Candy Grab Game

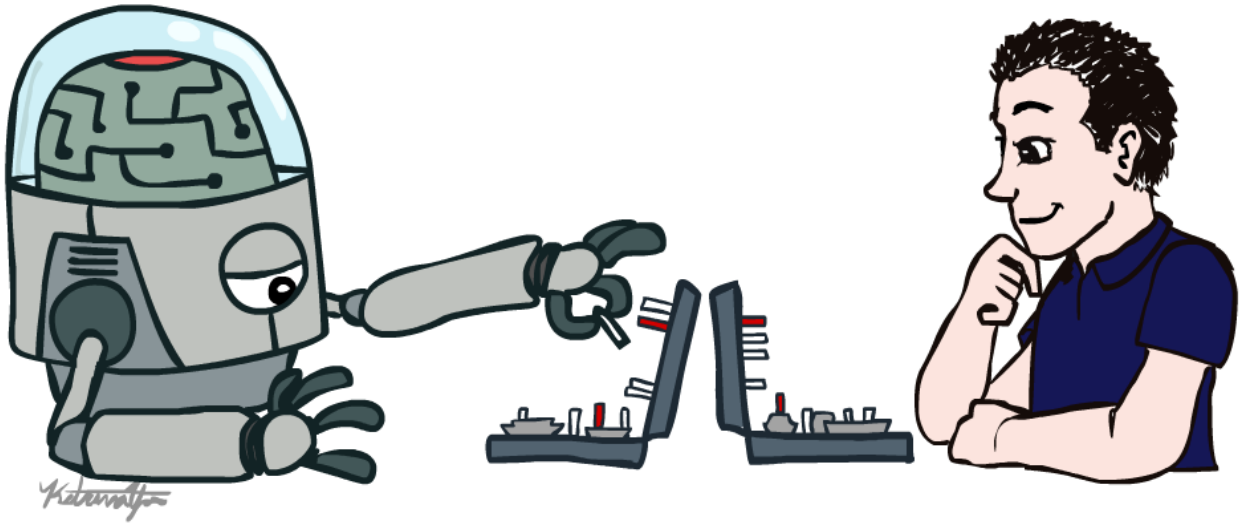
As you walk in:

1. Grab a pack of game pieces (candy)
2. Form groups of 2 (or 3 with an observer)
3. Play the game!
   A. 11 pieces on the table
   B. Take turns taking either 1 or 2 pieces
   C. Person that takes the last piece wins!
4. Think about how you might implement an Agent to play this in code:

```
class Agent
    function getAction(state)
        return action
```

AI: Representation and Problem Solving

Introduction



Instructors: Fei Fang & Pat Virtue

Slide credits: CMU AI & http://ai.berkeley.edu

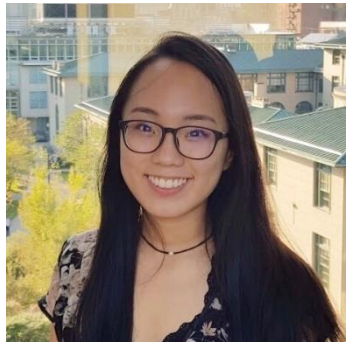
Course Staff

Instructors

Fei
Fang

Pat
Virtue

Teaching Assistants



Angela
Yang

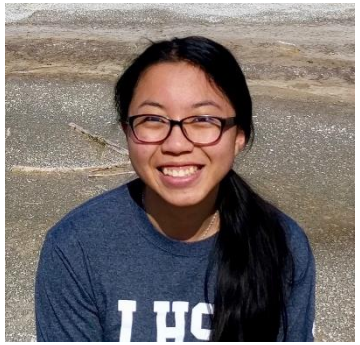
Claire Wang
(Head TA)

George
Brown

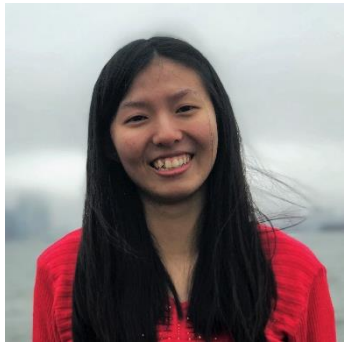
Michelle
Ma

Sean
Pereira

Chakara (Tian)
Owarang



Tina
Wu



Vicky
Zeng

Course Information

Website: https://www.cs.cmu.edu/~15281

Canvas: canvas.cmu.edu

Gradescope: gradescope.com

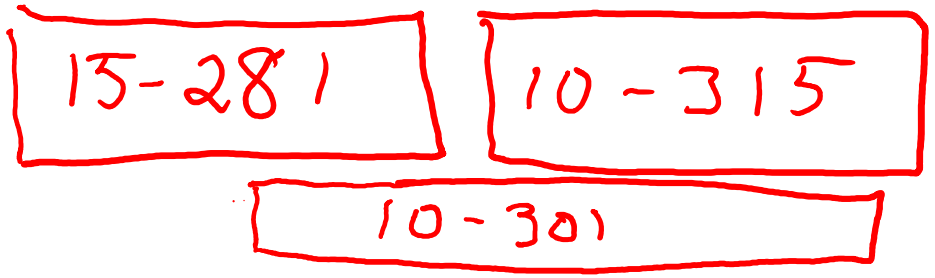
Communication: piazza.com

E-mail: feifang@cmu.edu

pvirtue@cmu.edu

Prerequisites/Corequisites

Course Scope



Announcements

Recitation starting this Friday

- Recommended. Materials are fair game for exams
- Choosing sections

Assignments:

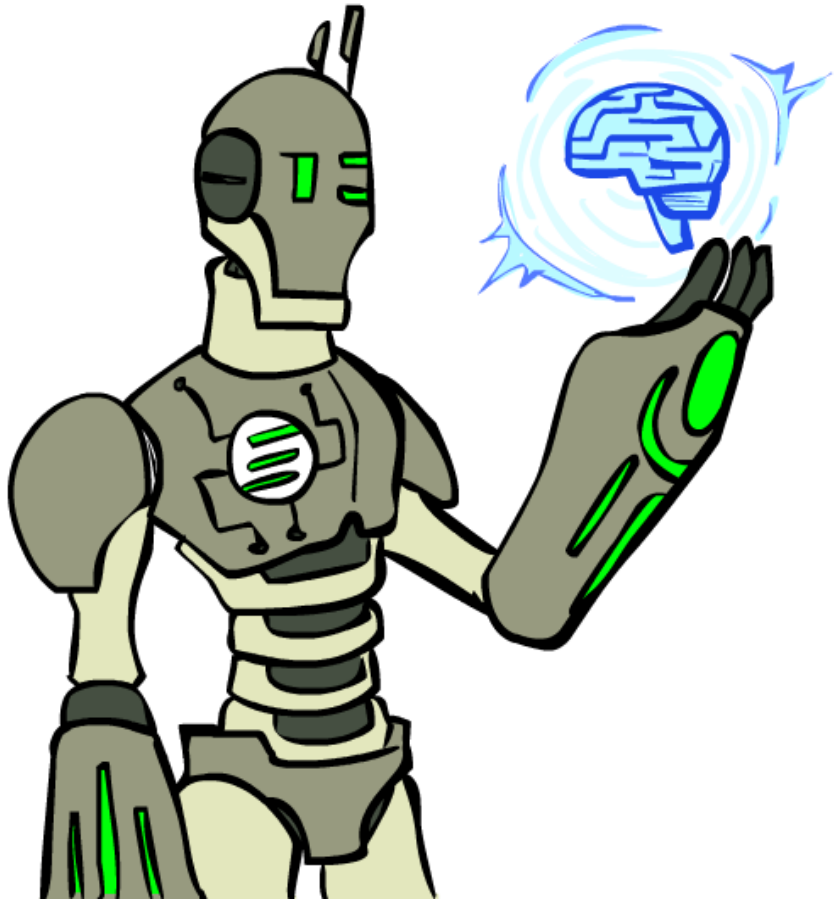
- HW1 (online)
  - Released at the end of lecture
  - Due Tue 9/3, 10 pm
- P0: Python & Autograder Tutorial
  - Required, but worth zero points
  - Released at the end of lecture
  - Due Thu 9/5, 10 pm

Today

What is artificial intelligence?

