

Artificial Intelligence

CSE 120 Spring 2017

Slide credits: Pieter Abbeel, Dan Klein,
Stuart Russell, Pat Virtue &
<http://csillustrated.berkeley.edu>

Instructor:

Justin Hsia

Teaching Assistants:

Anupam Gupta, Braydon Hall, Eugene Oh, Savanna Yee

Candy Grab Game

- 1) Grab a pack of “game pieces” (at least 10 per pair of students)
- 2) Play the following game
 - a) 10 pieces on the table
 - b) Take turns taking either 1 or 2 pieces
 - c) Player that takes the last piece(s) wins 😊
- 3) How do humans learn to play this game?
- 4) How would a computer learn to play this game?

```
int takeTurn(int numPiecesAvailable)
```

Administrivia

❖ Assignments:

- Tic-Tac-Toe due tonight (5/19)
- Project Proposal due Saturday (5/20)
- Innovation Exploration post due Sunday (5/21)

❖ Project:

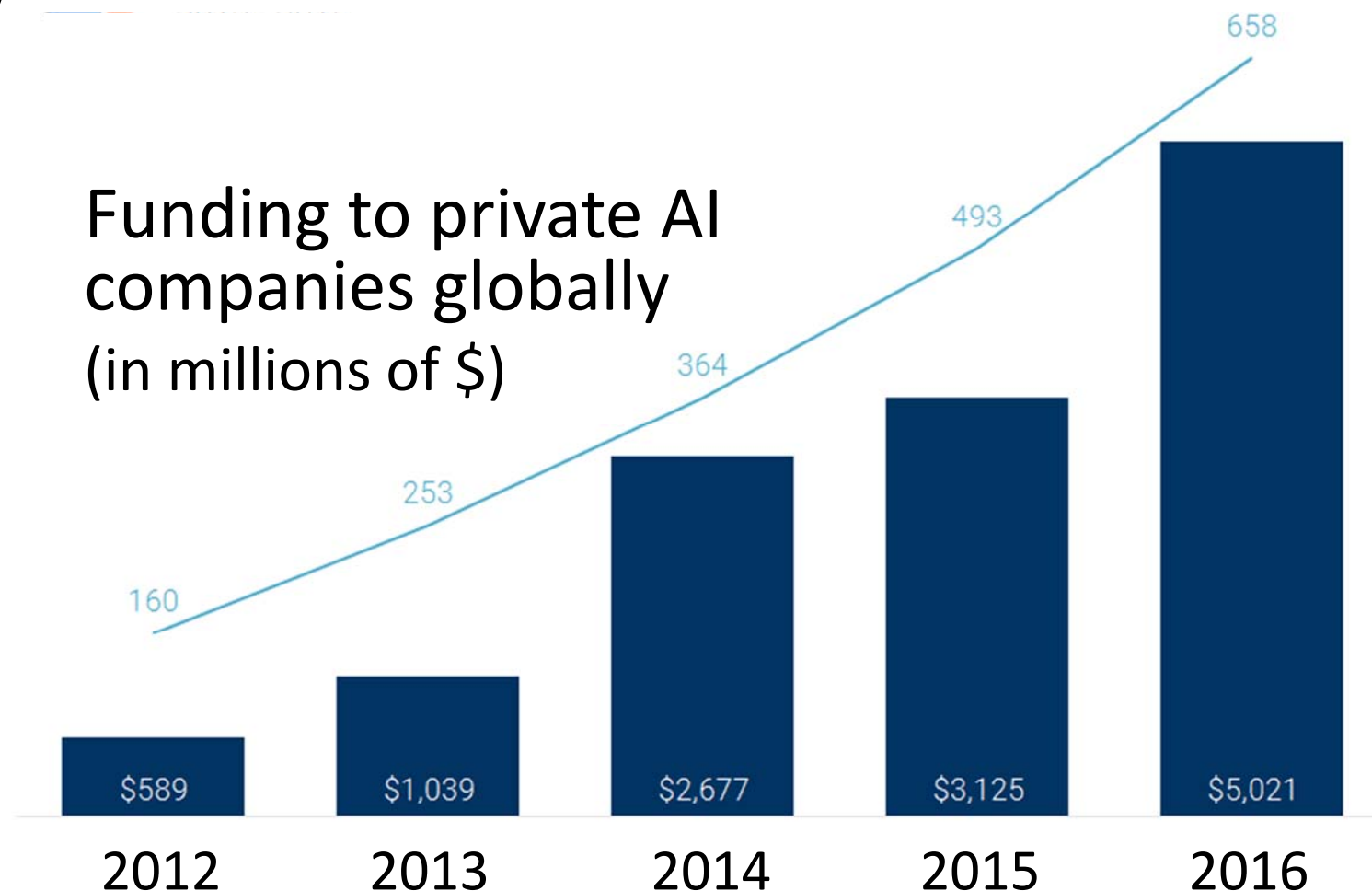
- Dream big! It's okay to scale back later
 - You might be surprised at what you can accomplish
- Feel free to brainstorm with a staff member
- Make it something that you're excited about

Outline

- ❖ **What is AI?**
- ❖ AI History
 - AI winter and the resurgence
- ❖ AI Today
 - Applications and how they work
- ❖ AI Tomorrow
 - Ethics and the singularity

Artificial Intelligence

❖ Why learn about AI?



<https://www.cbinsights.com/blog/artificial-intelligence-startup-funding/>

Candy Grab Game

```
int takeTurn(int numPiecesAvailable) {  
    return ? ;
```

```
}
```

Candy Grab Game

- ❖ Agent 001 – always choose 1

```
int takeTurn(int numPiecesAvailable) {  
    return 1;  

```

```
}
```

Candy Grab Game

- ❖ Agent 002 – always choose 2

```
int takeTurn(int numPiecesAvailable) {  
    return 2;  

```

```
}
```

Candy Grab Game

- ❖ Agent 007 – whatever you think is best

```
int takeTurn(int numPiecesAvailable) {  
    return ?;  
  
}
```


Candy Grab Game

- ❖ Agent 007 – whatever you think is best

```
int takeTurn(int numPiecesAvailable) {  
    if(numPiecesAvailable%3 == 2) {  
        return 2;  
    } else {  
        return 1;  
    }  
}
```

Candy Grab Game

- ❖ Agent 007 – whatever you think is best

```
int takeTurn(int numPiecesAvailable) {  
    return ?;  
}
```

