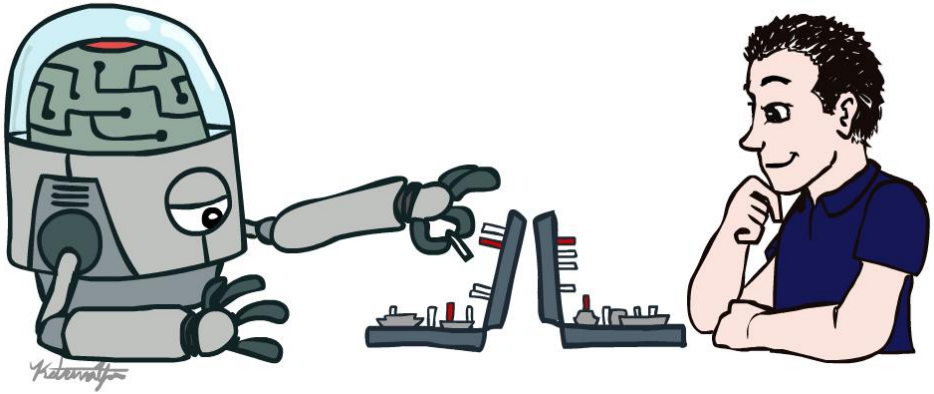
Artificial Intelligence

Introduction



(slides adapted from Anca Dragan)

Slides by Dan Klein, Pieter Abbeel, Anca Dragan (ai.berkeley.edu)

Robots look like this. We have autonomous cars that figure out how to take us to our destination

