

Candy Grab Game

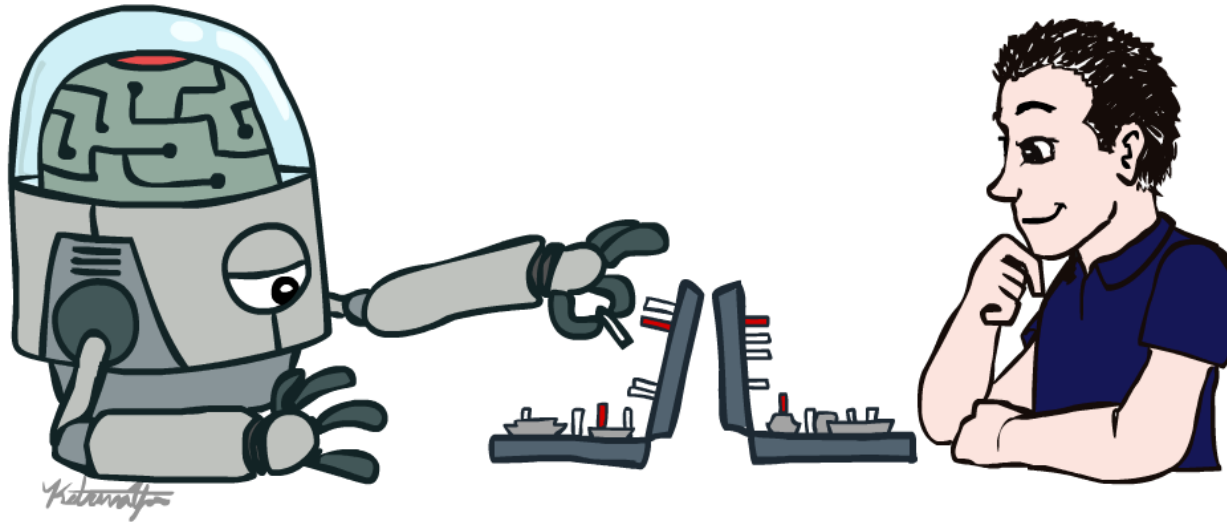
As you walk in:

1. Grab a pack of game pieces (candy)
2. Form groups of 2 (or 3 with an observer)
3. Play the game based on your Agent card!
 - 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

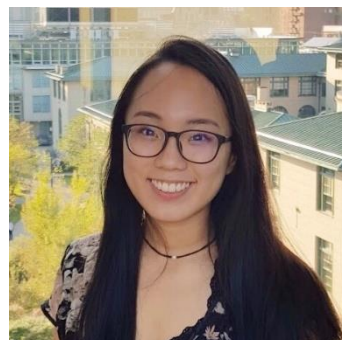


Fei
Fang



Pat
Virtue

Teaching Assistants



Angela
Yang



Claire Wang
(Head TA)



George
Brown



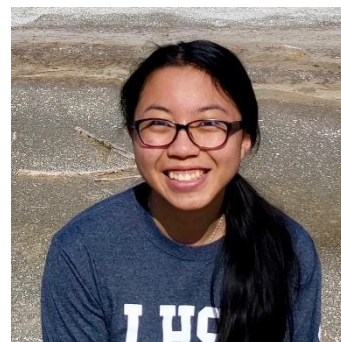
Michelle
Ma



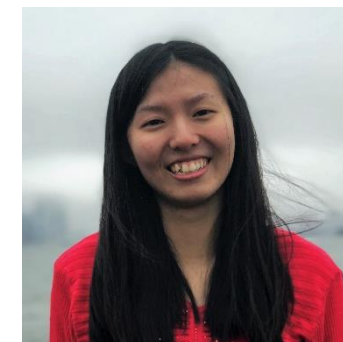
Sean
Pereira



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:

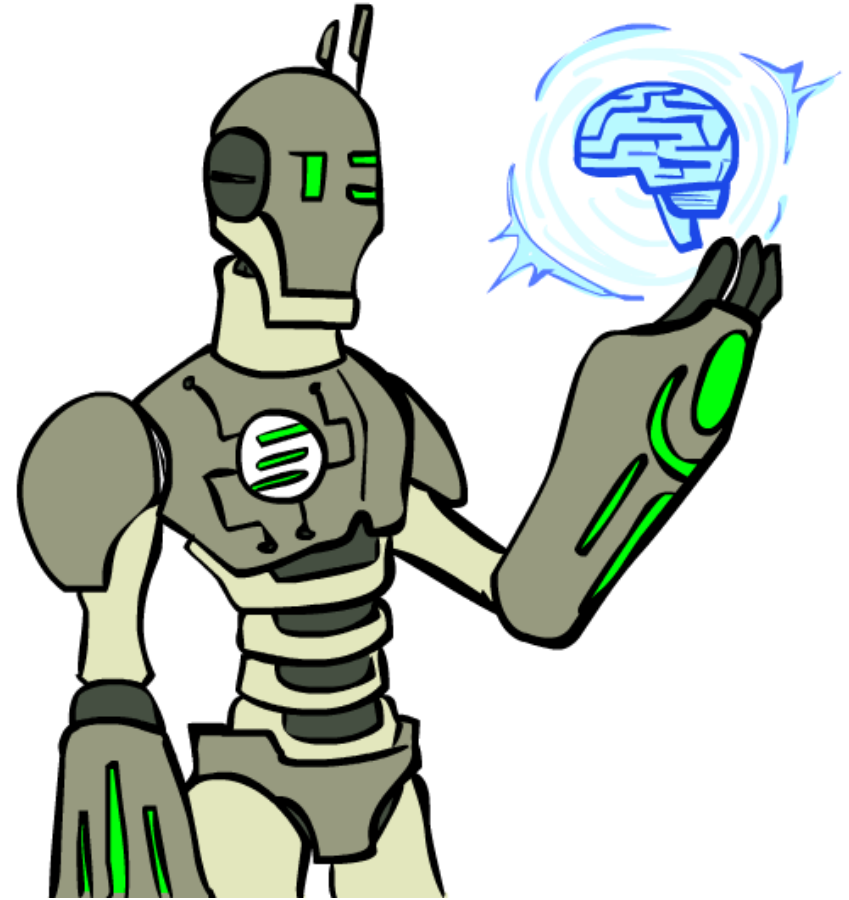
- HW1 (online)
 - Released at the end of lecture
 - Due Tue 9/3, 10 pm
- P0: Python & Autograder Tutorial
 - Required, but worth zero points
 - Released at the end of lecture
 - Due Thu 9/5, 10 pm

Today

What is artificial intelligence?

