act like people



AI Definition by John McCarthy

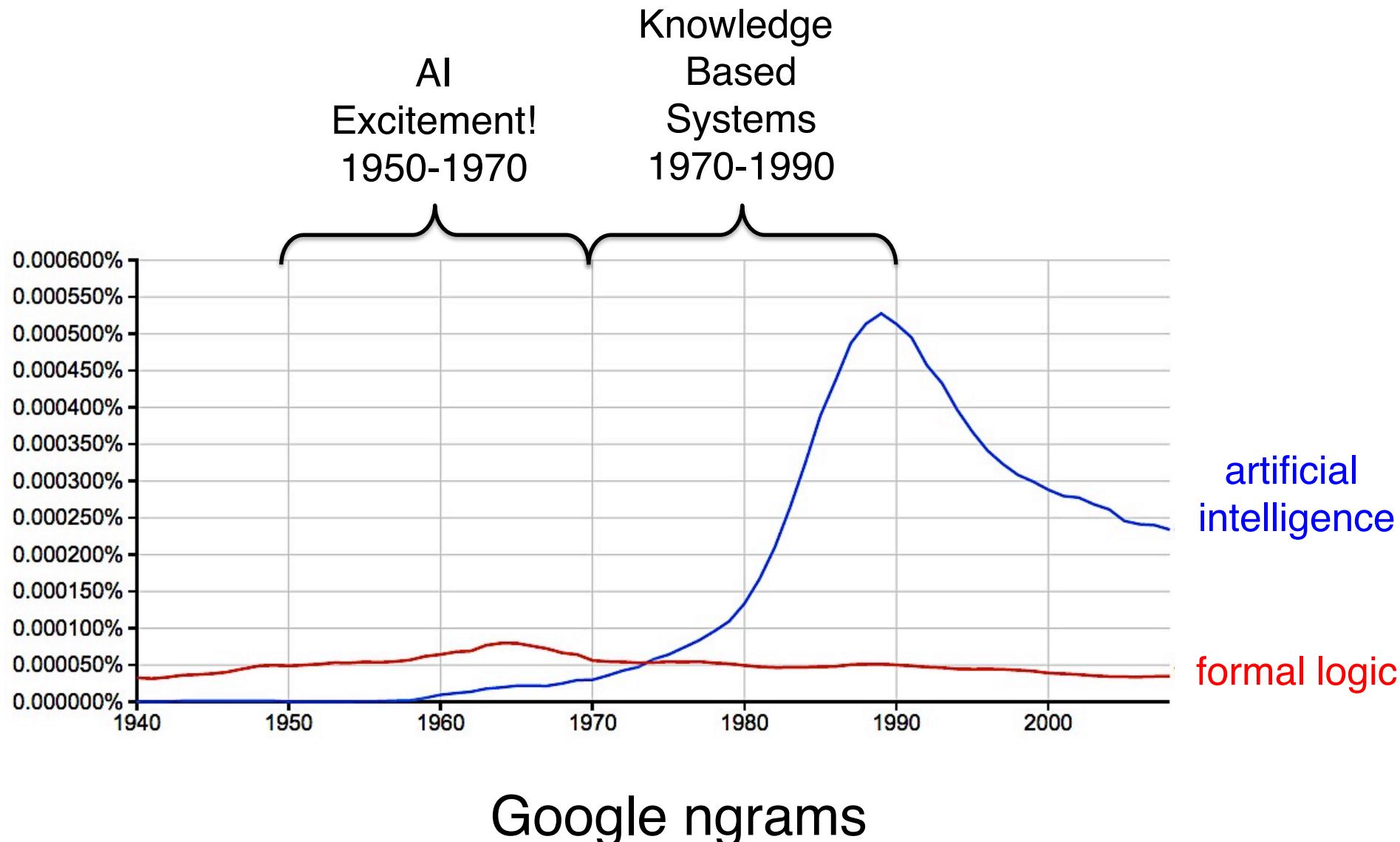
- “Getting a computer to do things which, when done by people, are said to involve intelligence”
- Fineses the idea of whether a computer has consciousness, whether they have rights, etc.