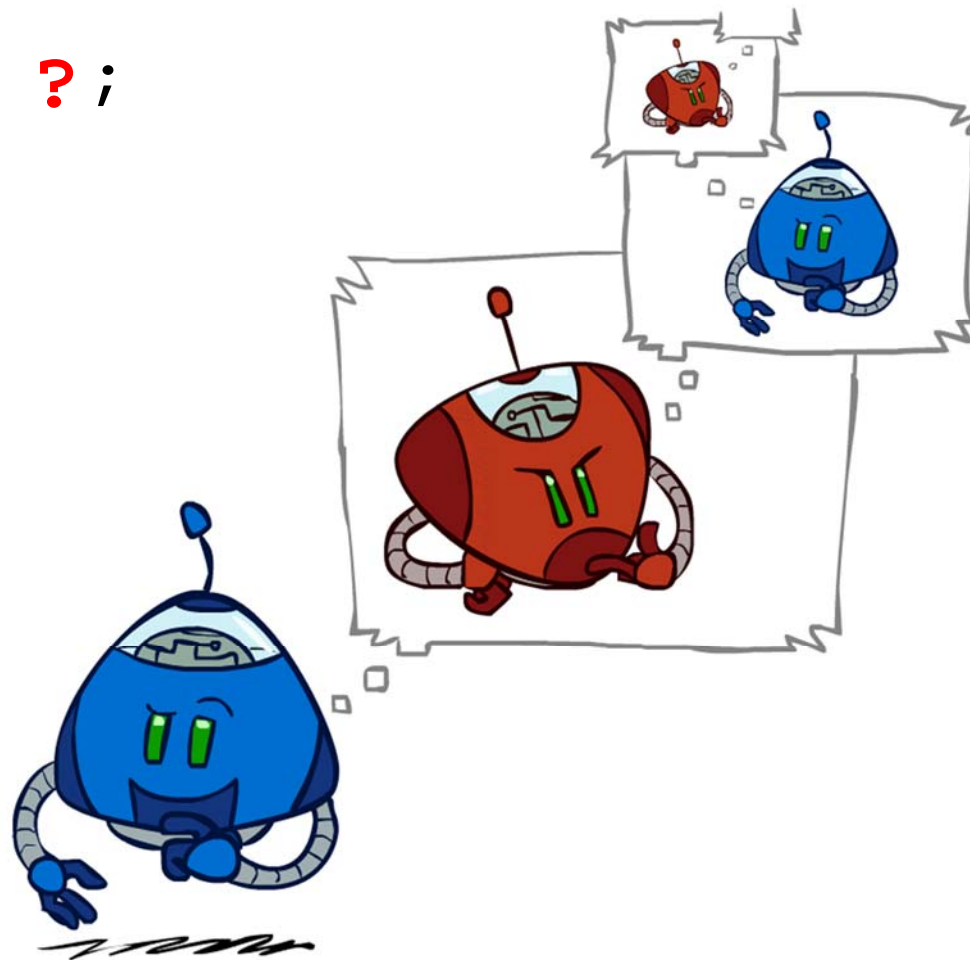
- What if we had:

```
boolean willIWin(int numPiecesAvailable,  
                boolean isMyTurn,  
                int action)
```

Candy Grab Game

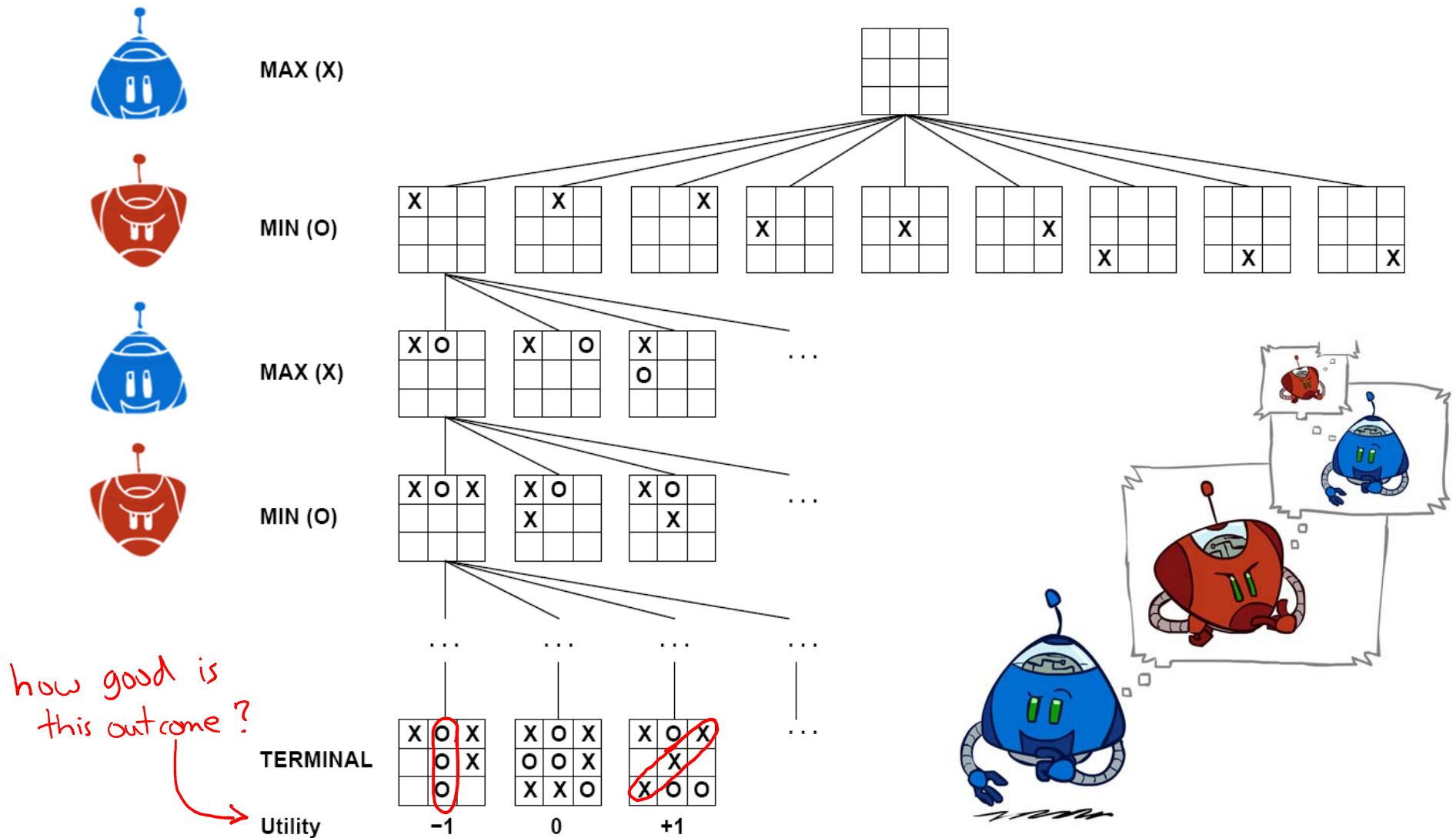
- ❖ Agent 007 – whatever you think is best

```
int takeTurn(int numPiecesAvailable) {  
    return ?;  
}
```



How: Search & Planning

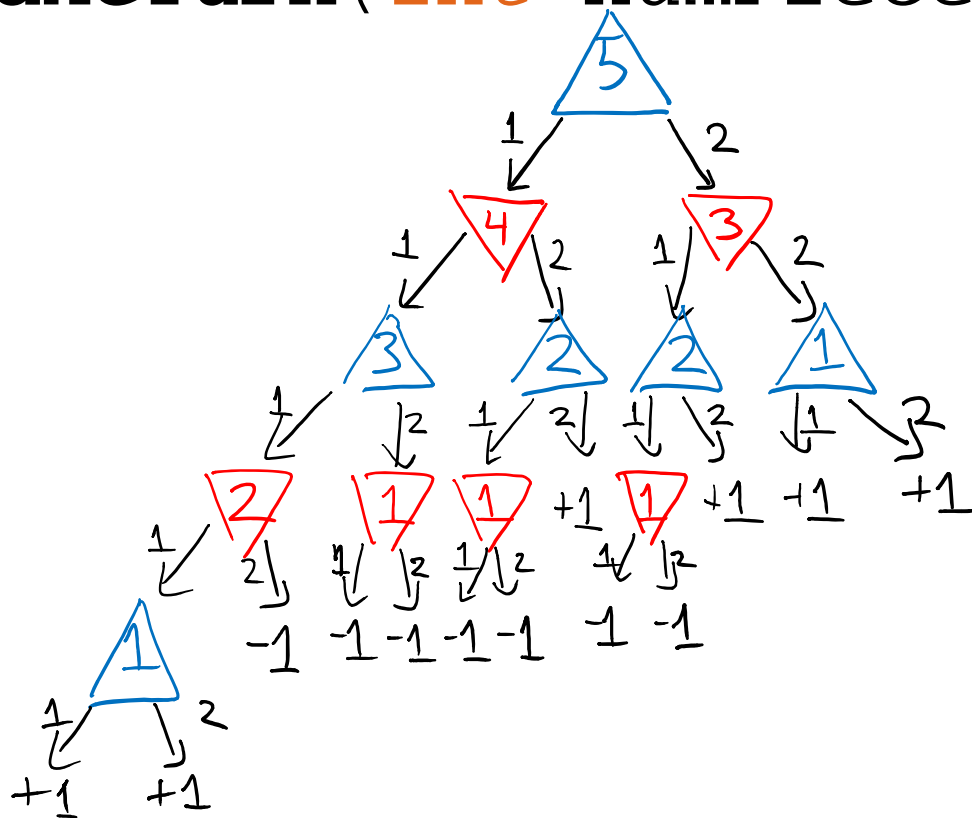
❖ I take an action... then what? ... then what?