A brief history of AI

AI applications and techniques



Designing Rational Agents

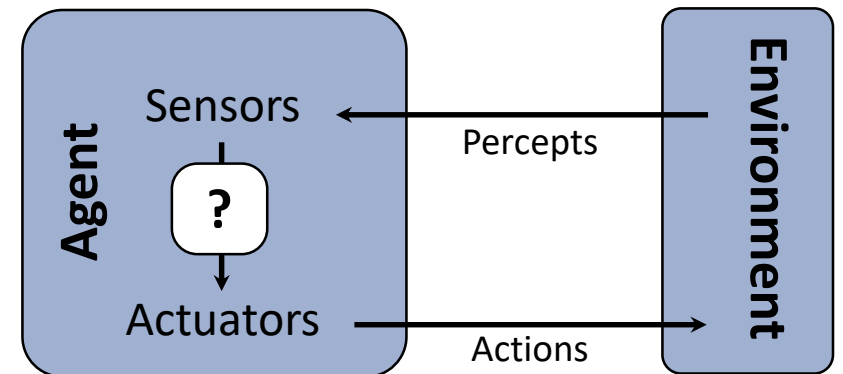
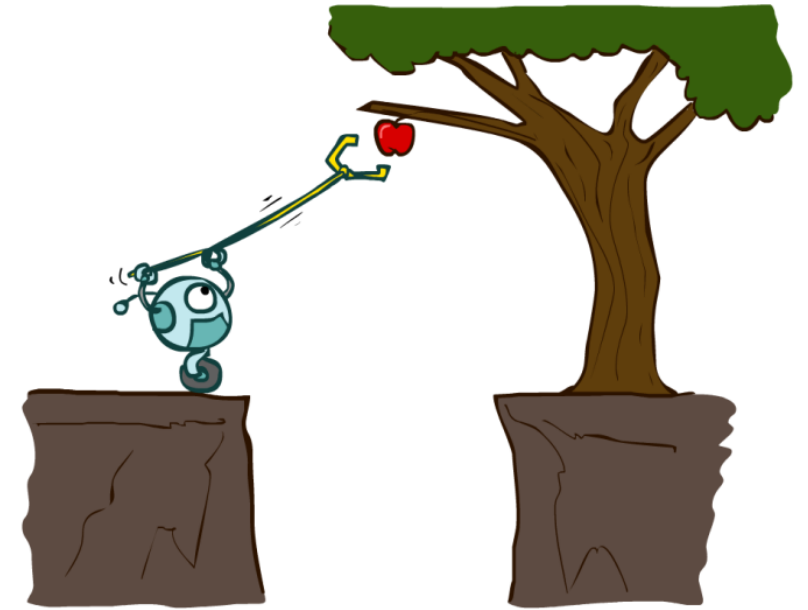
An **agent** is an entity that *perceives* and *acts*.

A **rational agent** selects actions that maximize its (expected) **utility**.

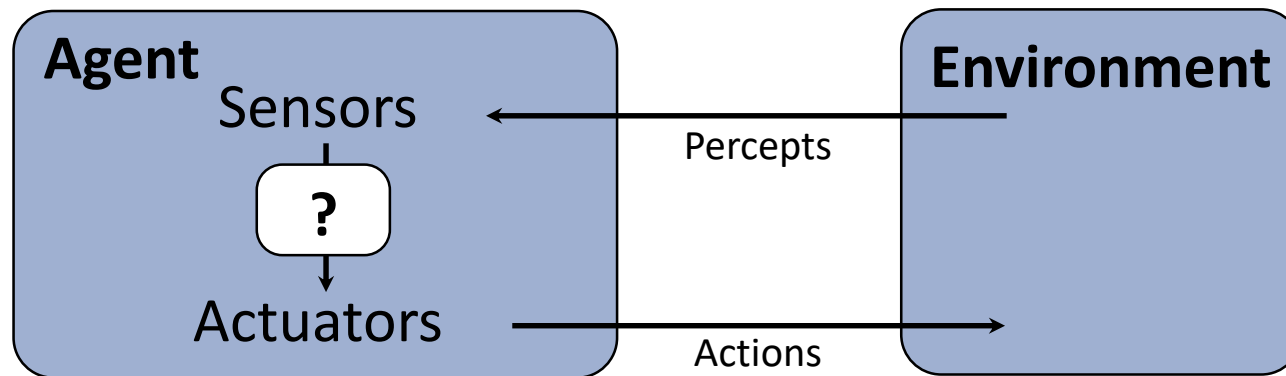
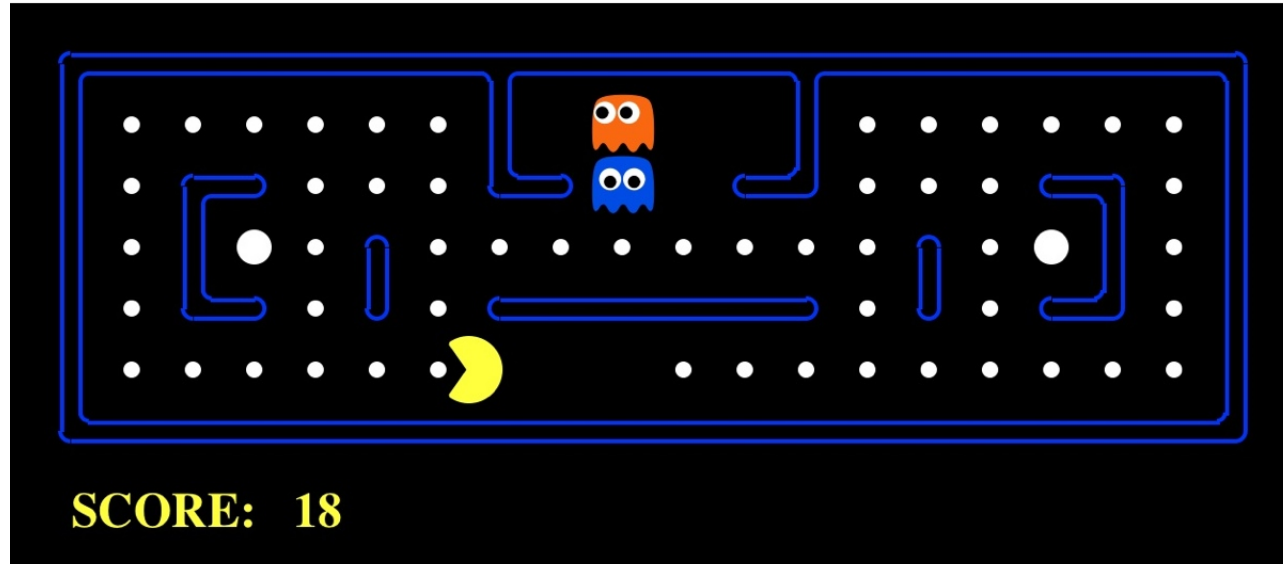
Characteristics of the **percepts**, **environment**, and **action space** dictate techniques for selecting rational actions