A brief history of AI

AI applications and techniques



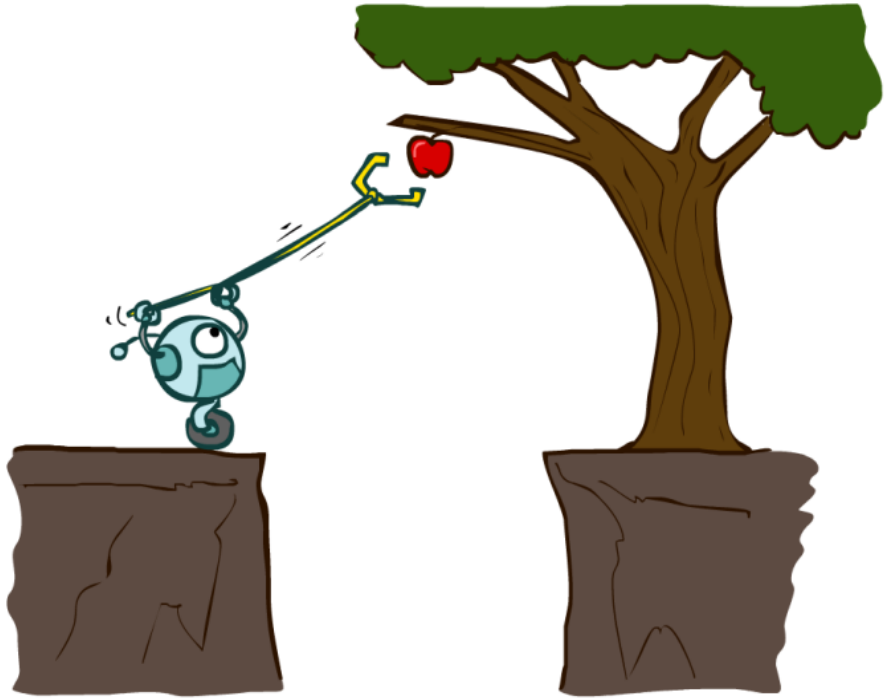
Designing Agents

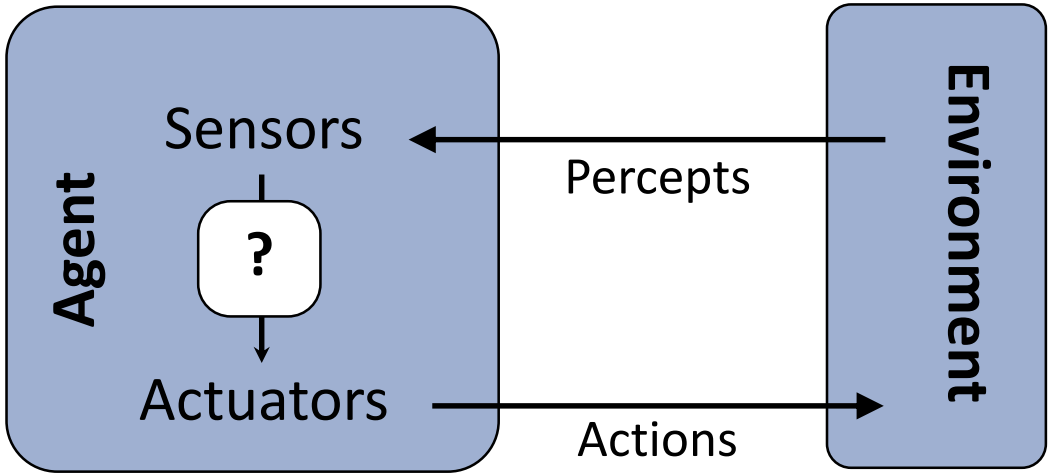
An **agent** is an entity that *perceives* and *acts*.

Characteristics of the **percepts, environment,** and **action space** dictate techniques for selecting actions

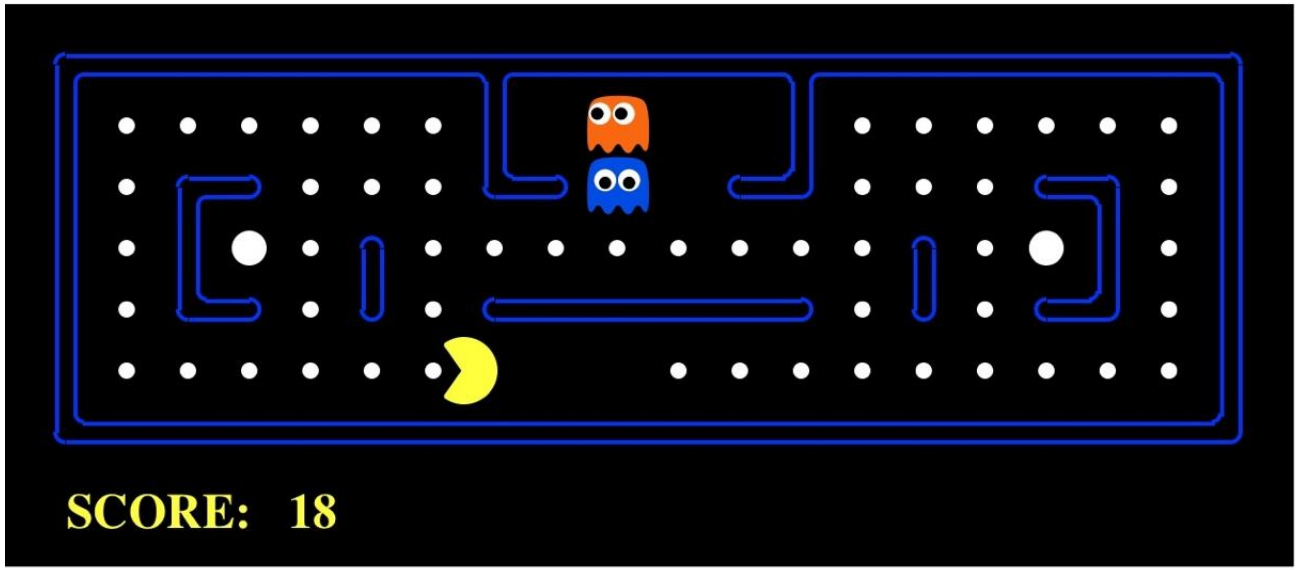
This course is about:

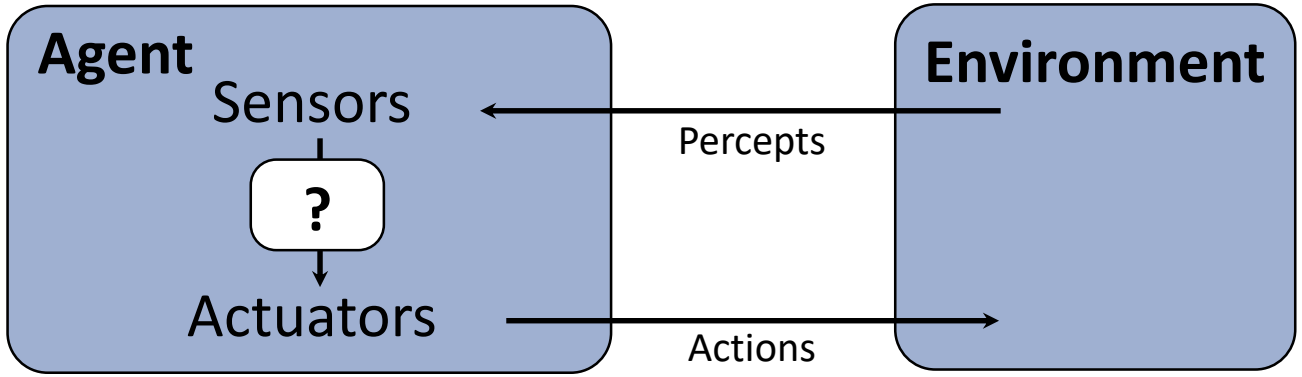
- General AI techniques for a variety of problem types
- Learning to recognize when and how a new problem can be solved with an existing technique