Robots help nurses in hospitals deliver stuff to different rooms

Drones that record cool videos of us as we do outdoor activities

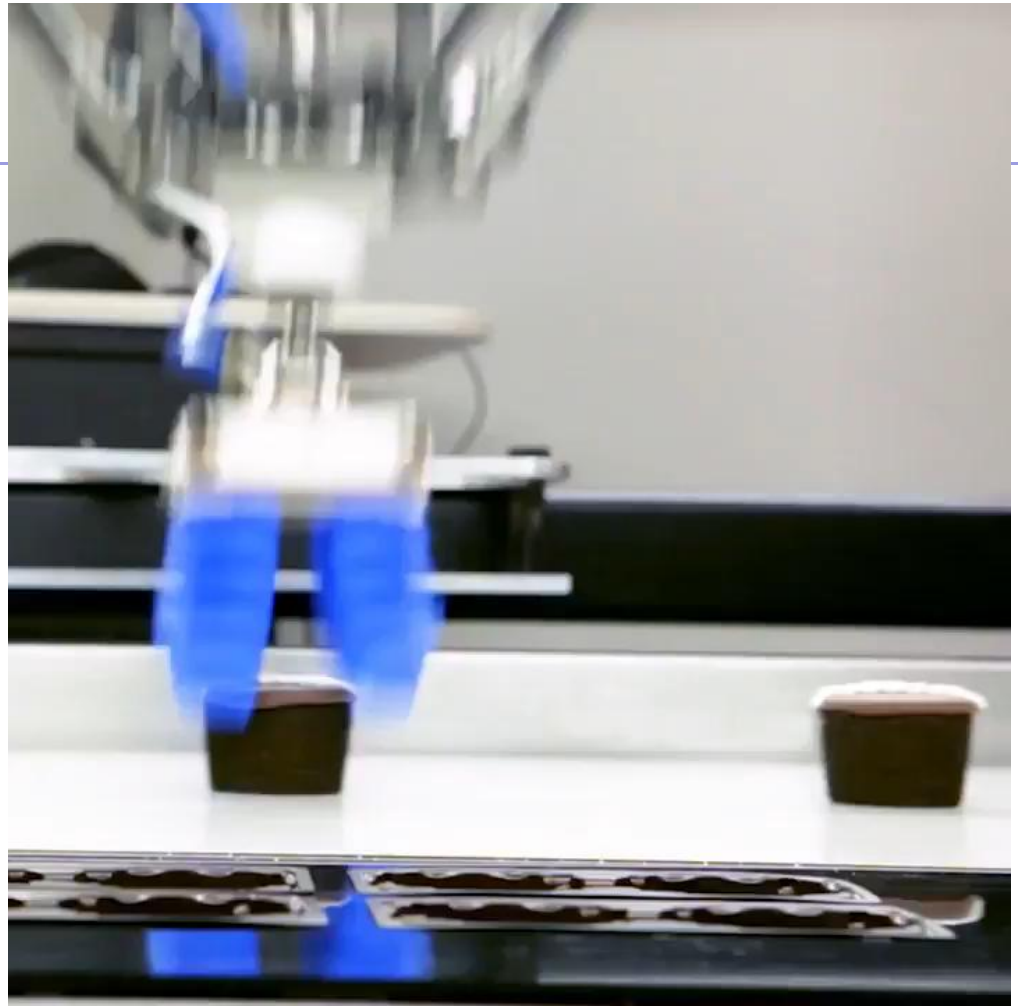
The state of the art of AI

- Link

Child 14, happy
Child 13, angry
Child 9, neutral
Child 7, sad
Child 0, neutral
Child 10, neutral
Child 4, neutral
Child 12, neutral
Child 3, neutral
Child 1, neutral
Child 11, neutral

A reminder for engineers trying to build AI systems that achieve human-level performance. It's often a lot harder than we at first realize. Humans are amazing.

clideo.com



Sofia

Sofia & “indeed” default answer

Deadly orders and rules that Blinly applied

- Rules: The mom said “if you keep doing this crap, I will tell Blinky to cook you for diner”

- Orders: Alex, “kill me, kill my parents, kill everybody ……”

3 Types of Artificial Intelligence

Artificial Narrow Intelligence (ANI)

Stage-1

Machine Learning

- Specialises in one area and solves one problem

Artificial General Intelligence (AGI)

Stage-2

Machine Intelligence

- Refers to a computer that is as smart as a human across the board

Artificial Super Intelligence (ASI)

Stage-3

Machine Consciousness

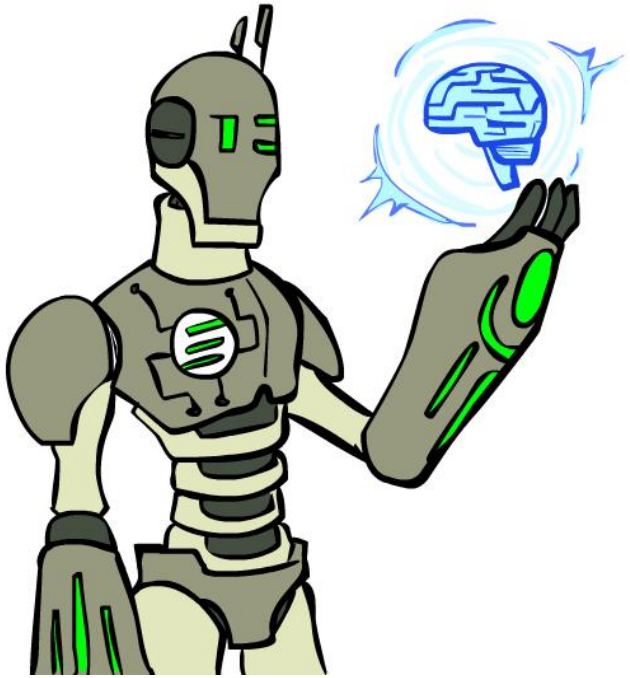
- An intellect that is much smarter than the best human brains in practically every field

Alexa helps to solve assignments ☺

AI powered Apps (Elsa App)

Today

- What is artificial intelligence?
- Where did it come from/What can AI do?
  - What should we and shouldn't we worry about? What can we do about the things we should worry about?
- What is this course?



What is AI?