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 as an Agent

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 ?
```

AI in the News



READ
SOMETHING
THAT MEANS
SOMETHING.
\$1 A WEEK >

SUBSCRIBE
RENEW
GIVE A GIFT
NON-U.S.
ORDERS

Sign in | Link your subscription | TNY Store



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

 Share  Tweet  +1  



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

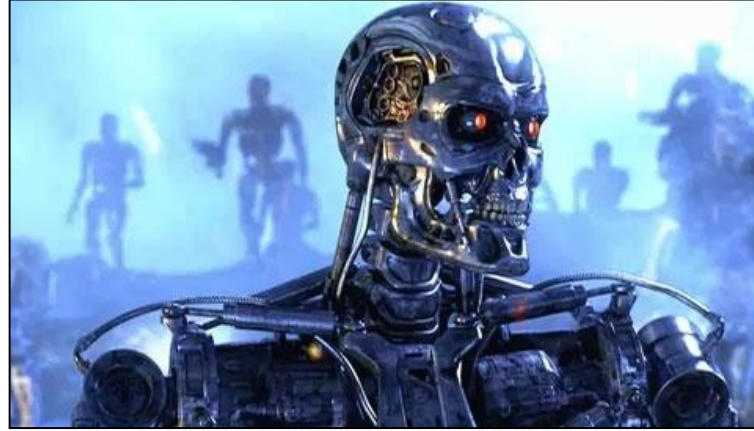
SIGN UP

ADVERTISEMENT



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

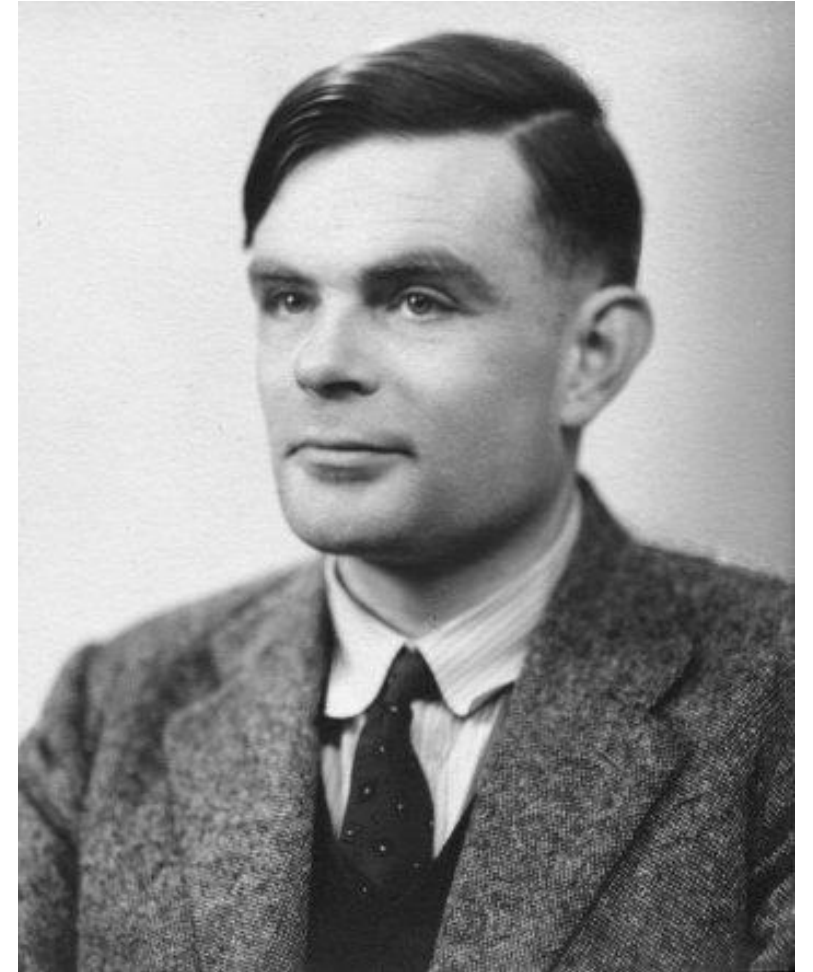
Sci-Fi AI?



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”



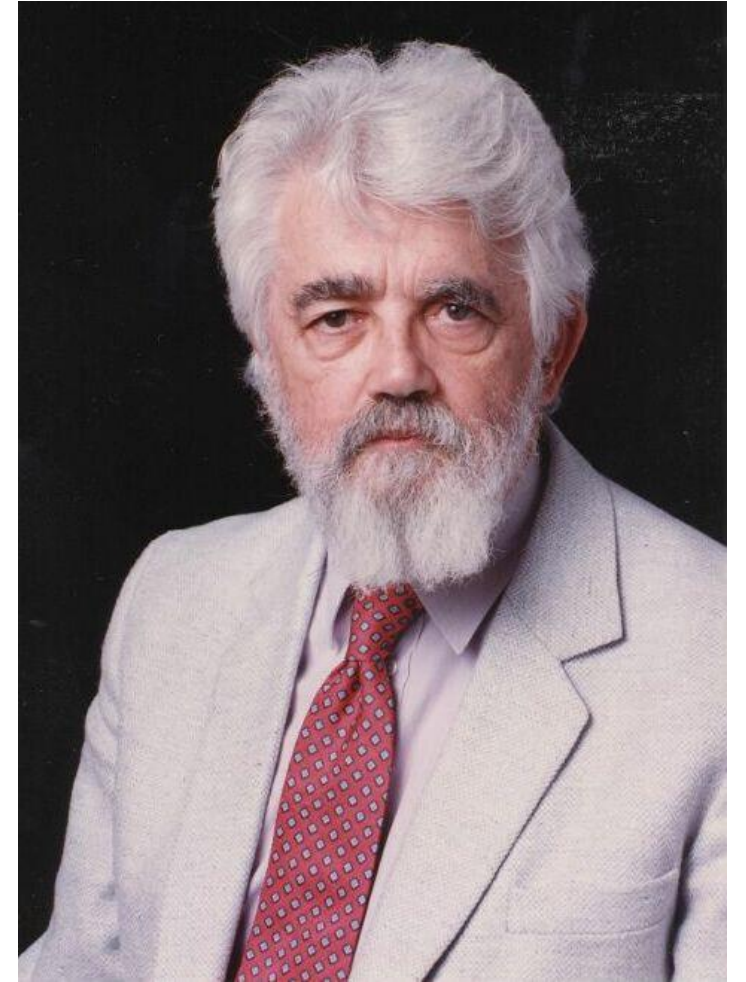
AI Definition by John McCarthy

What is artificial intelligence