Candy Grab Game (Min-Max)

- ❖ Agent 007 – whatever you think is best

```
int takeTurn(int numPiecesAvailable)
```



Candy Grab Game (Statistical)

- ❖ Agent 007 – whatever you think is best

```
int takeTurn(int numPiecesAvailable)
```

Pieces Available	Take 1	Take 2
2	0%	100%
3	2%	1%
4	75%	2%
5	4%	68%
6	5%	6%

AI Games in the News

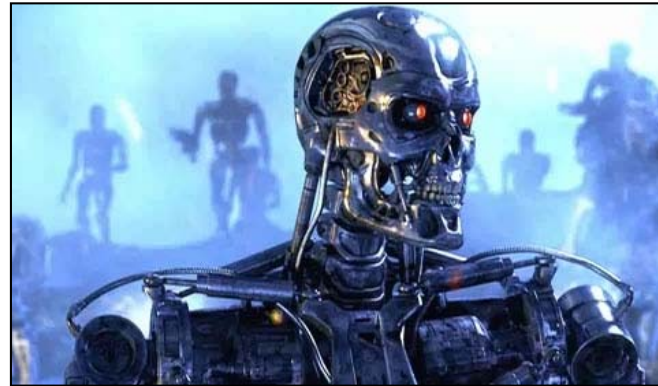


The screenshot shows the top of a web page for The New Yorker. At the top left, there is a promotional banner for the magazine with the text "READ SOMETHING THAT MEANS SOMETHING. \$1 A WEEK" and "SUBSCRIBE RENEW GIVE A GIFT NON-U.S. ORDERS". The main title "THE NEW YORKER" is centered at the top. Below the title is a navigation menu with links for NEWS, CULTURE, BOOKS & FICTION, SCIENCE & TECH, BUSINESS, HUMOR, MAGAZINE, VIDEO, ARCHIVE, and SUBSCRIBE. The date "FEBRUARY 25, 2015" is displayed on the left. The main headline is "ARTIFICIAL INTELLIGENCE GOES TO THE ARCADE" by "BY NICOLA TWILLEY". Below the headline are social media sharing icons for Facebook, Twitter, Google+, and email. On the right side, there is a logo for "ELEMENTS" featuring a star, a crescent moon, and a planet. Below the headline, the article text begins with a large "A" and reads: "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". To the right of the text is a video player showing a classic Atari game, Breakout, with a score of 07531. Below the video player is a sign-up form for newsletters with the text "SIGN UP FOR NEWSLETTERS", an input field for "E-mail address", and a "SIGN UP" button. Below the sign-up form is an advertisement placeholder labeled "ADVERTISEMENT".

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

So What is AI?

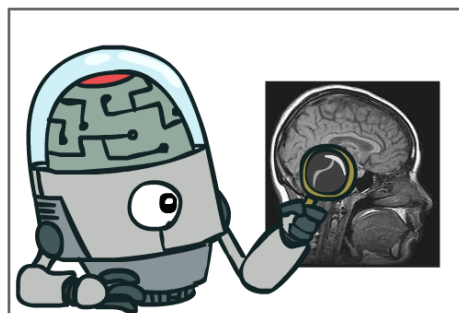
Sci-Fi AI?



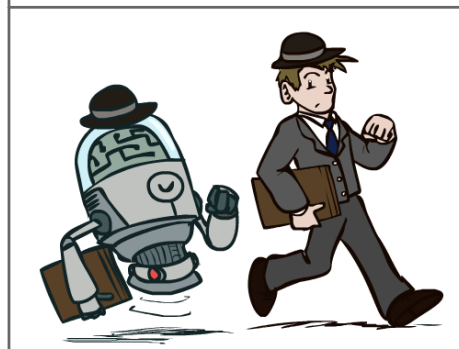
So What is AI?

- ❖ The science of making machines that:

Think like people

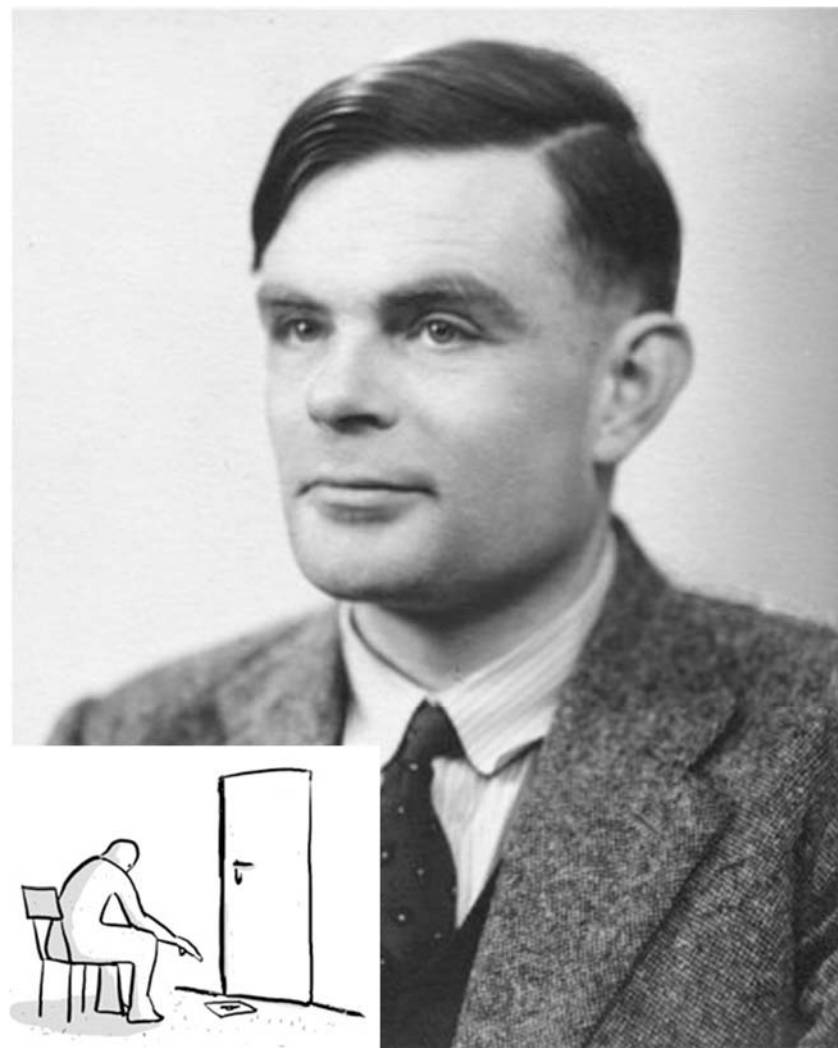


Act like people



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.”

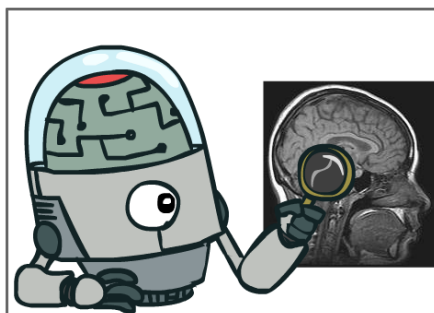


http://en.wikipedia.org/wiki/Turing_test

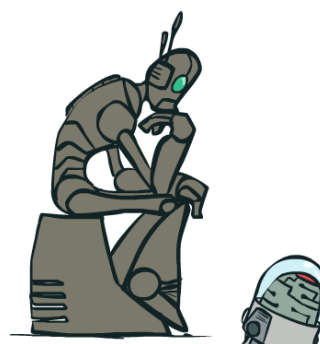
So What is AI?