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A Brief History of AI



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



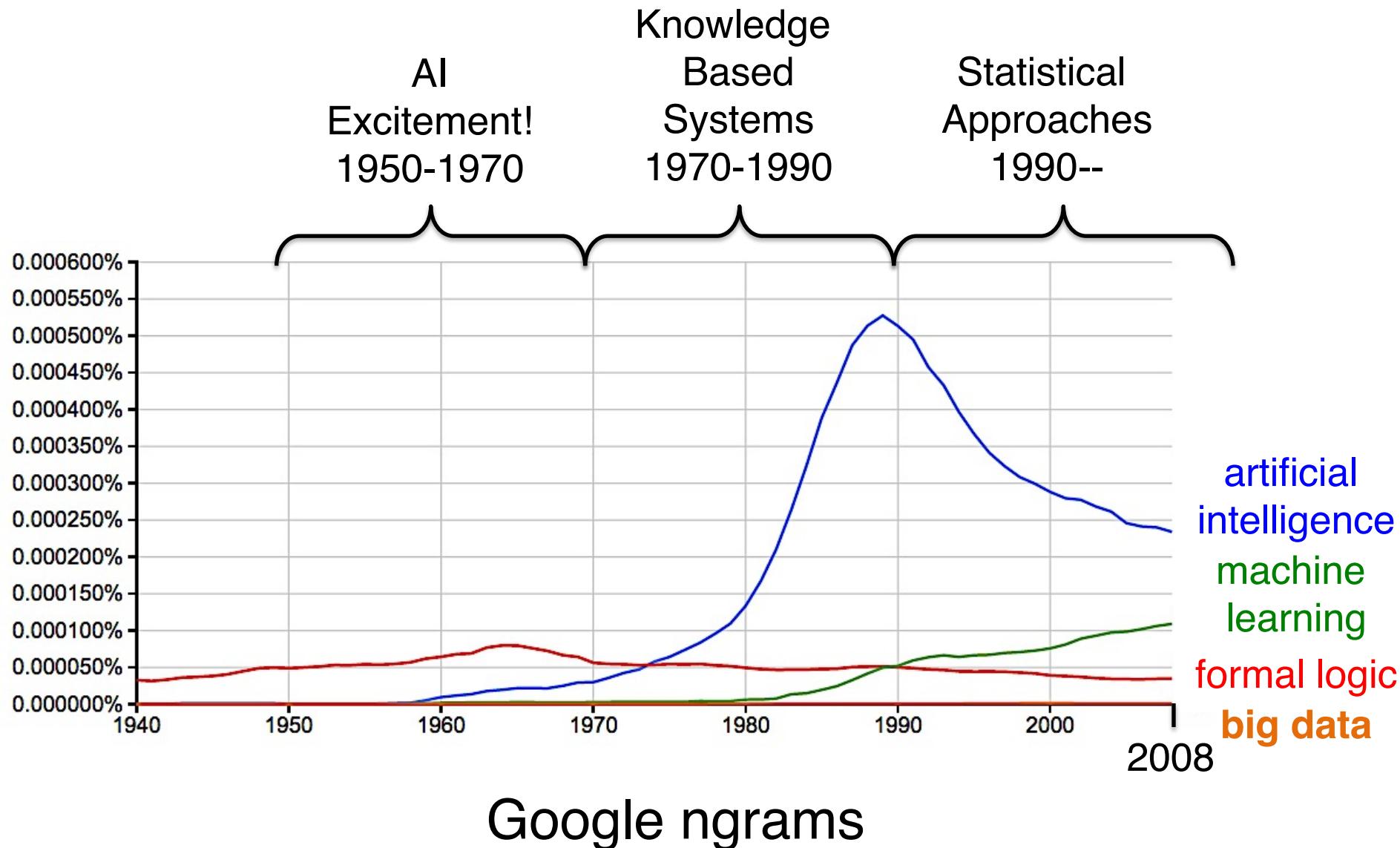
(Image from: http://vision.stanford.edu/resources_links.html)

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



Summary of AI History



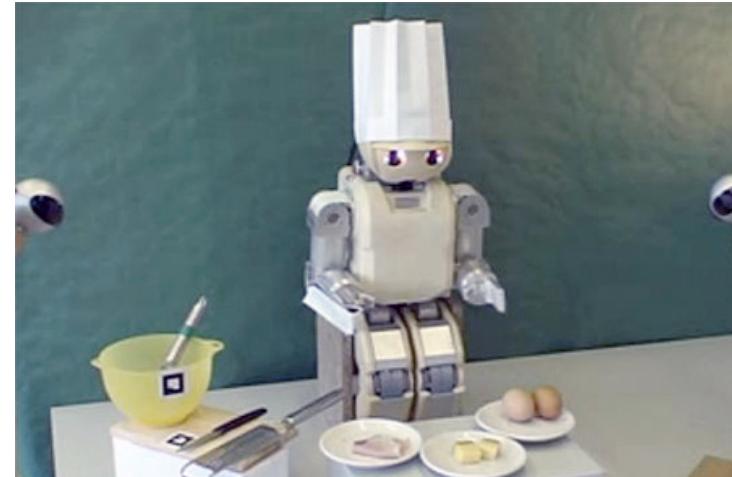
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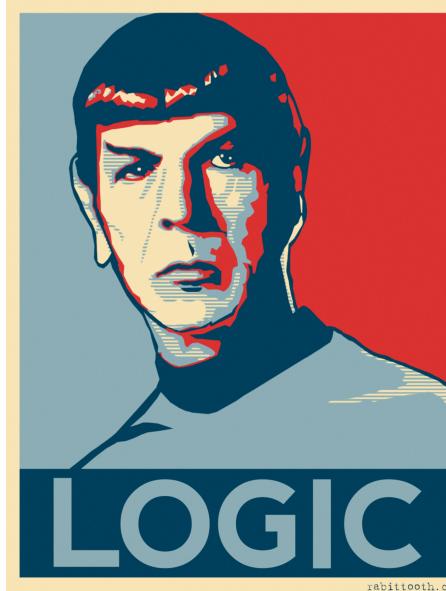
What intelligent things do people do?