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

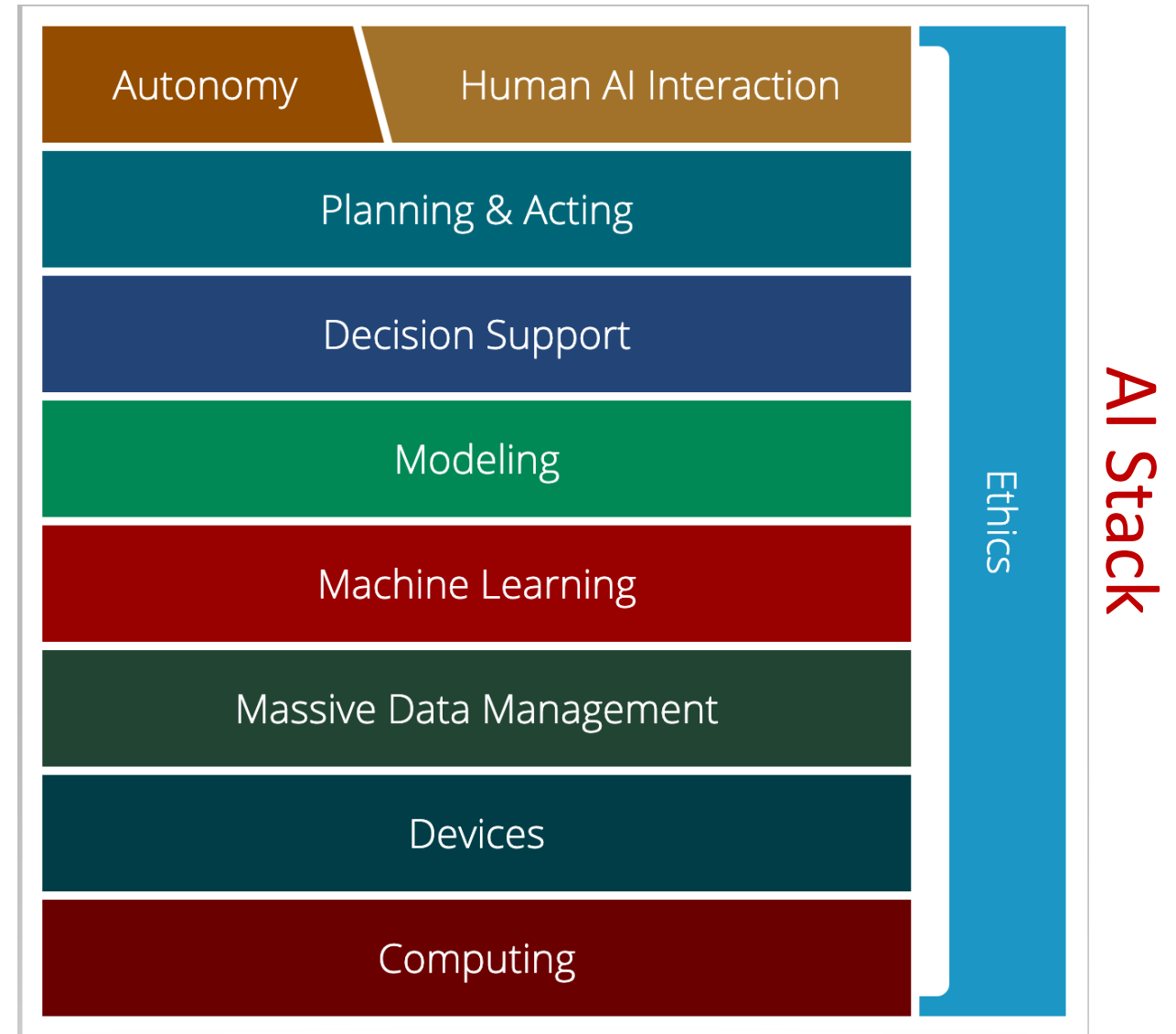
What is intelligence

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



AI Stack for CMU AI

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



/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

SHAKY

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