- ❖ The science of making machines that:

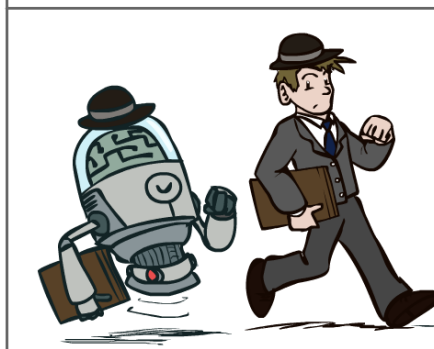
Think like people



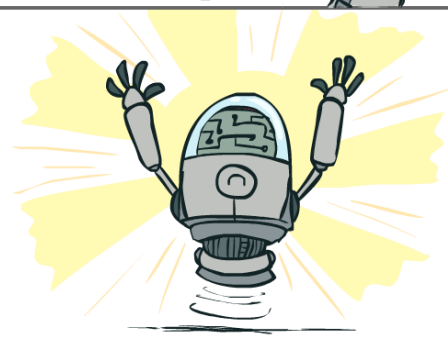
Think rationally



Act like people

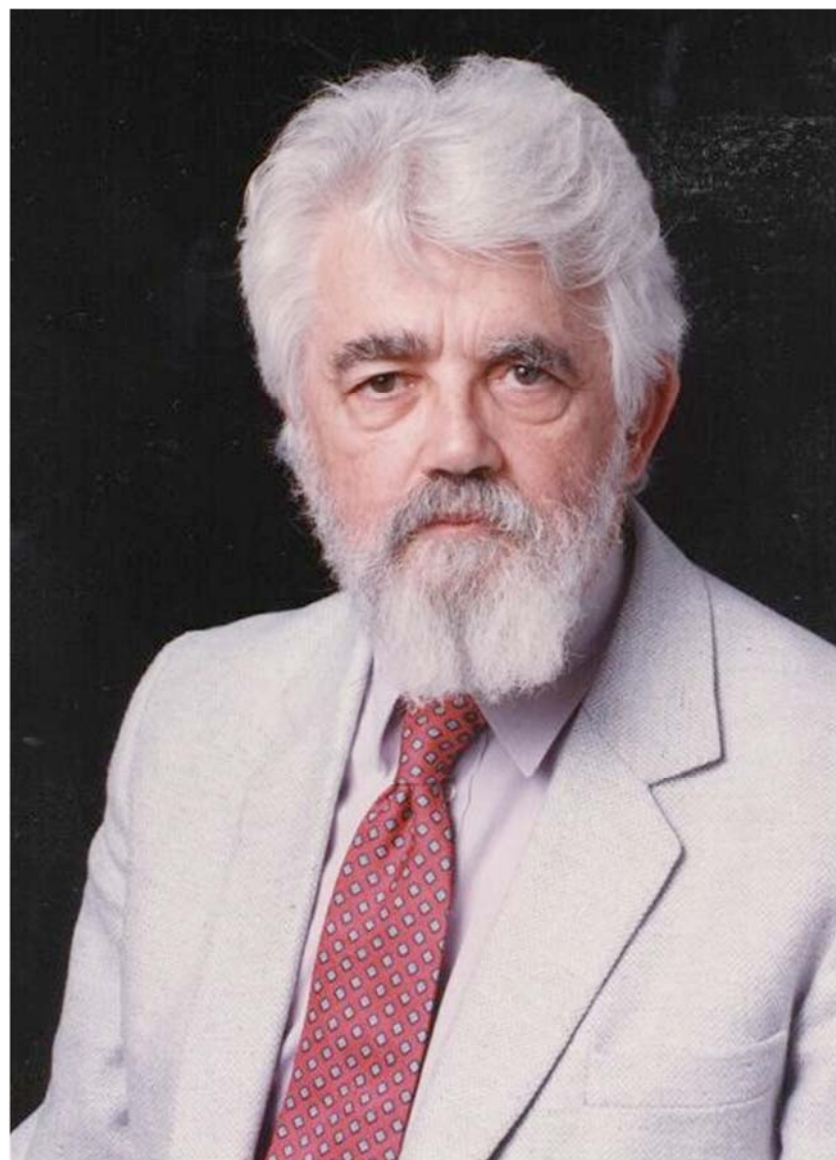


Act rationally



AI Definition by John McCarthy

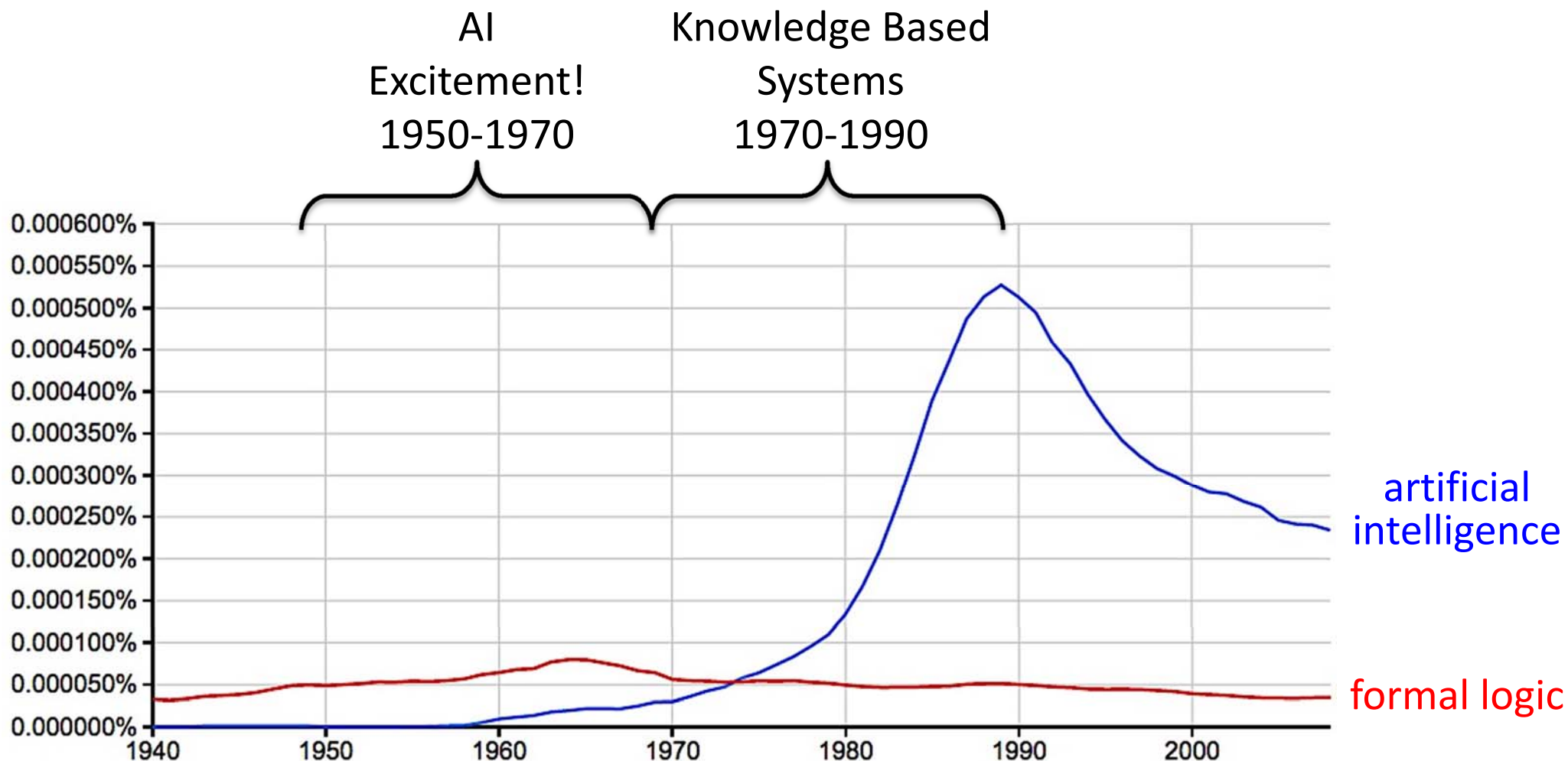
- ❖ “Getting a computer to do things which, when done by people, are said to involve intelligence”
 - Finesses the idea of whether a computer has consciousness, whether they have rights, etc.