Imagine cooking a meal with your roommates...

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

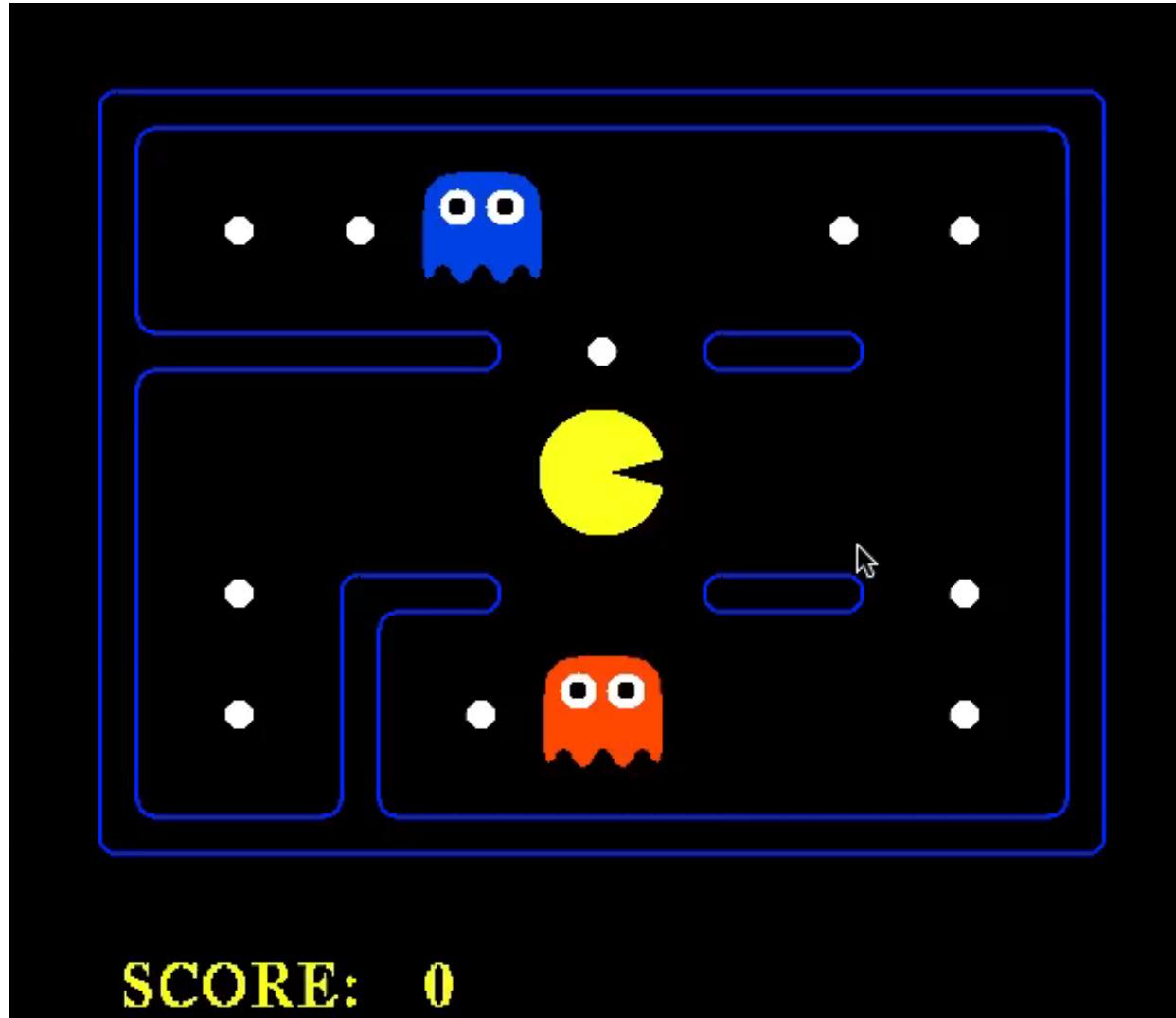


Techniques: Logic



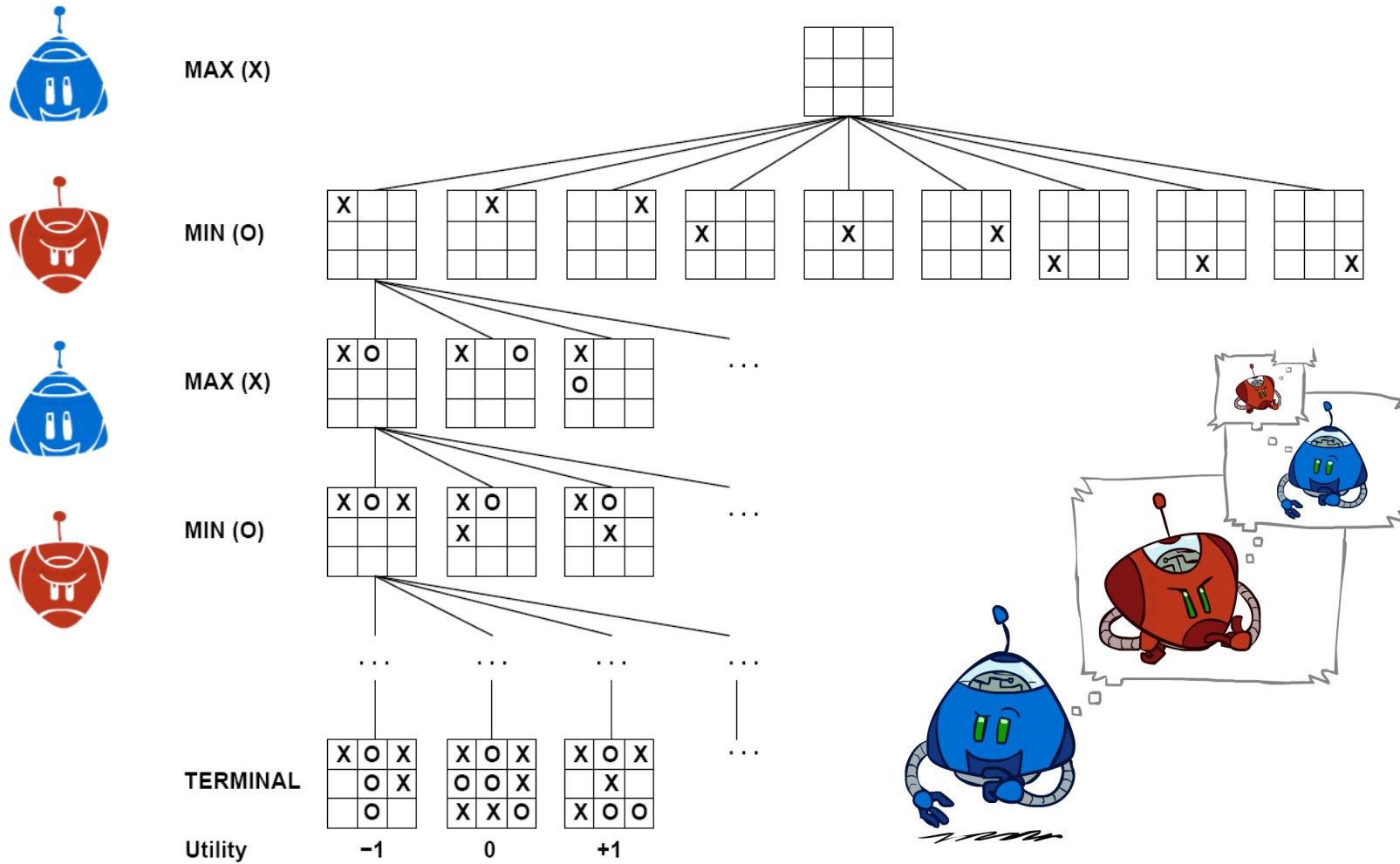
- A formal representation of our knowledge of the world
- Use **knowledge base** and **perception** to infer new knowledge

Techniques: Logic



Techniques: Search & Planning

- I take an action...then what?...then what?