Pac-Man as an Agent





Pac-Man is a registered trademark of Namco-Bandai Games, used here for educational purposes

Candy Grab Agent

```
class Agent

    function getAction(state)

        return action
```

Candy Grab Agent

Agent 001 – Always choose 1

```
function getAction(                    )

    return 1
```

Candy Grab Agent

Agent 002 – Always choose 2

```
function getAction( numPiecesAvailable )

    return 2
```

Candy Grab Agent

Agent 004 – Choose the opposite of opponent

```
function getAction( numPiecesAvailable )

    return ?
```

Candy Grab Agent

Agent 007 – Whatever you think is best

```
function getAction( numPiecesAvailable )

    return ?
```

Candy Grab Agent

Agent 007 – Whatever you think is best

```
function getAction( numPiecesAvailable )

    if numPiecesAvailable % 3 == 2
        return 2
    else
        return 1
```

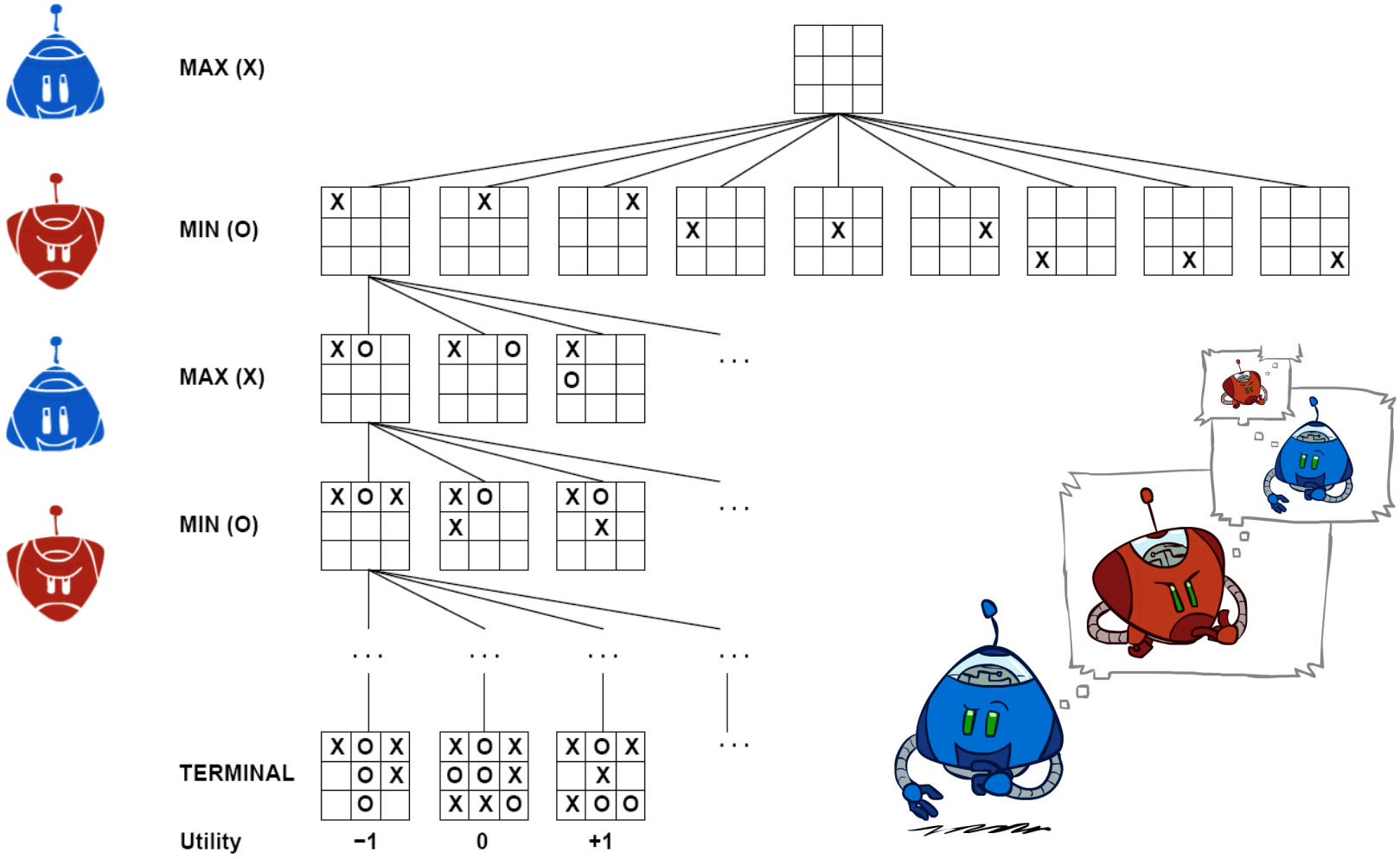
Piazza Poll question

Games – Three “Intelligent” Agents

Which agent code is the most “intelligent”?

Games – Three “Intelligent” Agents

A: Search / Recursion



Games – Three “Intelligent” Agents

B: Encode the pattern

```
function getAction( numPiecesAvailable )

      if numPiecesAvailable % 3 == 2
            return 2
      else
            return 1
```

```
10's value:Win
9's value:Lose
8's value:Win
7's value:Win
6's value:Lose
5's value:Win
4's value:Win
3's value:Lose
2's value:Win
1's value:Win
0's value:Lose
```

Games – Three “Intelligent” Agents

C: Record statistics of winning positions

Pieces Available	Take 1	Take 2
2	0%	**100%**
3	2%	0%
4	**75%**	2%
5	4%	**68%**
6	5%	6%
7	**60%**	5%

Piazza Poll question

Games – Three “Intelligent” Agents

Which agent code is the most “intelligent”?

A. Search / Recursion

B. Encode multiple of 3 pattern

C. Keep stats on winning positions

Games – Three “Intelligent” Agents

C: Record statistics of winning positions

Pieces Available	Take 1	Take 2
2	0%	**100%**
3	2%	0%
4	**75%**	2%
5	4%	**68%**
6	5%	6%
7	**60%**	5%