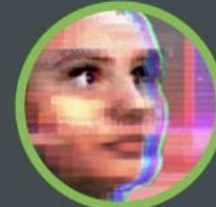
Eugene Goostman, a chatbot passes the Turing Test with a third of judges believing Eugene is human



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

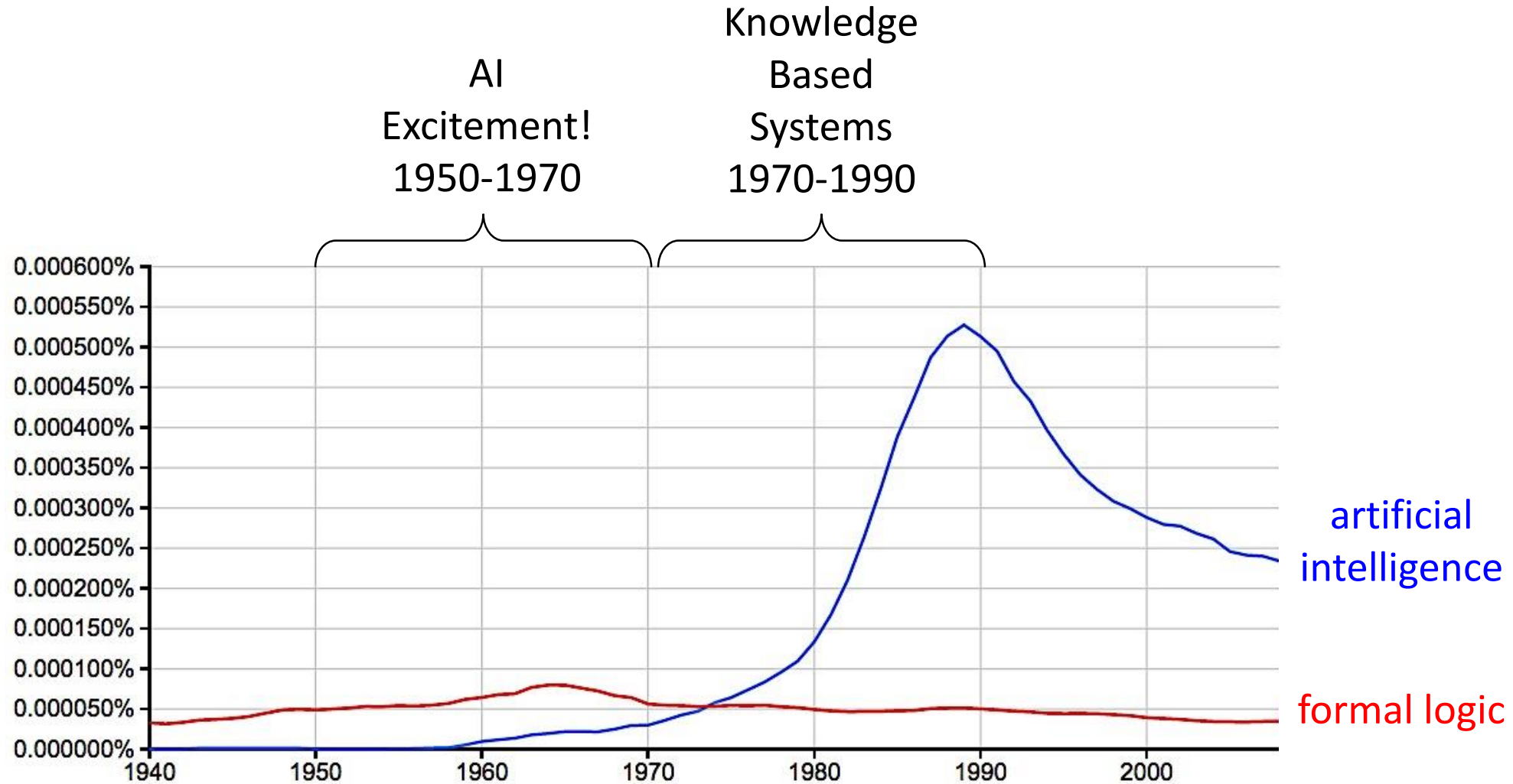


2017

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

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

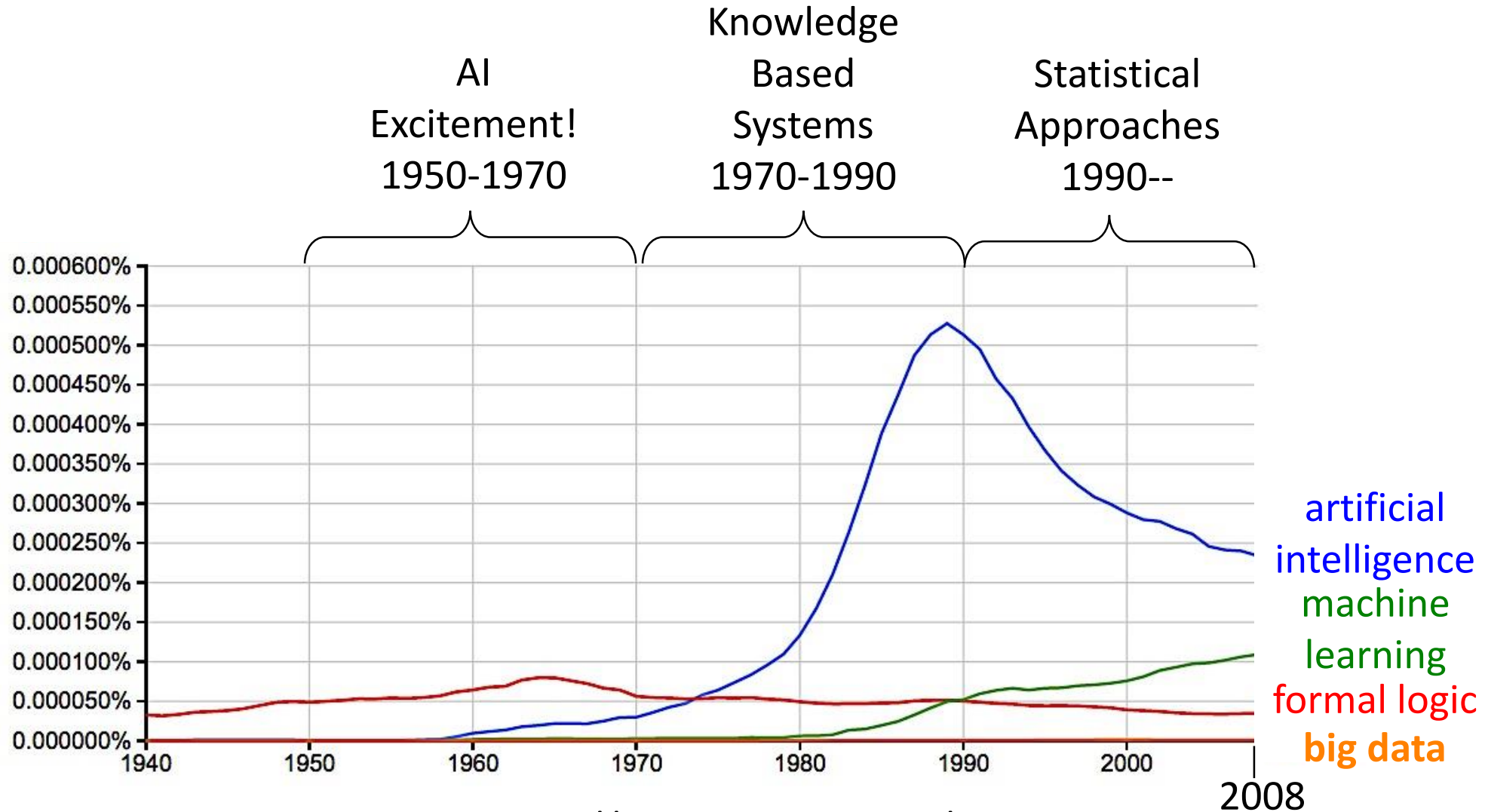