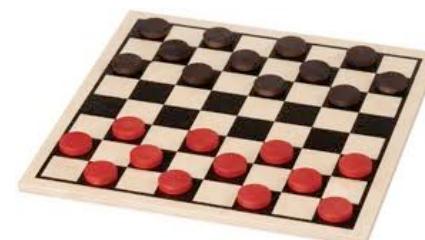
Techniques: Machine Learning

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

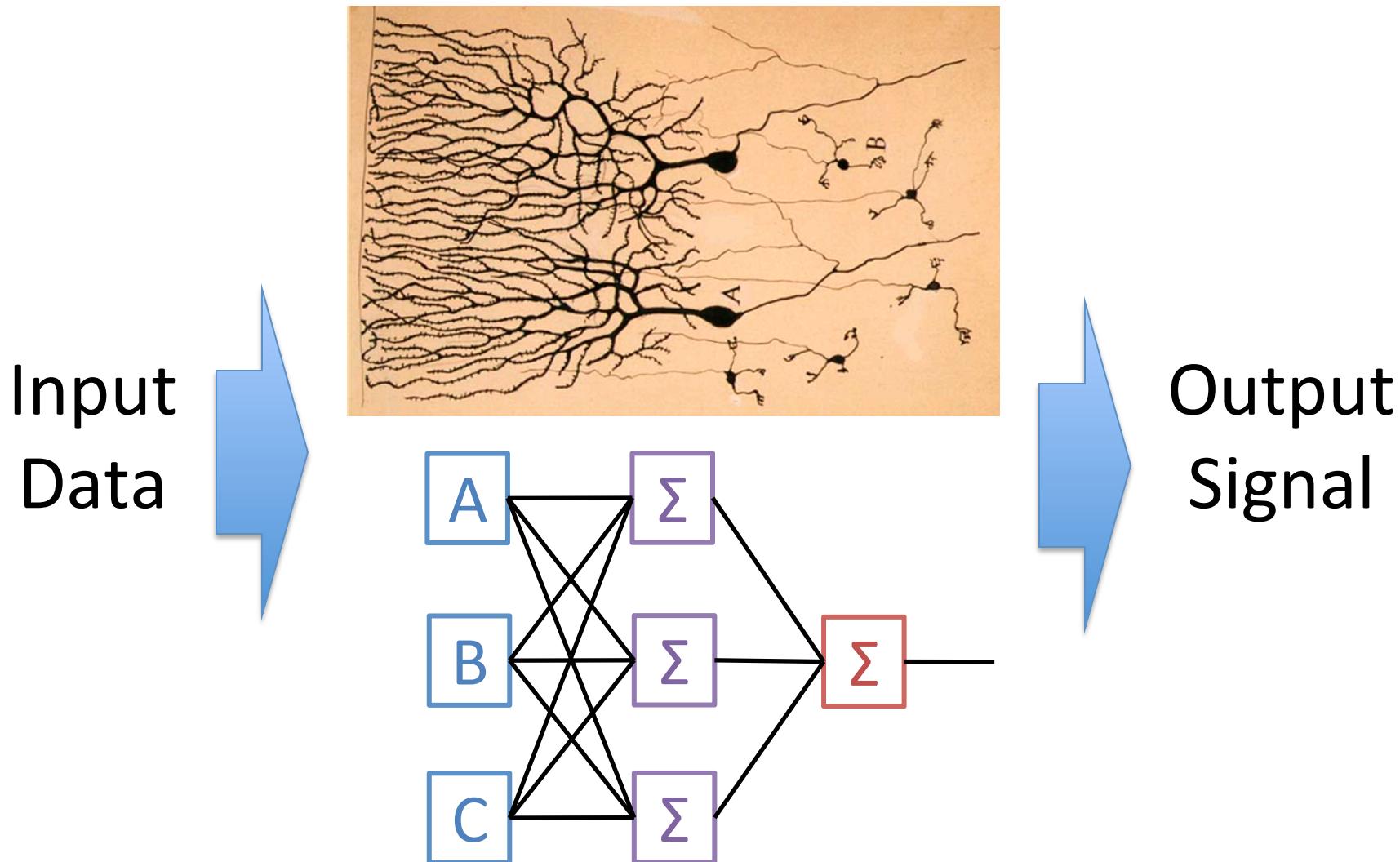


Techniques: Machine Learning

- 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

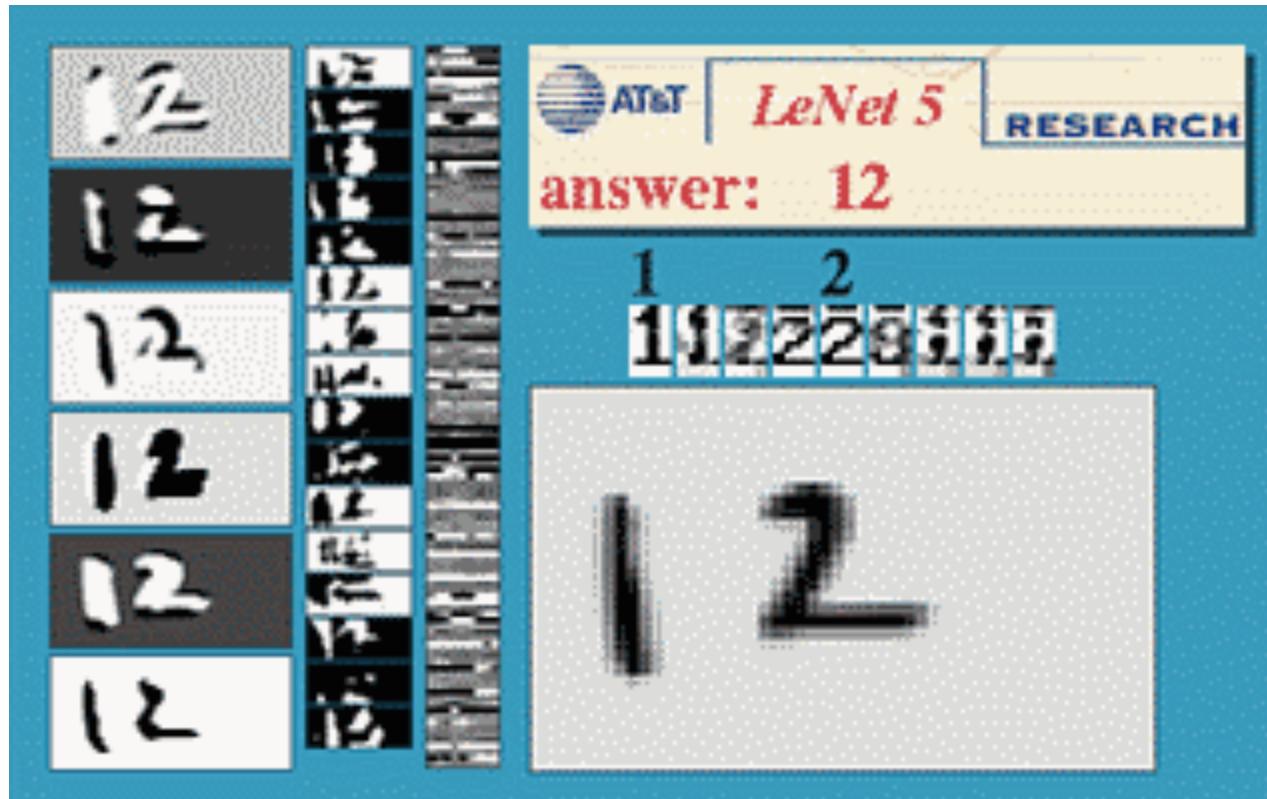


Example: Neural Network



Example: Neural Network

Neural network trained to recognize handwritten digits



<http://yann.lecun.com/exdb/lenet/a12.html>