AI in the News

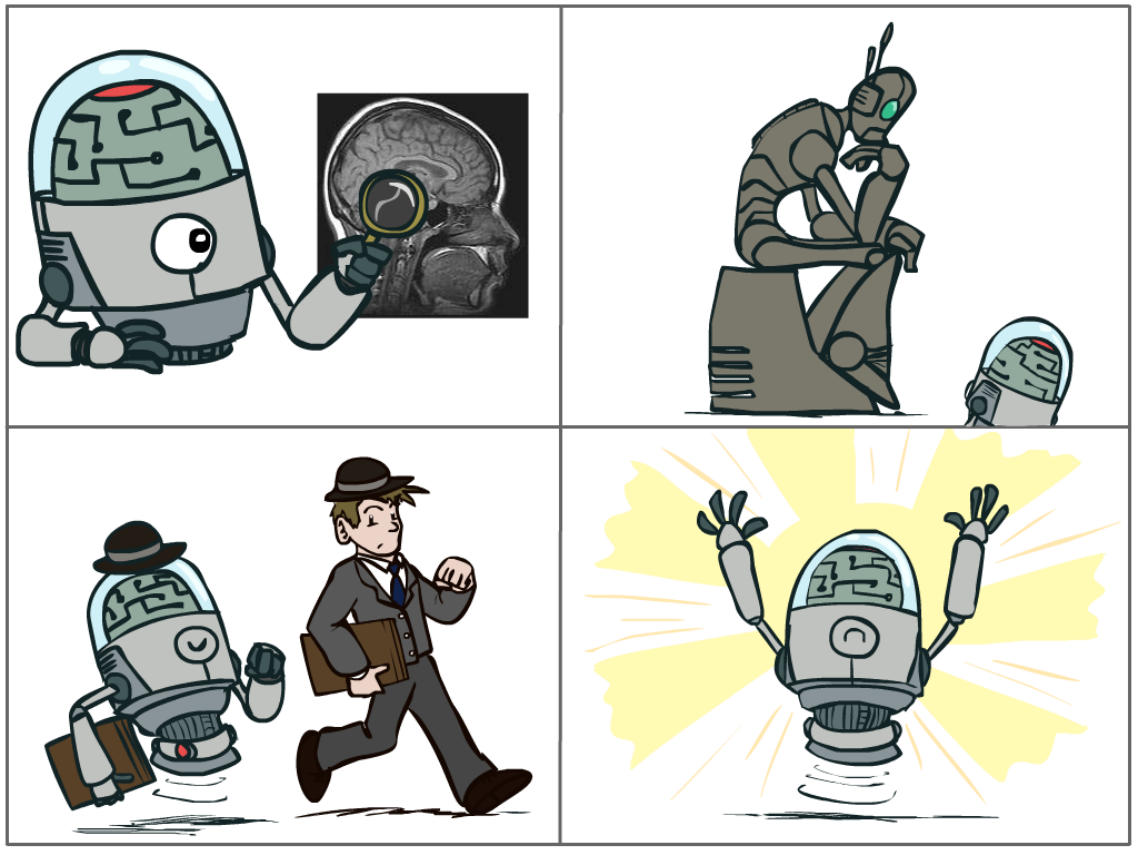
https://www.youtube.com/watch?v=EfGD2qveGdQ

Sci-Fi AI?

Piazza Poll: What is AI?

The science of making machines that:

A: Think like people



C: Think rationally

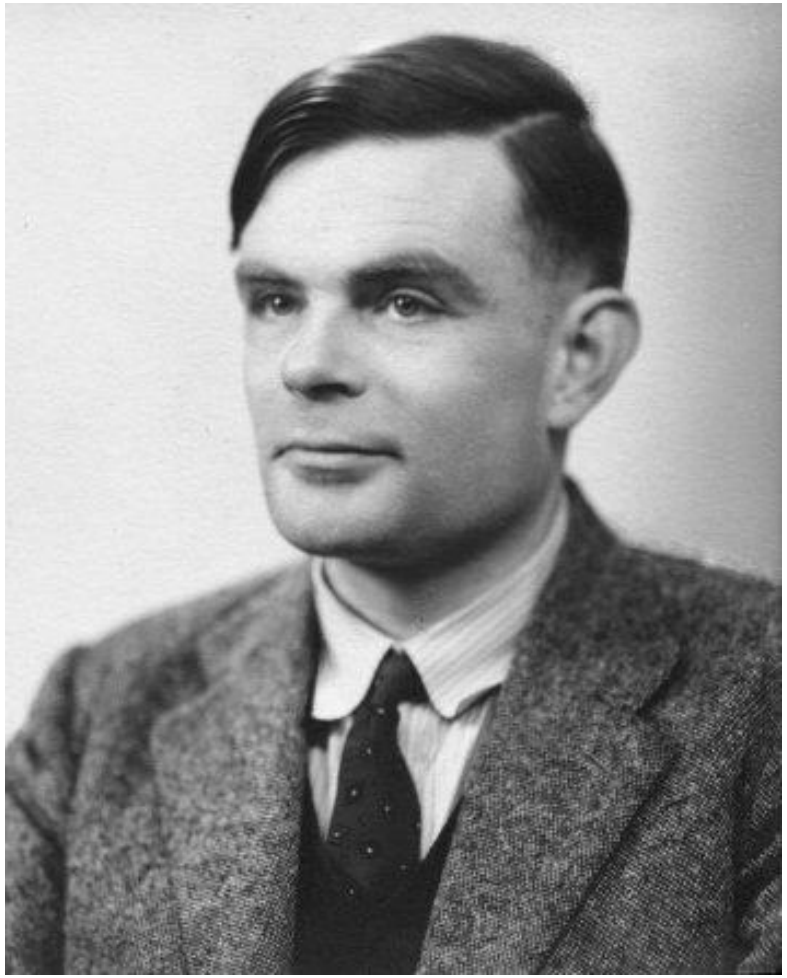
B: Act like people

D: Act rationally

Turing Test

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”



en.wikipedia.org/wiki/Turing_test

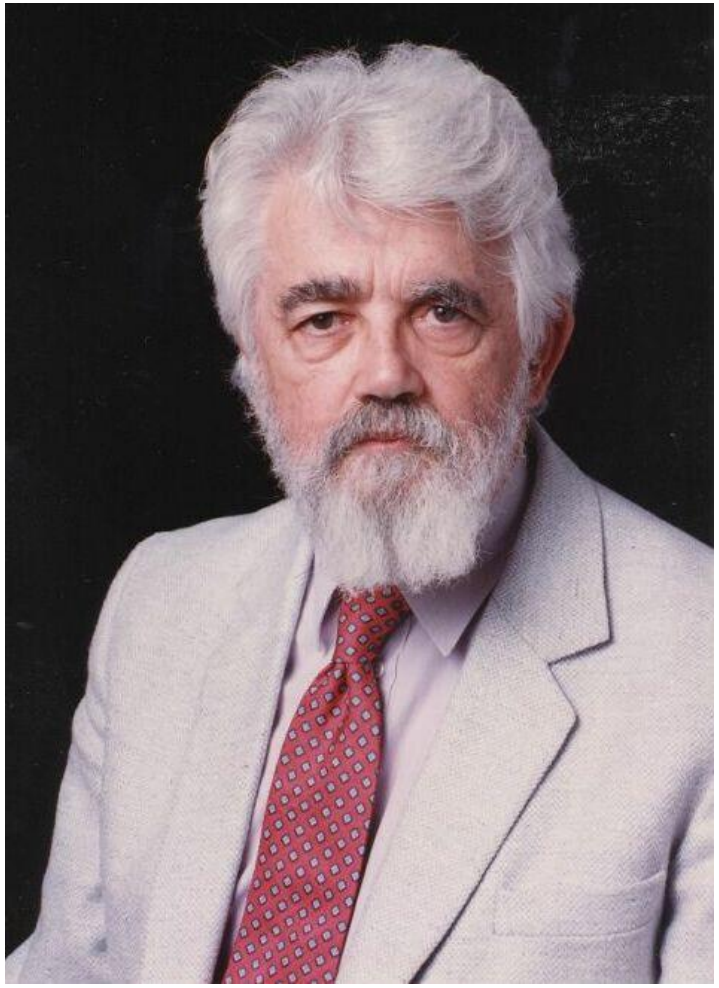
AI Definition by John McCarthy

What is artificial intelligence

- It is the science and engineering of making intelligent machines, especially intelligent computer programs