The science of making machines that:

Rational Decisions

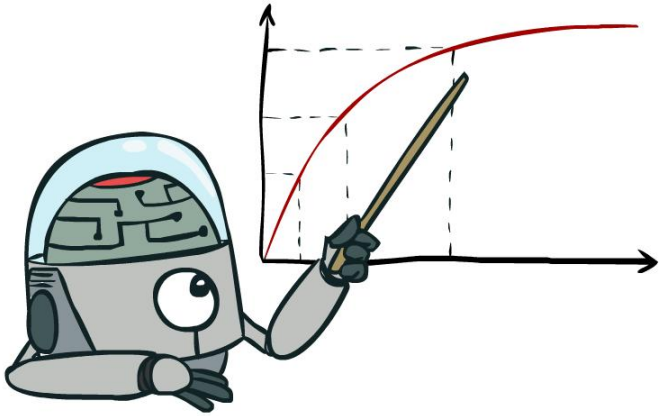
We'll use the term **rational** in a very specific, technical way:

- Rational: maximally achieving pre-defined goals
- Rationality only concerns what decisions are made (not the thought process behind them)
- Goals are expressed in terms of the **utility** of outcomes
- Being rational means **maximizing your expected utility**

A better title for this course would be:

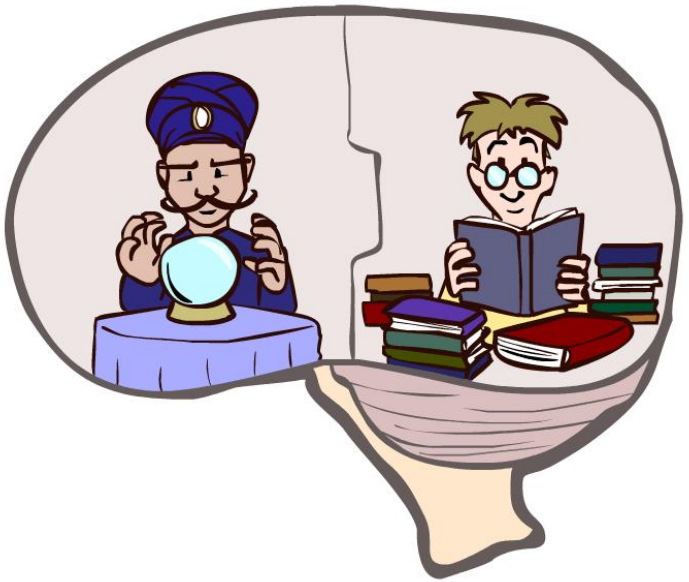
Computational Rationality

Maximize Your Expected Utility



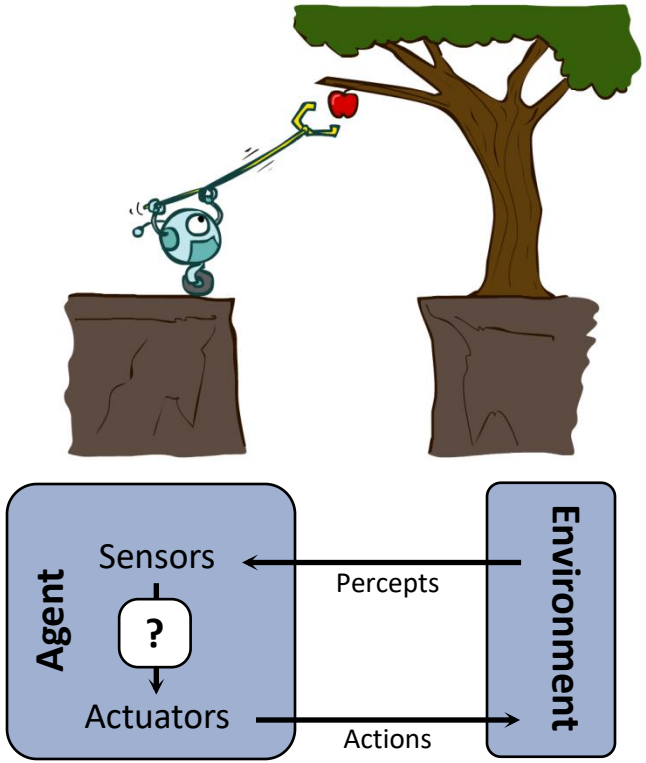
What About the Brain?