Outline

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 - Ethics and the singularity

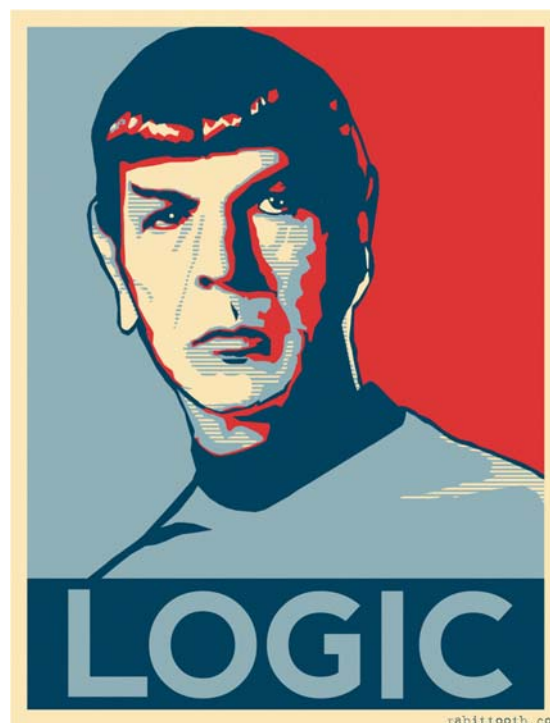
A Brief History of AI



Google Books Ngram Viewer: <https://books.google.com/ngrams>

Logic

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



http://www.rabbittooth.com/gallery/spock_in_2012_by_rabbittooth.jpg

isDog(animal)

❖ *barks & fur & fourLegs* \Leftrightarrow *dog*

```
boolean isDog(Animal A) {  
    if(!barks(A)) {  
        return false;  
    }  
    if(!hasFur(A)) {  
        return false;  
    }  
    if(!hasFourLegs(A)) {  
        return false;  
    }  
    return true;  
}
```

What's the problem?

Dog

- Barks
- Has Fur
- Has four legs

isDog(animal)

❖ *barks & fur & fourLegs* \Leftrightarrow *dog*



What's the problem?

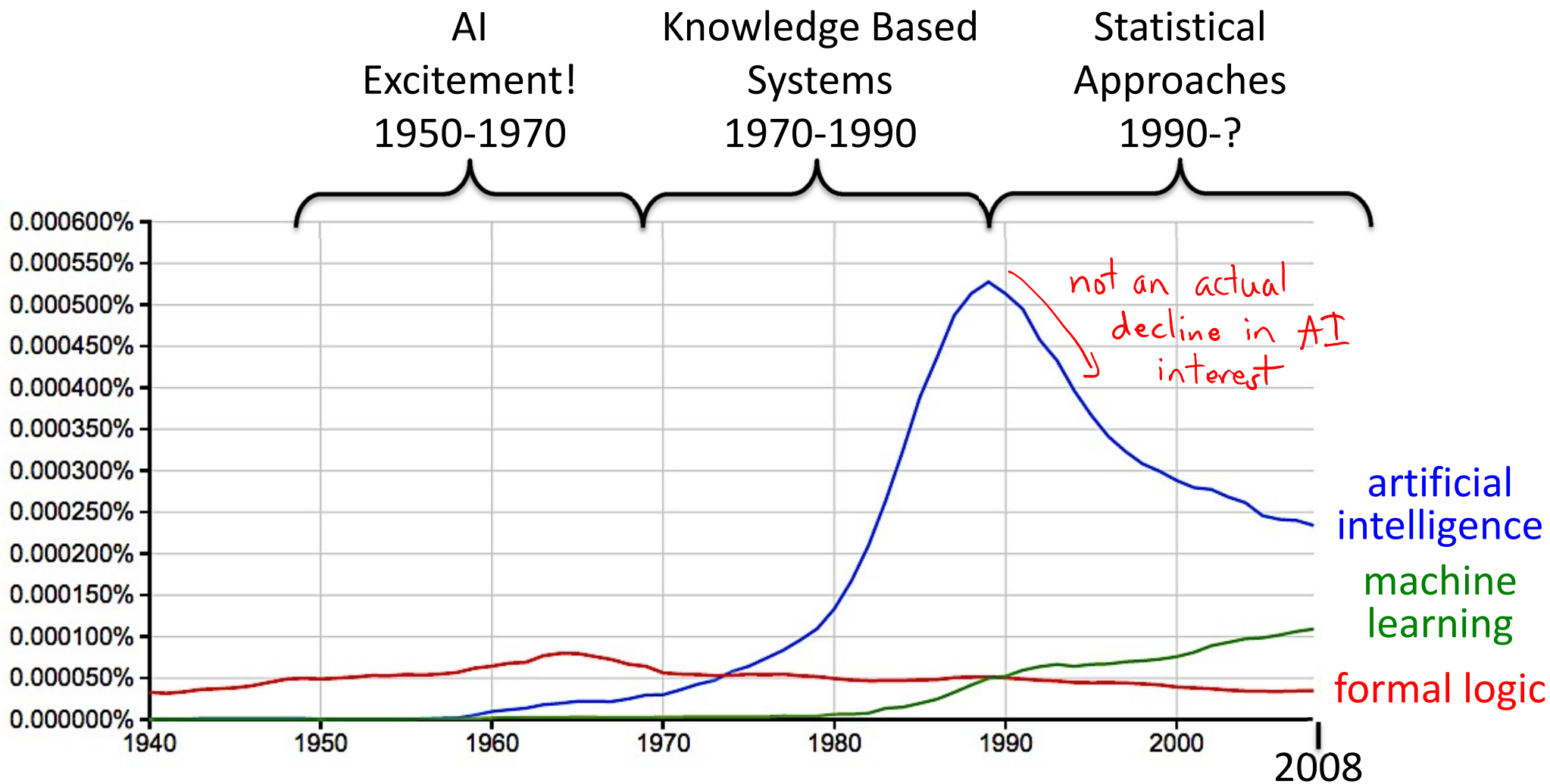
Dog

- Barks
- Has Fur
- Has four legs

Sheila



A Brief History of AI



Google Books Ngram Viewer: <https://books.google.com/ngrams>

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“Intelligent” Applications

- ❖ Discuss in pairs/groups:
 - List at least four existing applications that seem intelligent

- ❖ Audience responses:
 - Alexa, Siri – learn preferences, speech recognition
 - Google Maps – routing, path following, real-time updates
 - Google Translate – language detection, grammar, syntax
 - Pandora – learn musical preferences, suggestions

Applications: Natural Language

- ❖ Speech technologies (*e.g.* Siri)
 - Automatic speech recognition (ASR)
 - Text-to-speech synthesis (TTS)
 - Dialog systems
- ❖ Language processing technologies
 - Google translation
 - Web search
 - Spam filter



How: Probability

Notation:

$$P(\text{limb} \mid \text{artificial}, \text{audio})$$

“Probability of ‘limb’ given ‘artificial’ and audio”

- ❖ Example: speech recognition of “artificial ...”
 - Find most probable next word given “artificial” and the audio for the second word

Which second word gives the highest probability?