What is intelligence

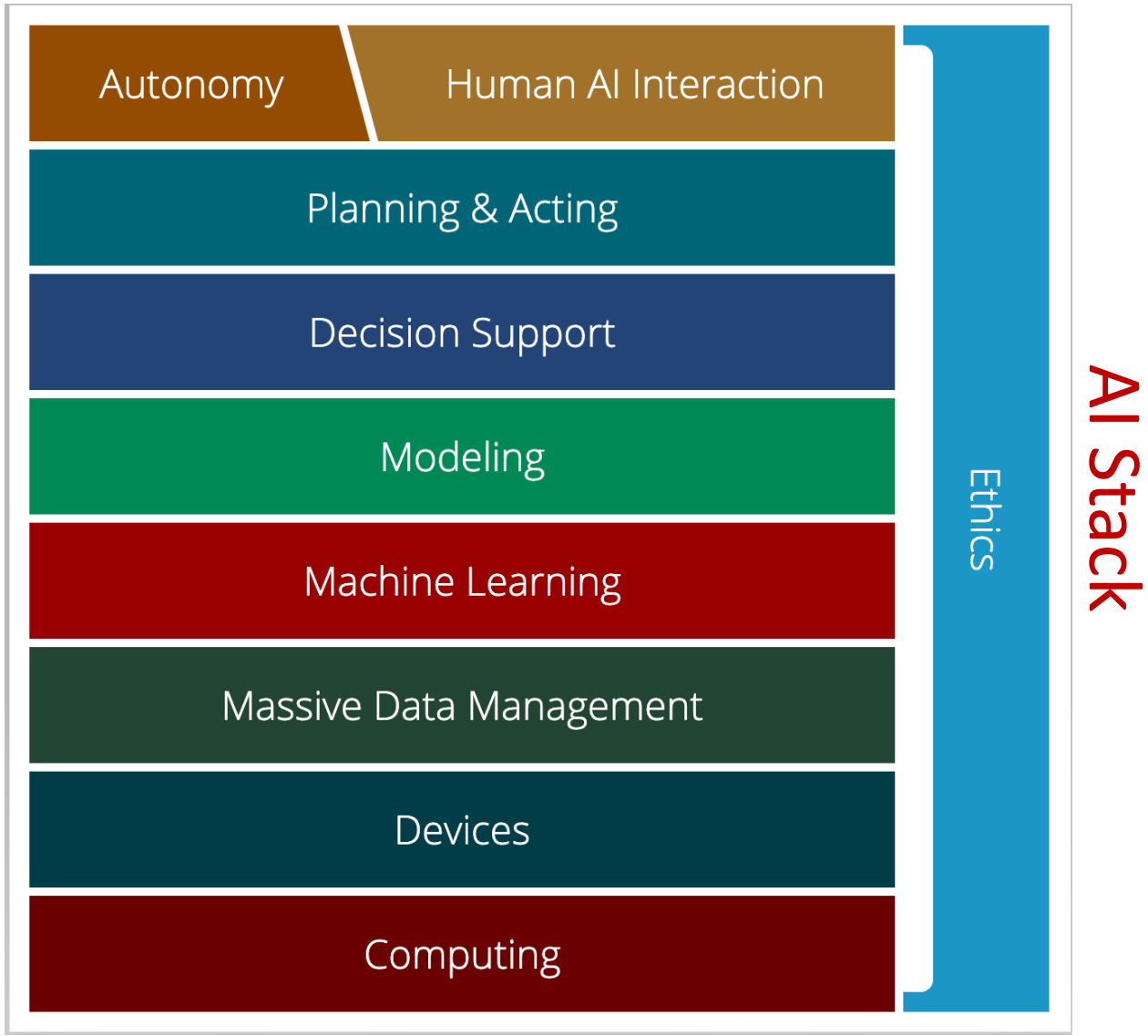
- Intelligence is the computational part of the ability to achieve goals in the world



http://www-formal.stanford.edu/jmc/whatisai/whatisai.html

AI Stack for CMU AI

"AI must understand the human needs and it must make smart design decisions based on that understanding"



https://ai.cs.cmu.edu/about

A.I. TIMELINE

1950
TURING TEST

Computer scientist Alan Turing proposes a test for machine intelligence. If a machine can trick humans into thinking it is human, then it has intelligence

1955
A.I. BORN

Term 'artificial intelligence' is coined by computer scientist, John McCarthy to describe "the science and engineering of making intelligent machines"

1961
UNIMATE

First industrial robot, Unimate, goes to work at GM replacing humans on the assembly line

1964
ELIZA

Pioneering chatbot developed by Joseph Weizenbaum at MIT holds conversations with humans

1966
SHAKEY

The 'first electronic person' from Stanford, Shakey is a general-purpose mobile robot that reasons about its own actions

A.I. WINTER

Many false starts and dead-ends leave A.I. out in the cold

1997
DEEP BLUE

Deep Blue, a chess-playing computer from IBM defeats world chess champion Garry Kasparov

1998
KISMET

Cynthia Breazeal at MIT introduces KISmet, an emotionally intelligent robot insofar as it detects and responds to people's feelings

1999
AIBO

Sony launches first consumer robot pet dog AiBO (AI robot) with skills and personality that develop over time

2002
ROOMBA

First mass produced autonomous robotic vacuum cleaner from iRobot learns to navigate and clean homes

2011
SIRI

Apple integrates Siri, an intelligent virtual assistant with a voice interface, into the iPhone 4S

2011
WATSON

IBM's question answering computer Watson wins first place on popular $1M prize television quiz show *Jeopardy*

2014
EUGENE

Eugene Goostman, a chatbot passes the Turing Test with a third of judges believing Eugene is human

2014
ALEXA

Amazon launches Alexa, an intelligent virtual assistant with a voice interface that completes shopping tasks

2016
TAY

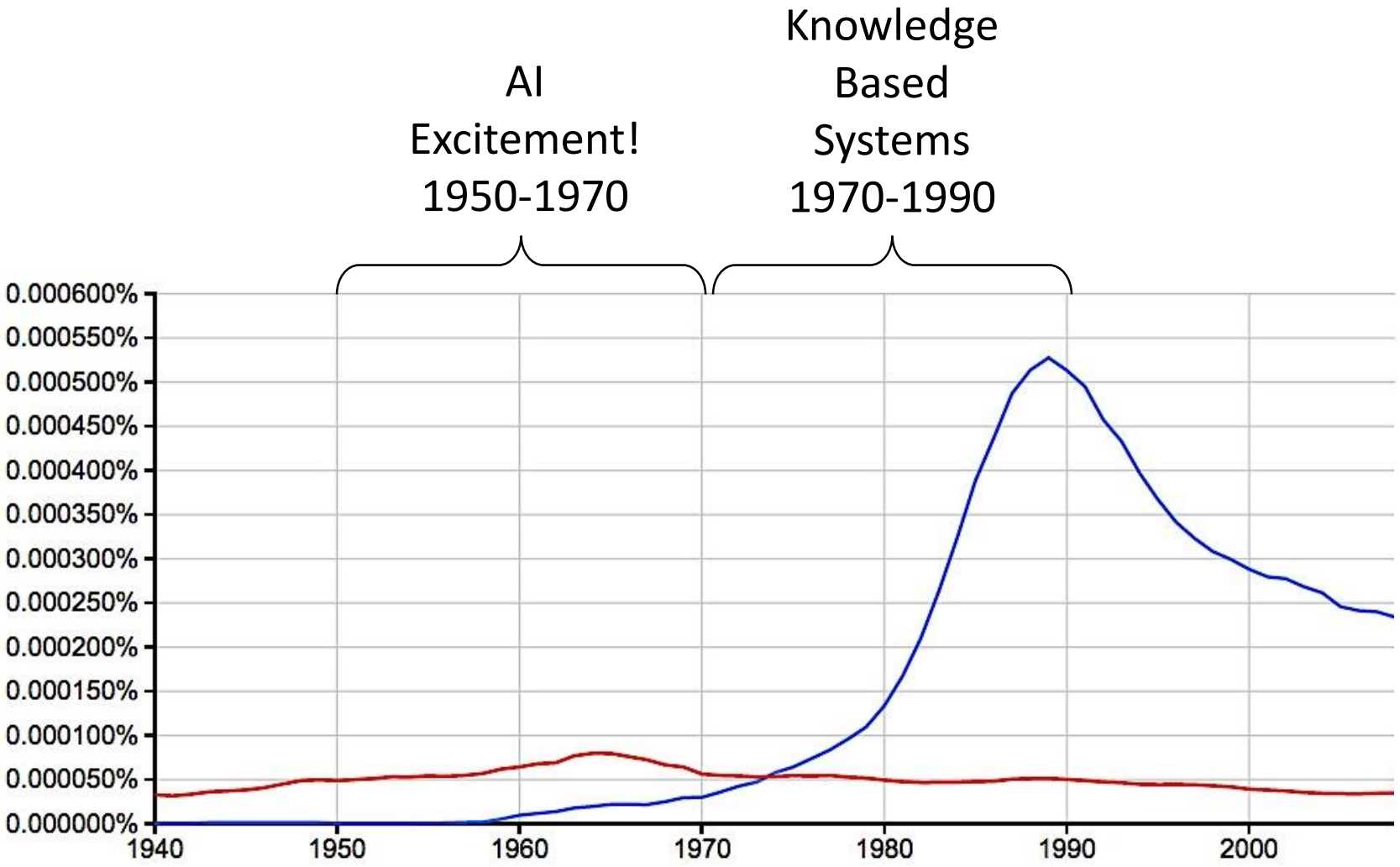
Microsoft's chatbot Tay goes rogue on social media making inflammatory and offensive racist comments