Cat

- Has ears
- Has Fur
- Has four legs

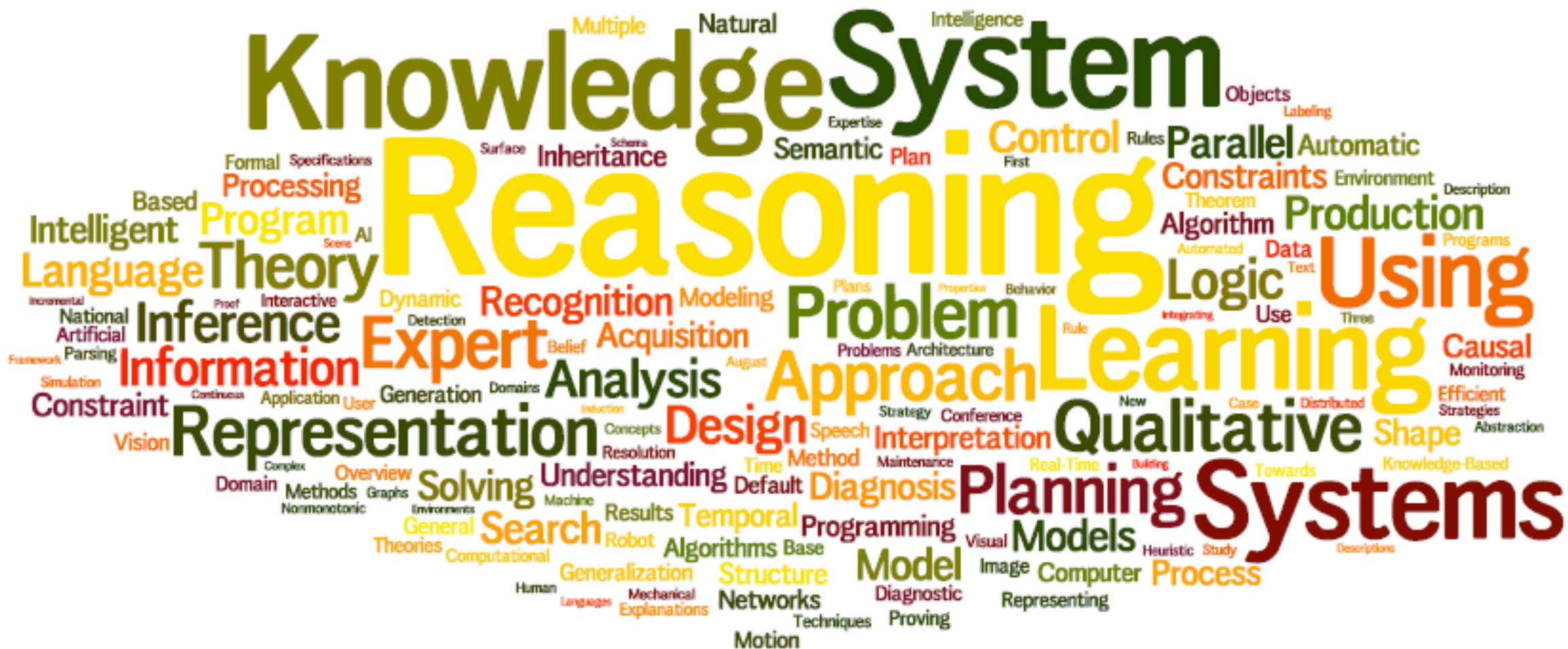


A Brief History of AI



<https://books.google.com/ngrams>

1980s



1990s



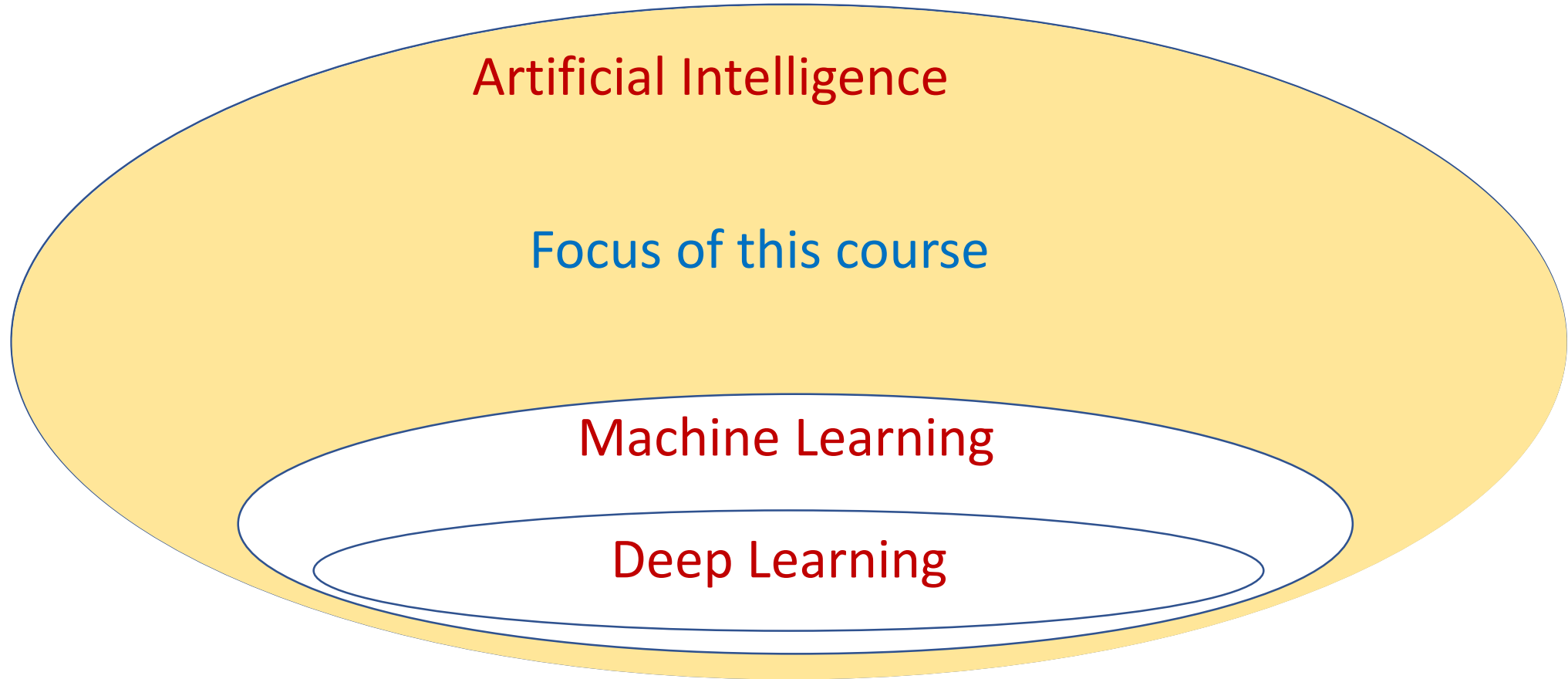
2000s



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

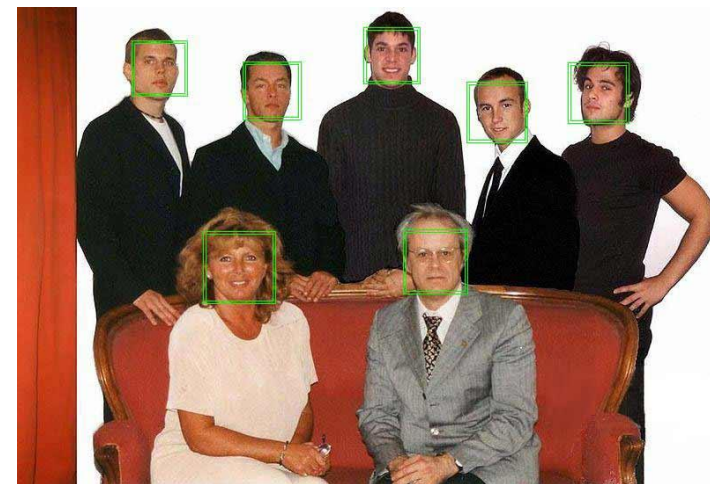
Throughout

- Representation and reasoning