Break down problem

n-gram probability * audio probability

$$P(\mathbf{limb} \mid \text{artificial}, \text{audio})$$

$$P(\mathbf{limb} \mid \text{artificial}) * P(\mathbf{limb} \mid \text{audio})$$

$$P(\mathbf{intelligence} \mid \text{artificial}, \text{audio})$$

$$P(\mathbf{intelligence} \mid \text{artificial}) * P(\mathbf{intelligence} \mid \text{audio})$$

$$P(\mathbf{flavoring} \mid \text{artificial}, \text{audio})$$

$$P(\mathbf{flavoring} \mid \text{artificial}) * P(\mathbf{flavoring} \mid \text{audio})$$

Applications: Vision (Perception)

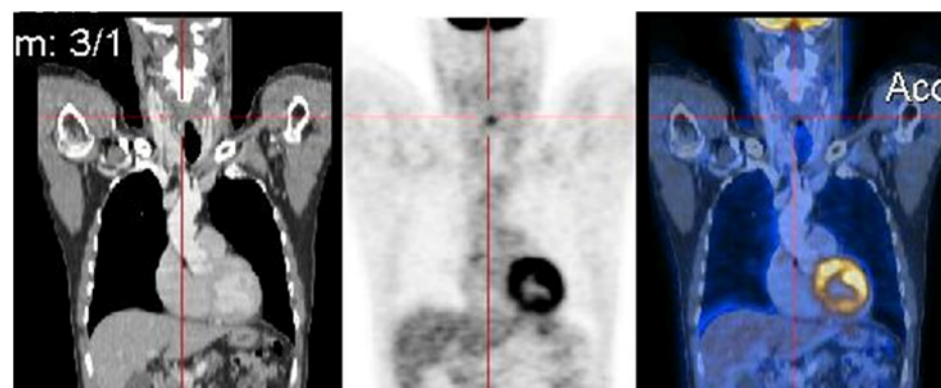
- ❖ Tasks related to understanding images/camera input



Segmentation



Pedestrian Detection



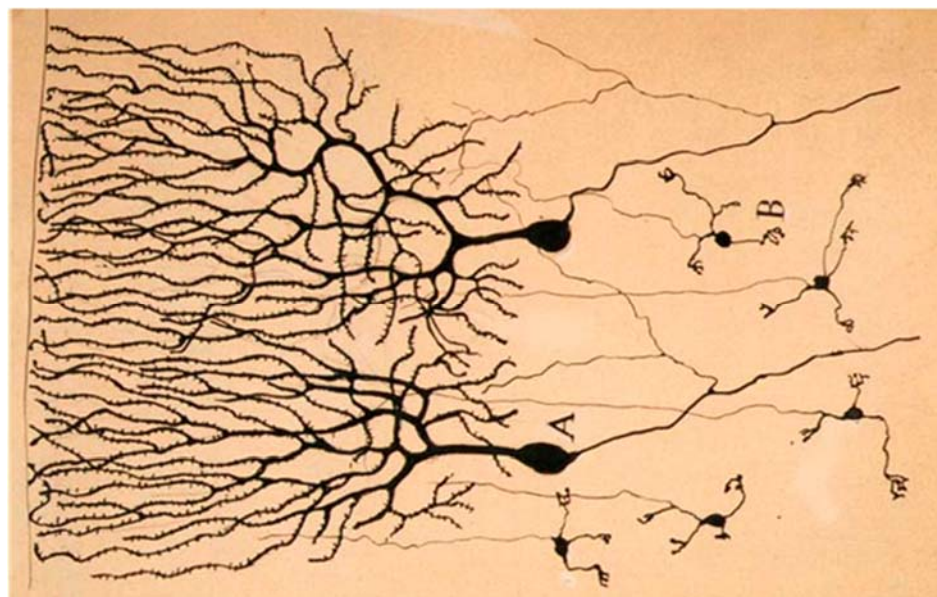
Alignment/Registration

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

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

How: Neural Networks

Input
Signal



Output
Signal



DOG



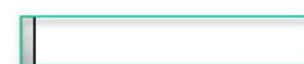
CAT



TREE



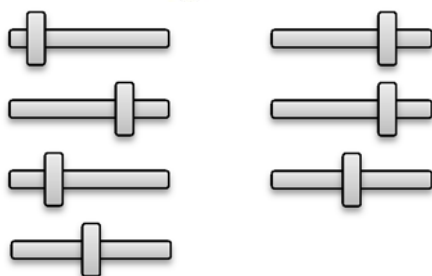
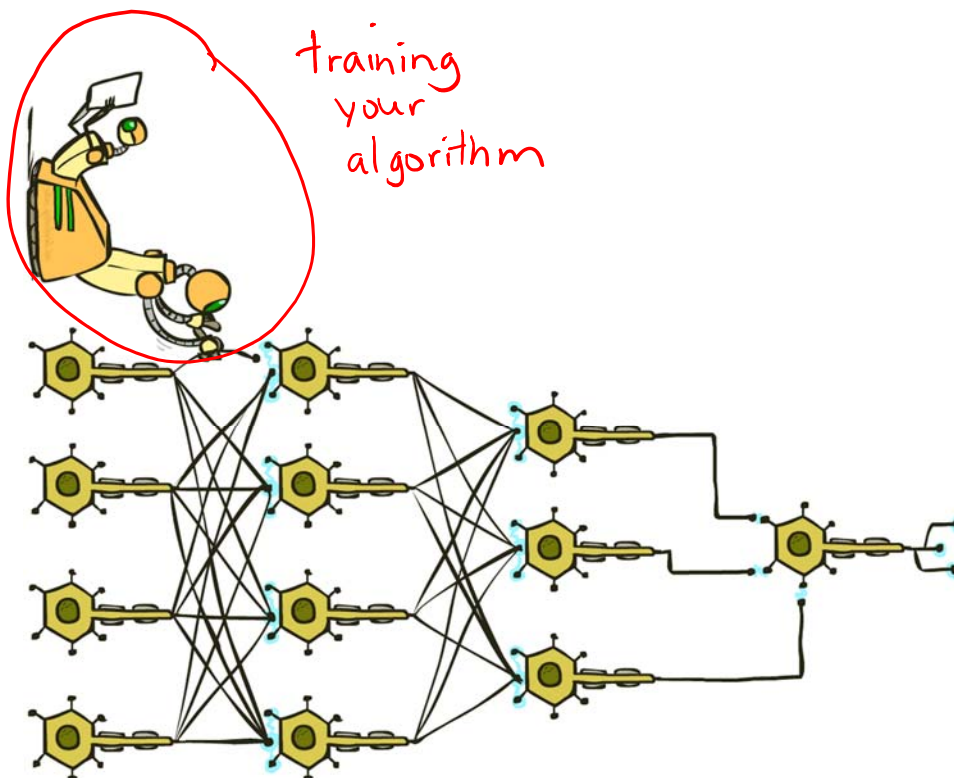
CAR