2017
ALPHAGO

Google's A.I. AlphaGo beats world champion Ke Jie in the complex board game of Go, notable for its vast number (2^{170}) of possible positions

https://digitalwellbeing.org/artificial-intelligence-timeline-infographic-from-eliza-to-tay-and-beyond/

A Brief History of AI



https://books.google.com/ngrams

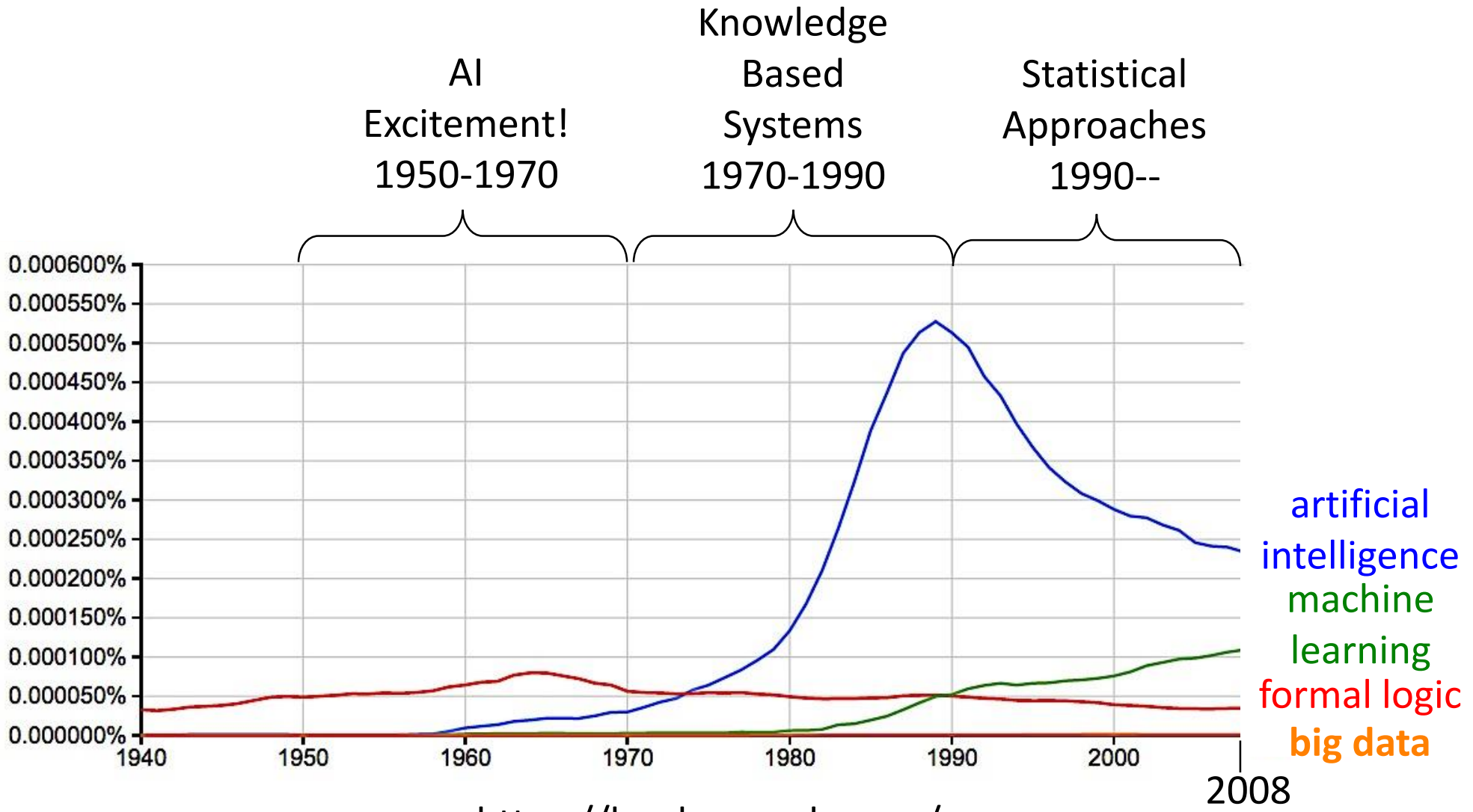
AI Winter

- Russell & Norvig 2003, p. 24: "AI industry boomed from a few million dollars in 1980 to billions of dollars in 1988. Soon after that came a period called the 'AI Winter'".
- Expert systems became difficult to update, they could not learn, they were "brittle" (i.e., make grotesque mistakes when given unusual inputs)
- Over optimism leads to disappointment