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Application: Natural Language

Speech technologies (e.g. Siri)

- Automatic speech recognition (ASR)
- Text-to-speech synthesis (TTS)
- Dialog systems

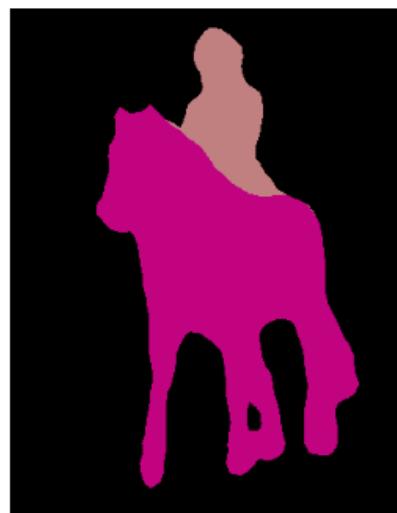
Language processing technologies

- Question answering
- Machine translation
- Web search
- Text classification, spam filter, etc...

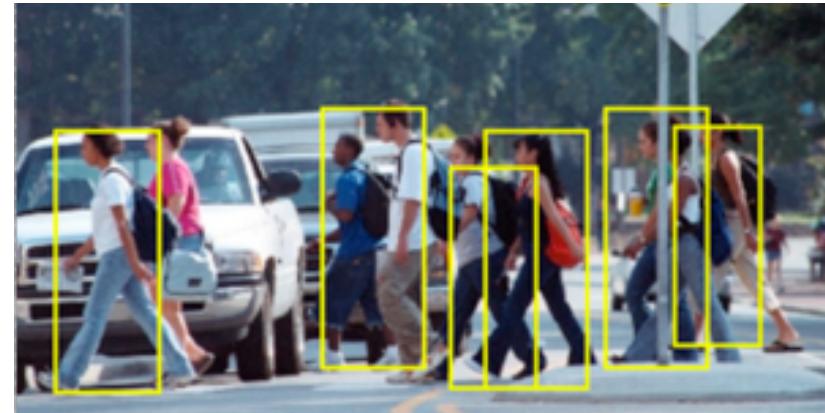


Application: Vision (Perception)