SKY

How: Neural Networks

Input
Signal



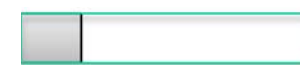
Output
Signal



DOG



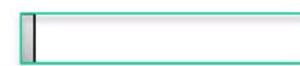
CAT



TREE

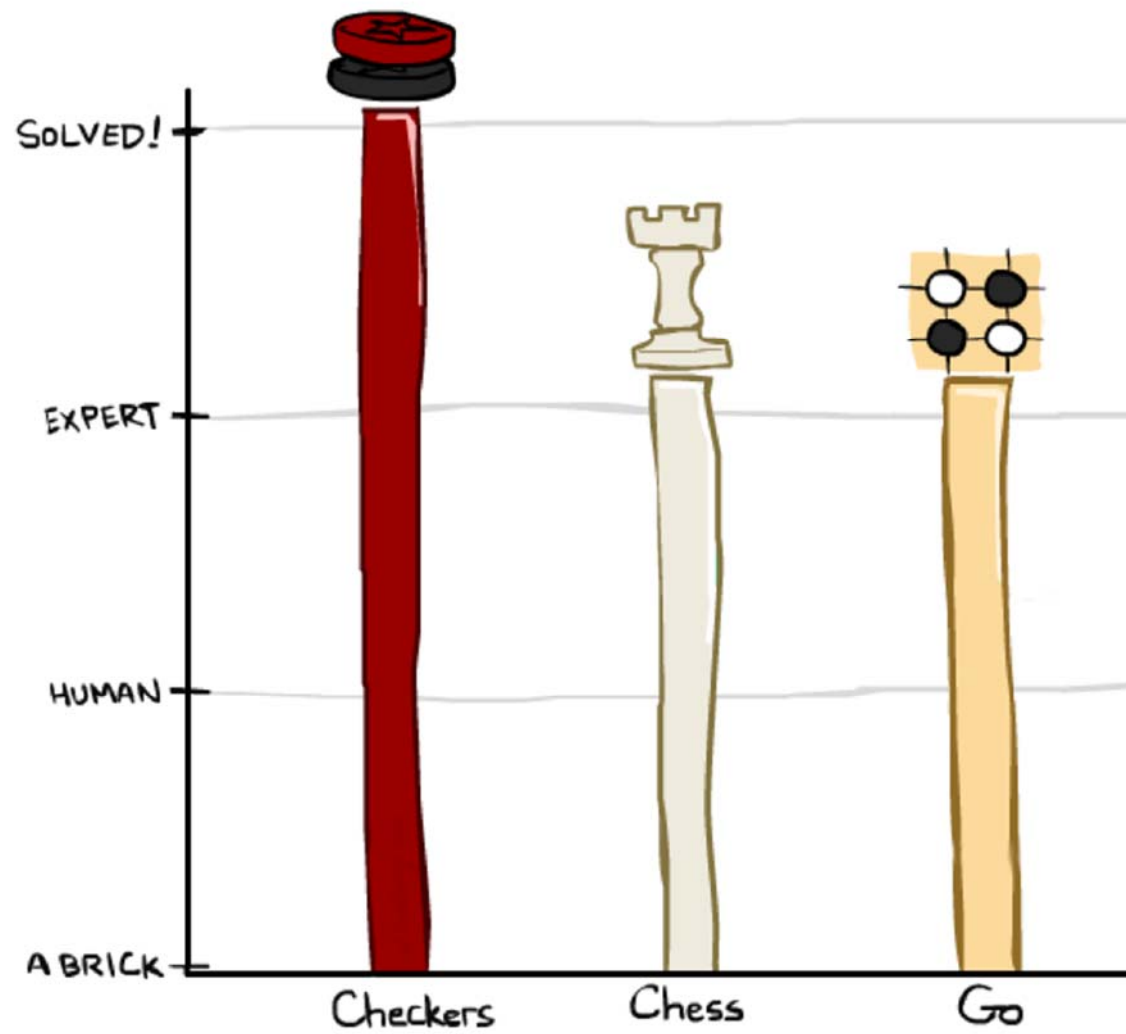


CAR



SKY

Applications: Games



How: Search & Planning

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



MAX (X)



MIN (O)



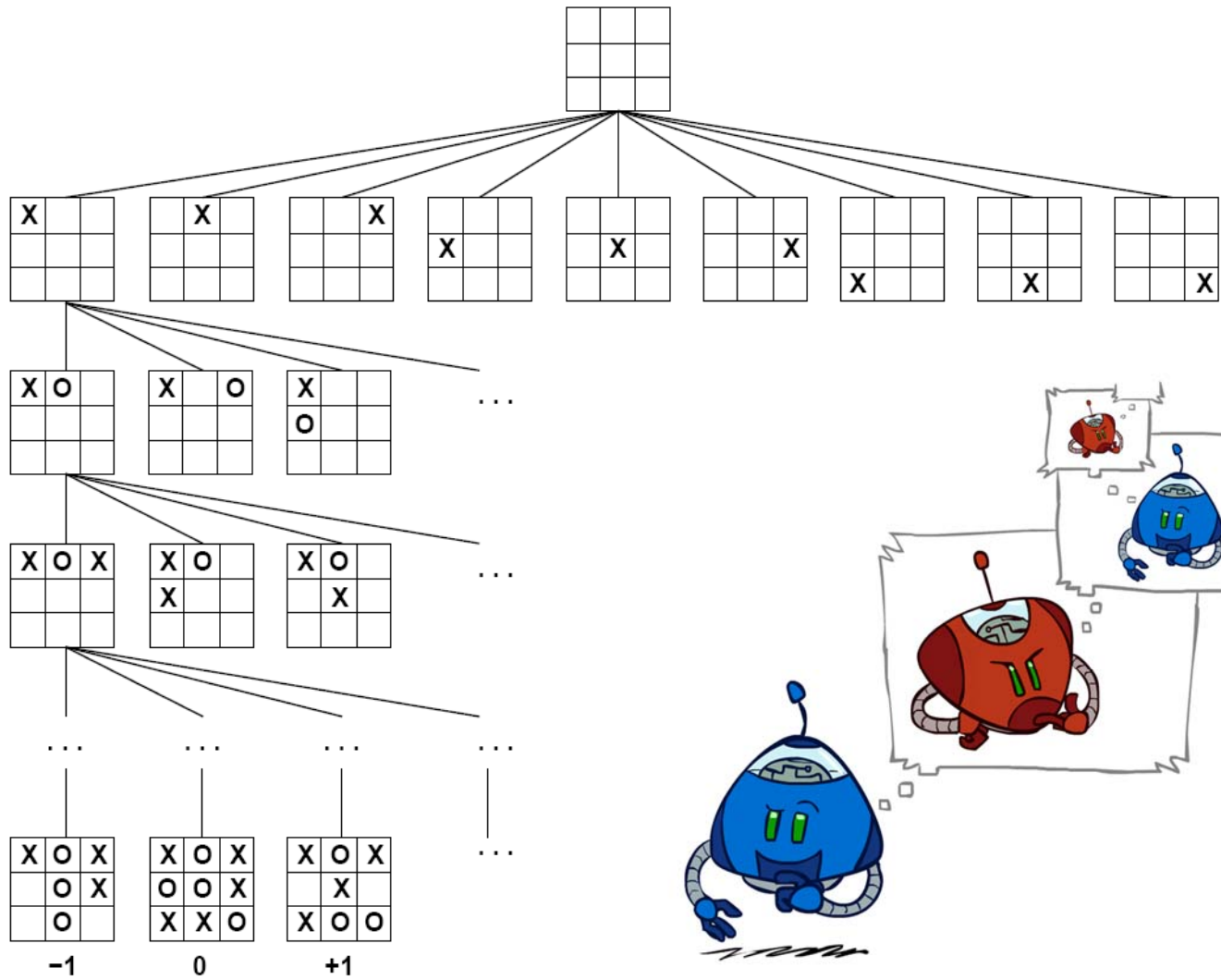
MAX (X)



MIN (O)

TERMINAL

Utility



Applications: Robotics

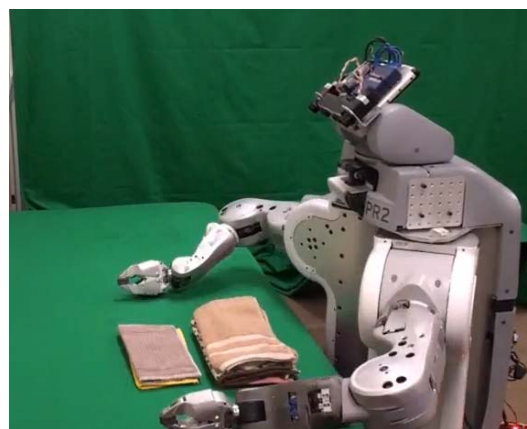
- ❖ For many, the coolest and scariest part of AI
- ❖ Combines fields of AI/CS
 - Speech recognition
 - Synthetic voice
 - Machine vision
 - Planning
 - HCI