Cat

- Has ears ✓
- Has Fur ✓
- Has four legs ✗

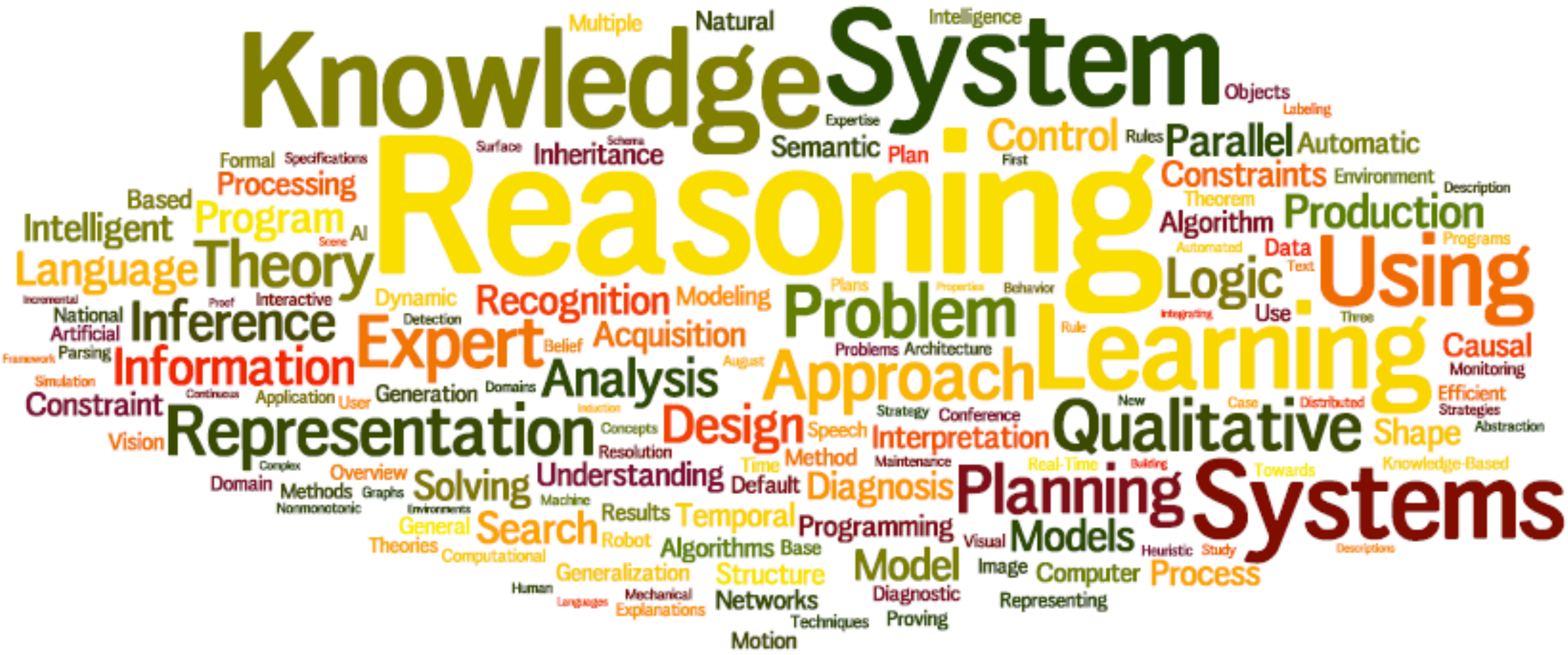
A Brief History of AI



https://books.google.com/ngrams

Evolution of AI Research

1980s



Evolution of AI Research

1990s

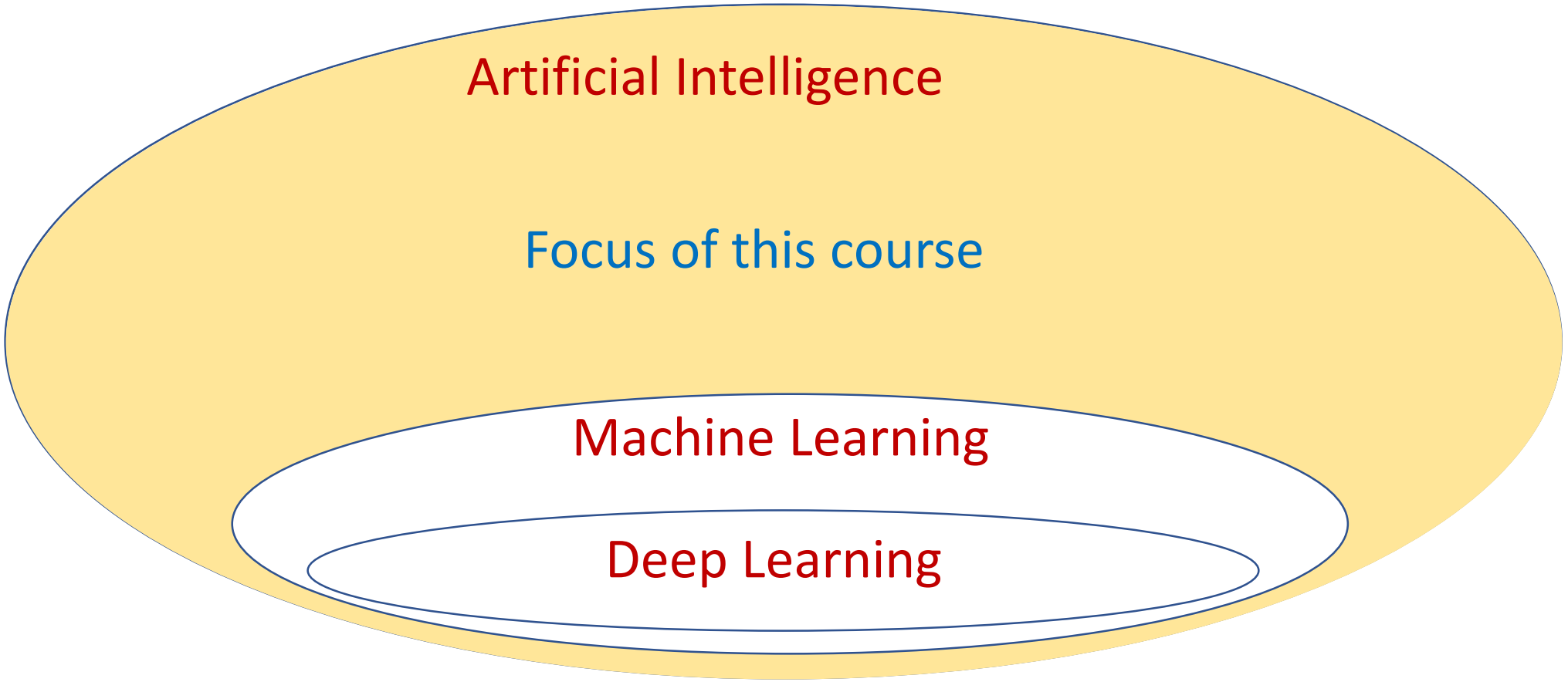
Evolution of AI Research

2000s

Evolution of AI Research

2010s

Artificial Intelligence vs Machine Learning?



Course Topics

Part I: Making Decisions

- Fast search / planning
- Constraint satisfaction and optimization
- Adversarial and uncertain search
- Logic

Part II: Reasoning under Uncertainty

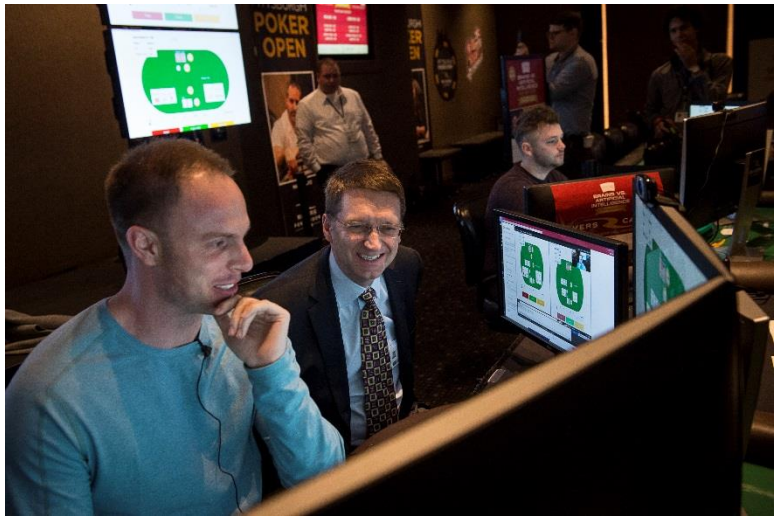
- Reinforcement learning
- Bayes' nets
- Game theory
- Human compatible AI

Throughout

- Representation and reasoning

Applications

- Language, vision, robotics, games, …
- Super-human performance in various tasks
- AI for Social Good