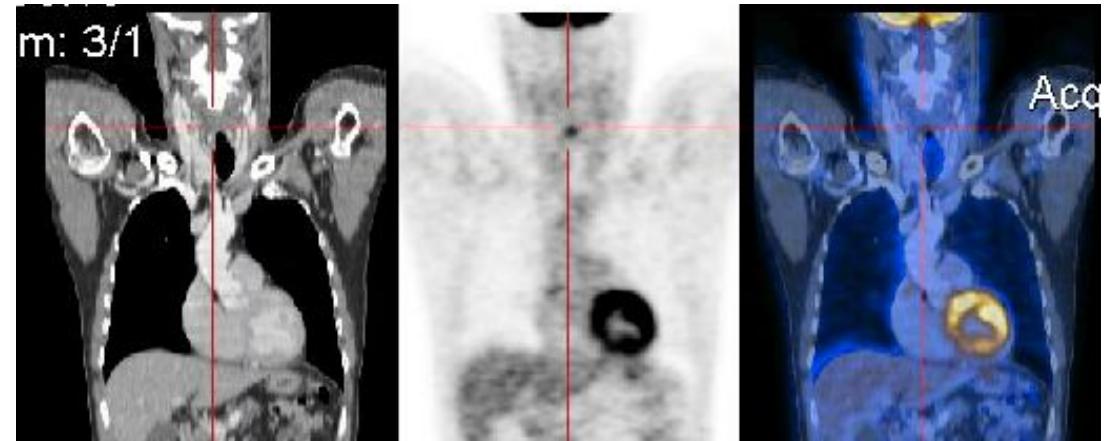
- Tasks related to understanding images/camera input



Segmentation



Pedestrian Detection



Alignment/Registration

Long, Shelhamer, Darrell. arXiv preprint arXiv:1411.4038 (2014).

https://en.wikipedia.org/wiki/Medical_image_computing#/media/File:CT-PET.jpg

Application: Vision (Perception)

Video: Terminator

<https://www.youtube.com/watch?v=9MeaaCwBW28>

Application: Robotics

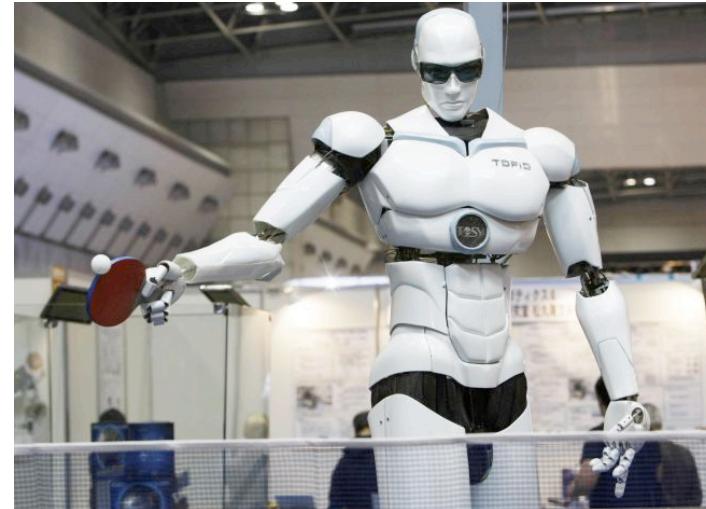
- For many, the coolest and scariest part of AI
- Combines fields of AI/CS
 - Speech recognition
 - Synthetic voice
 - Machine vision
 - Planning
 - HCI



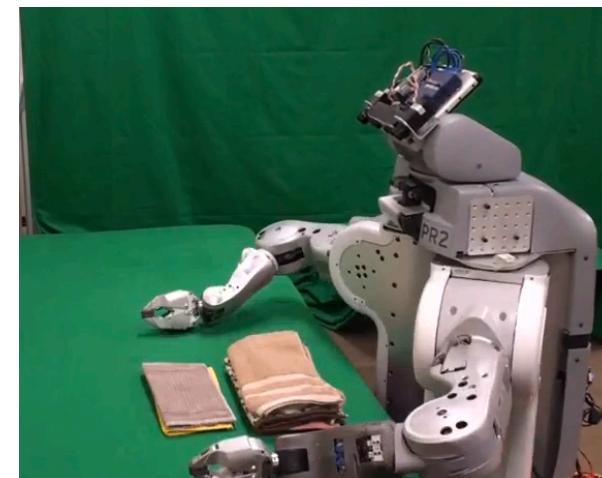
Autonomous
helicopter



Surgical robots



TOPIO, the ping-pong playing robot



Towel-folding!