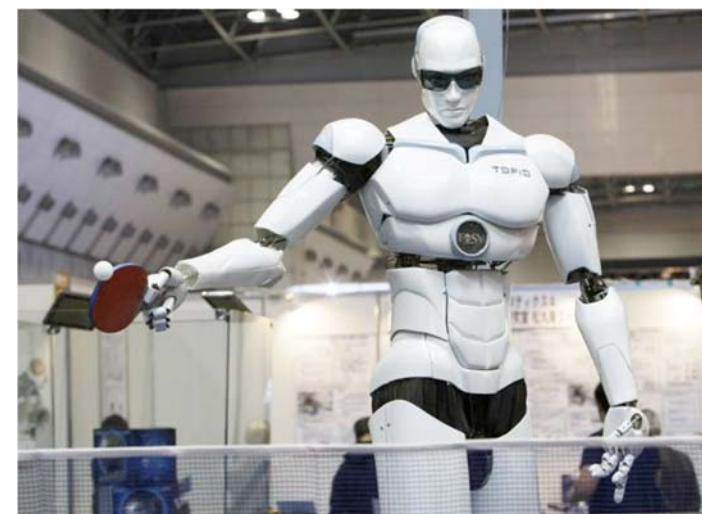
Surgical robots



Autonomous helicopter



Towel-folding!



TOPIO, the ping-pong playing robot

Applications: Robotics

- ❖ Video: Bipedal Robot – Boston Dynamics
 - <https://www.youtube.com/watch?v=rVlhMGQgDkY>
- ❖ Video: Robot Preschool – UC Berkeley
 - <http://www.bloomberg.com/features/2015-preschool-for-robots/>

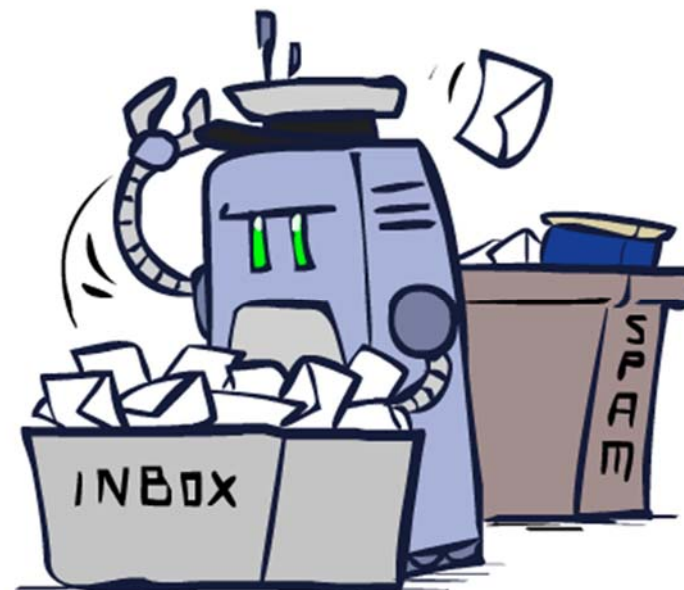
Applications: Driving



Image: <https://www.google.com/selfdrivingcar/how/>

Applications: 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!



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 - **Ethics and the singularity**

What's In a Training Set?

❖ Just like humans, machines can only learn what they are taught (or can read about on their own)

■ Biased training set = biased behavior

★ <https://techcrunch.com/2016/12/10/5-unexpected-sources-of-bias-in-artificial-intelligence/>

❖ Examples:

■ In March 2016, Microsoft released AI Twitter bot Tay

• <http://www.complex.com/life/2016/03/microsoft-racist-ai>

■ Software used to predict future criminals is biased against African Americans

• <https://www.propublica.org/article/machine-bias-risk-assessments-in-criminal-sentencing>

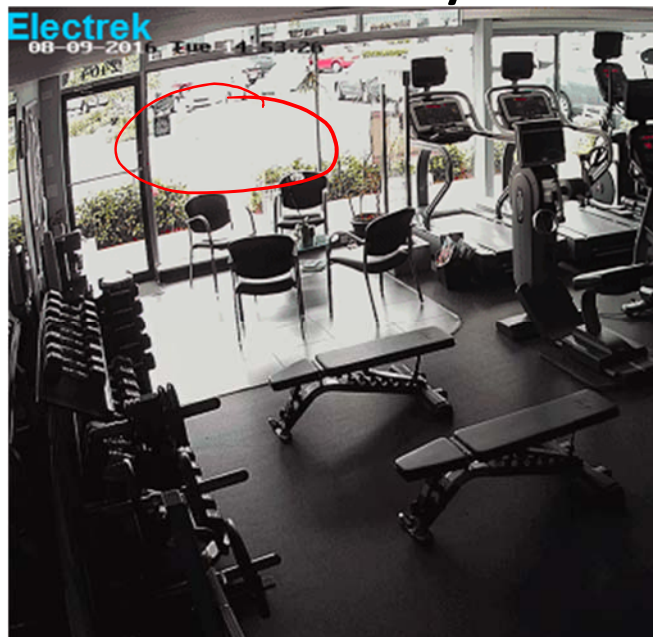
AI: What Should We Worry About?

❖ AI Ethics: Immediate concerns

Jobs



Liability



Weapons



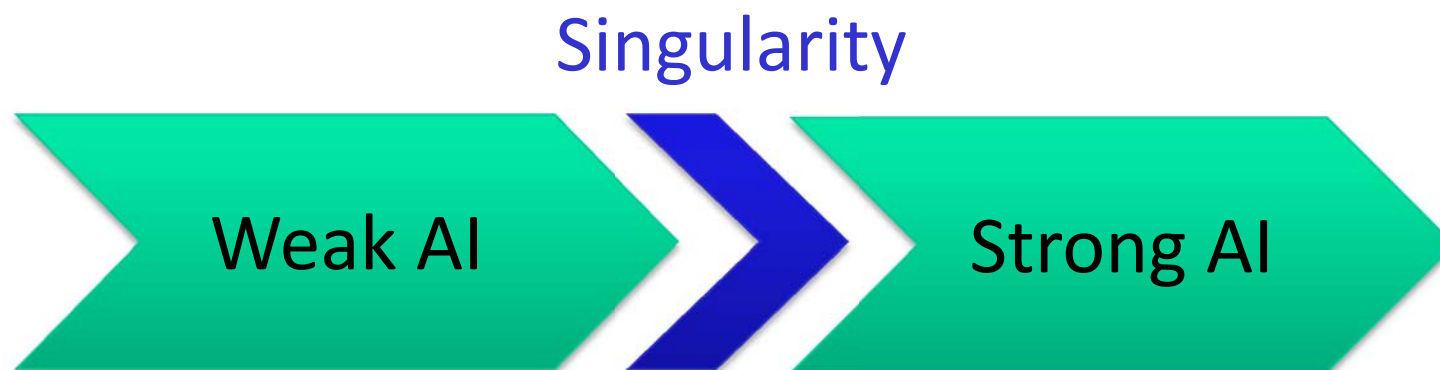
Images:

<http://ot.to/>

<https://electrek.co/2016/09/25/tesla-model-s-crashes-into-gym-driver-claims-autonomous-accel>

<http://futureoflife.org/2016/09/20/podcast-what-is-nuclear-risk/>

AI: Superintelligence



- Narrow AI
 - Limited number of applications
- Artificial General Intelligence
 - Recursive self-improvement
 - Beyond human control