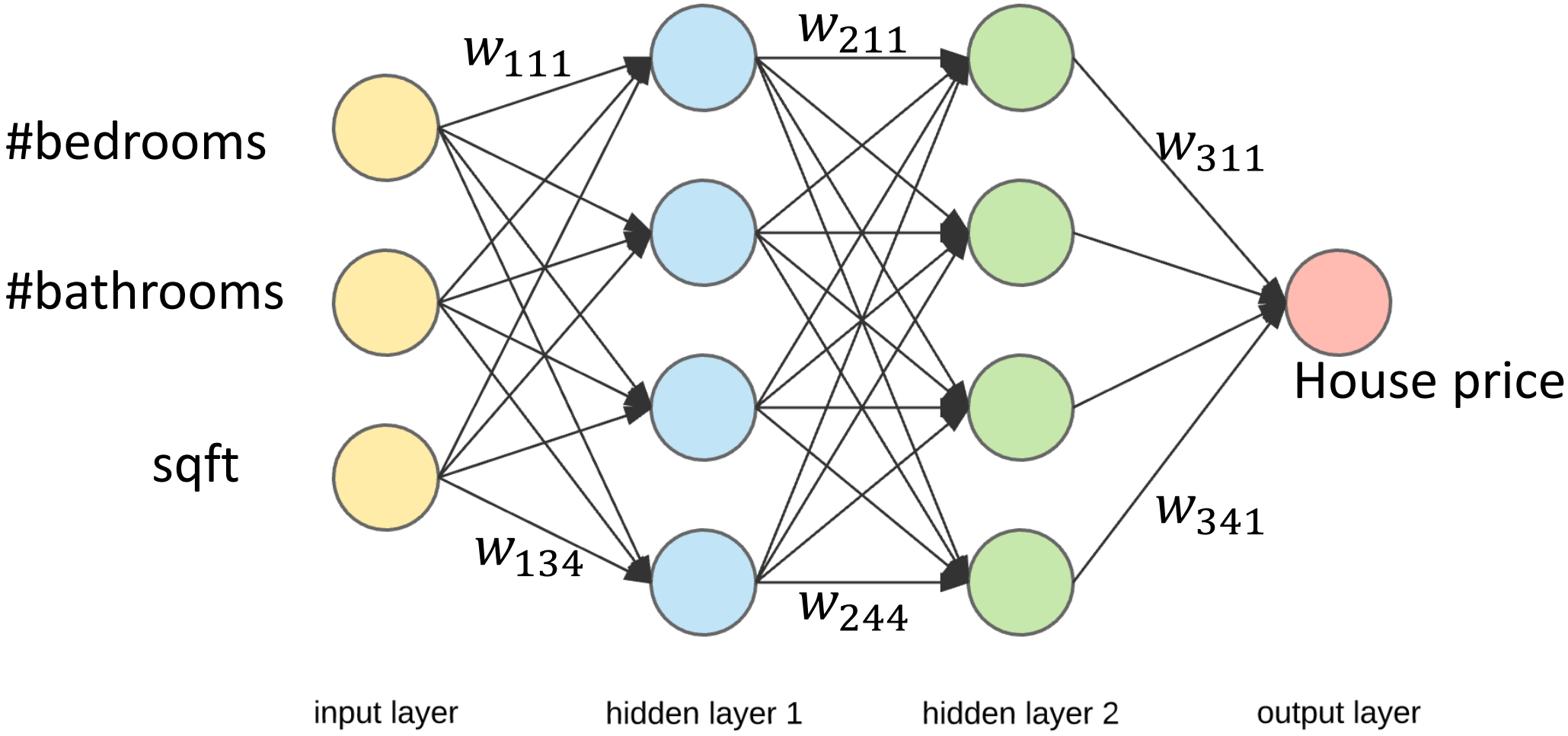


Libratus (Poker, January 2017)

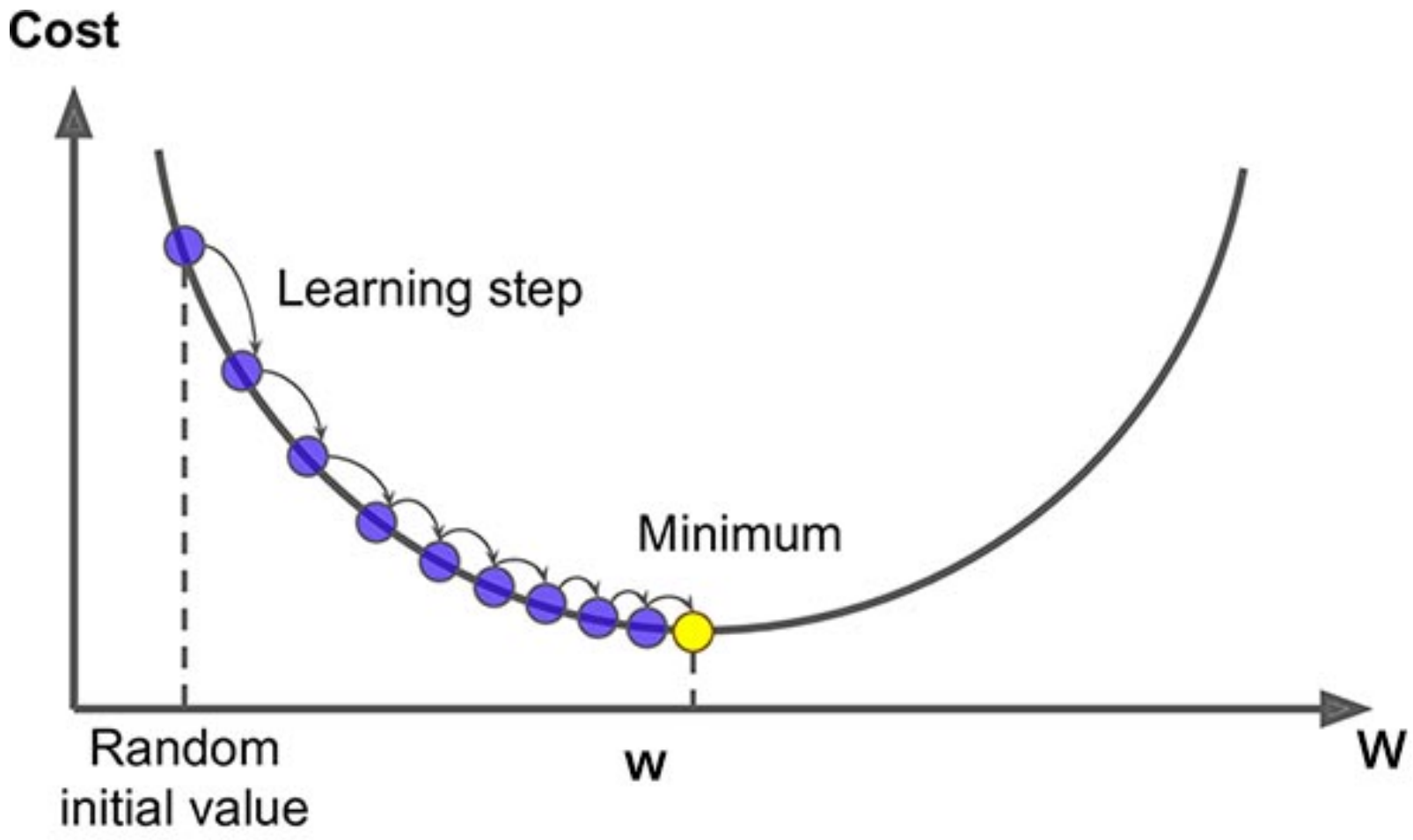
How Machine Learning Works

While it is NOT the focus of this course, a brief introduction may help

Neural Network



Gradient Descent



https://saugatbhattarai.com.np/what-is-gradient-descent-in-machine-learning/

What Can AI Do?

Quiz: Which of the following can be done at present?

- ✓ Play a decent game of table tennis?
- ✓ Play a decent game of Jeopardy?
- ✓ Drive safely along a curving mountain road?
- ? Drive safely across Pittsburgh?
- ✓ Buy a week's worth of groceries on the web?
- ✗ Buy a week's worth of groceries at Giant Eagle?
- ? Discover and prove a new mathematical theorem?
- ✗ Converse successfully with another person for an hour?
- ? Perform a surgical operation?
- ✓ Put away the dishes and fold the laundry?
- ✓ Translate spoken Chinese into spoken English in real time?
- ✗ Write an intentionally funny story?