Application: Robotics

Video: Towel Folding

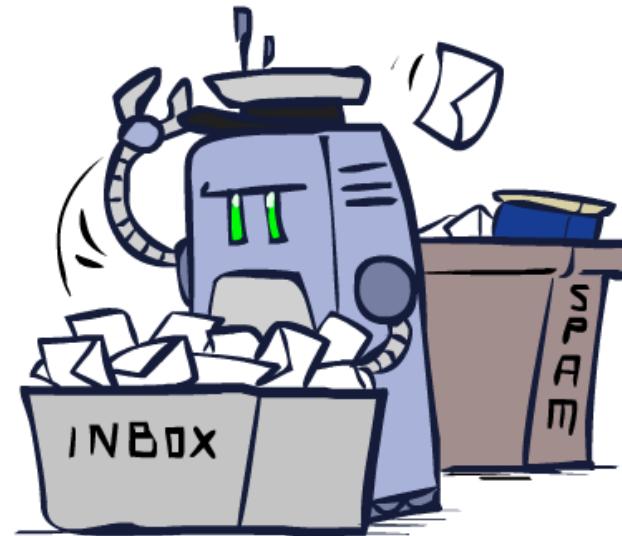
<http://www.youtube.com/watch?v=gy5g33S0Gzo>

Video: Bicycle Robot

<http://www.youtube.com/watch?v=SqBw7XapJKk>

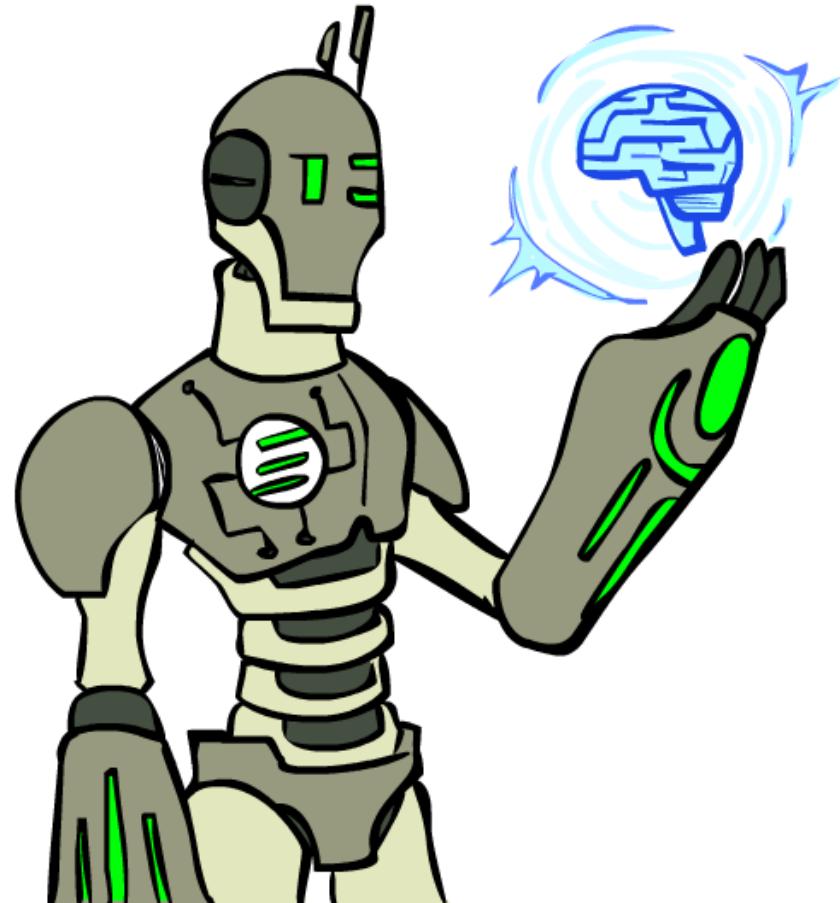
Application: Much, Much More

- Scheduling, e.g. airline routing, military
- Route planning, e.g. Google maps
- Medical diagnosis
- Web search engines
- Spam classifiers
- Automated help desks
- Fraud detection
- Product recommendations
- ... Lots more!



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
- CogSci131: Computational Models of Cognition



That's all folks



Feel free to send me questions:

Pat Virtue
virtue@eecs.berkeley.edu