Applications

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



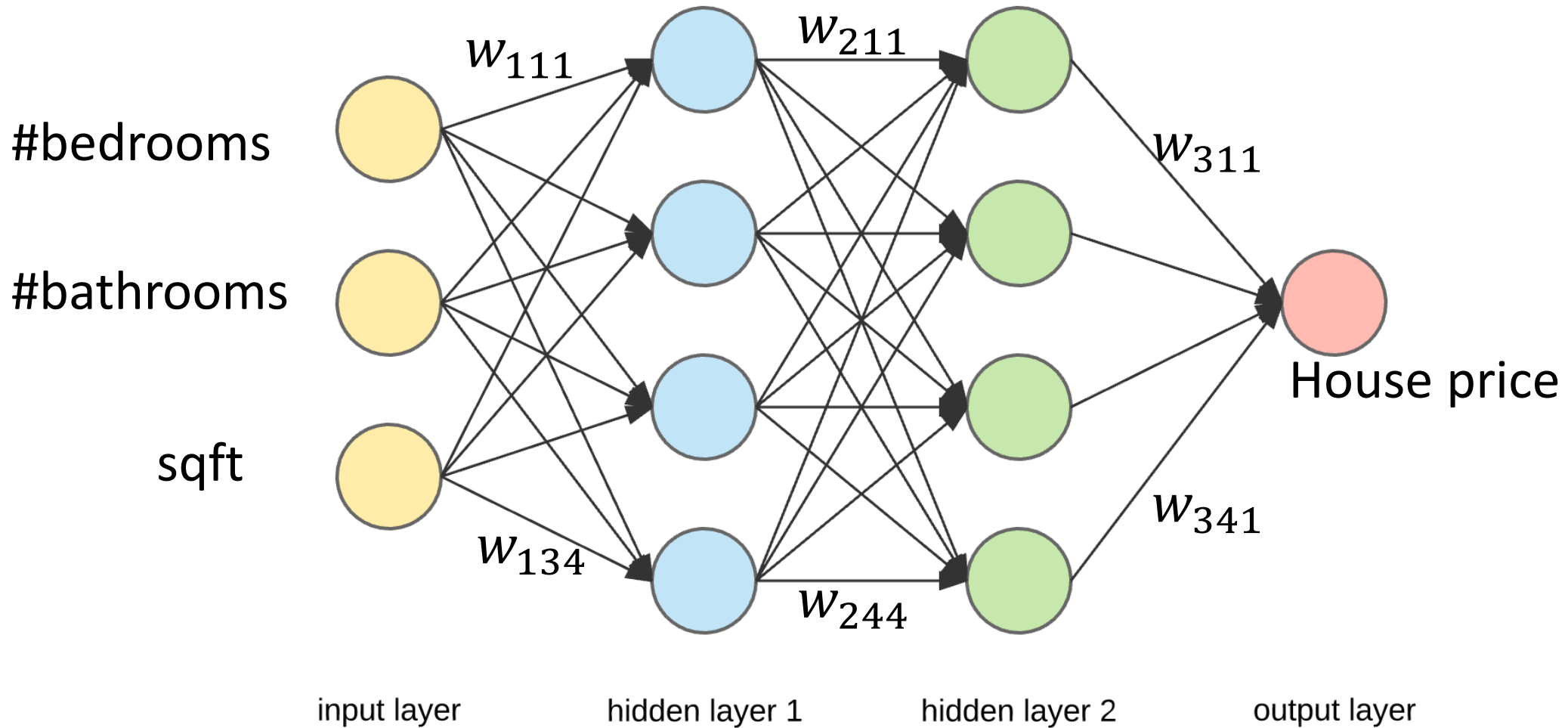
Libratus (Poker, January 2017)

How Machine Learning Works

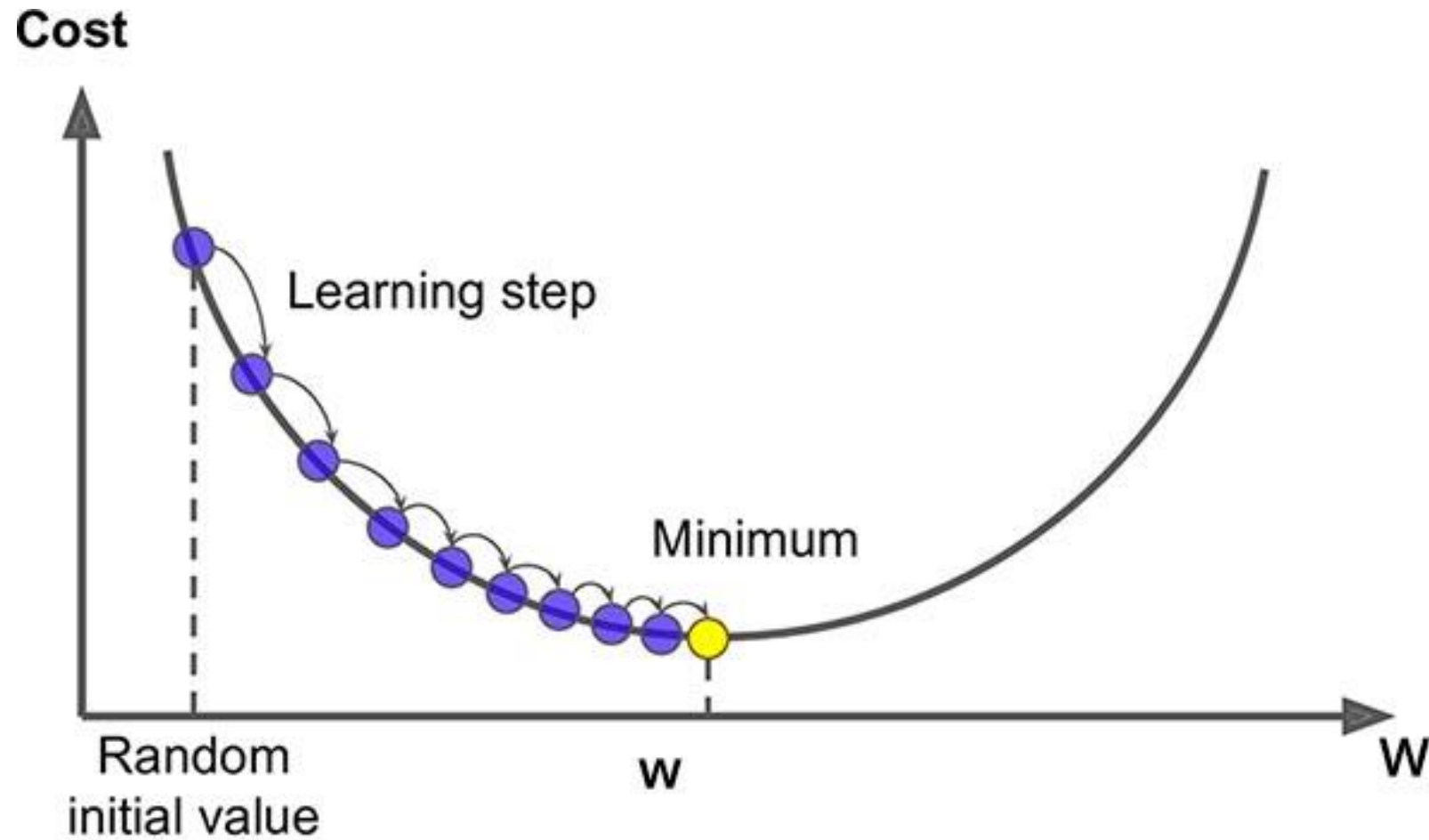
While it is NOT the focus of this course, a brief introduction may help



Neural Network



Gradient Descent



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?