- Brains (human minds) are very good at making rational decisions, but not perfect
- Brains aren't as modular as software, so hard to reverse engineer!
- "Brains are to intelligence as wings are to flight"
- Lessons learned from the brain: memory and simulation are key to decision making

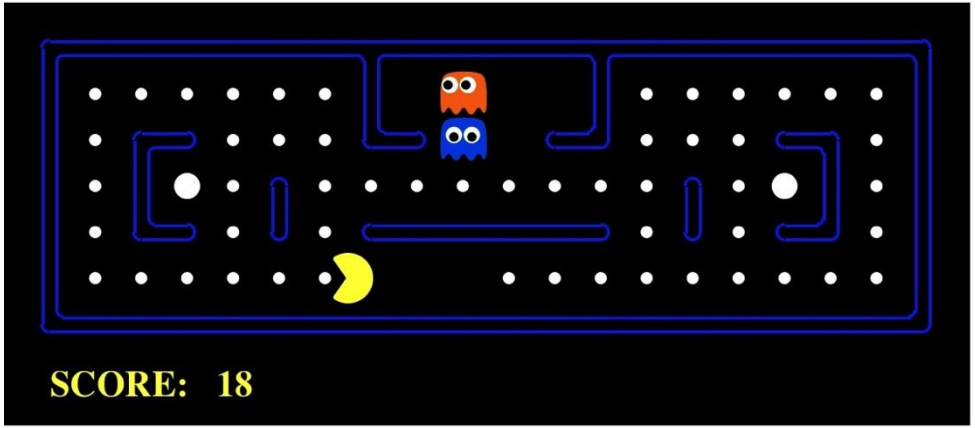


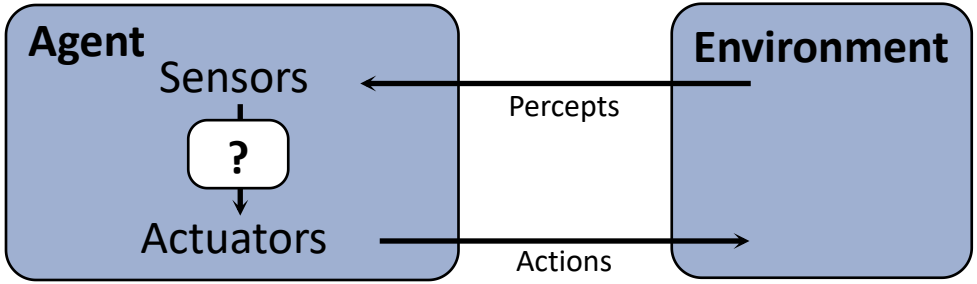
Designing Rational Agents

- 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



Pac-Man as an Agent



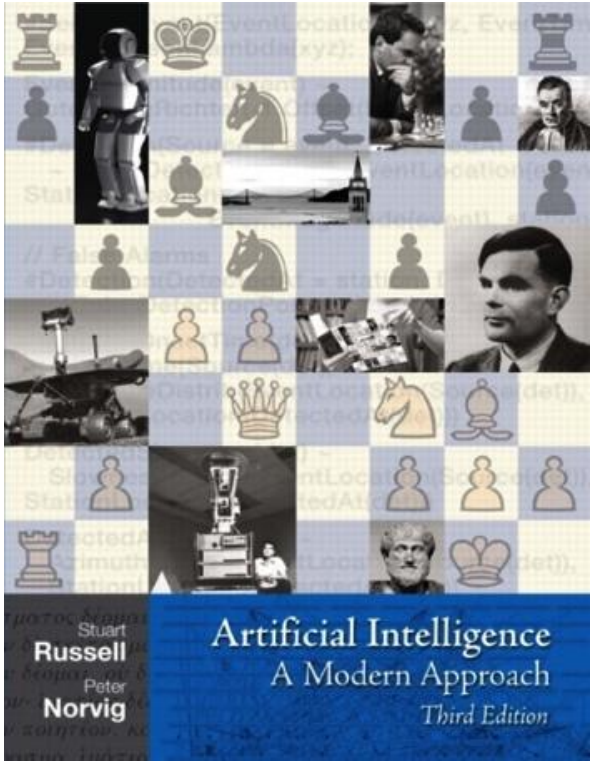


Pac-Man is a registered trademark of Namco-Bandai Games, used here for educational purposes

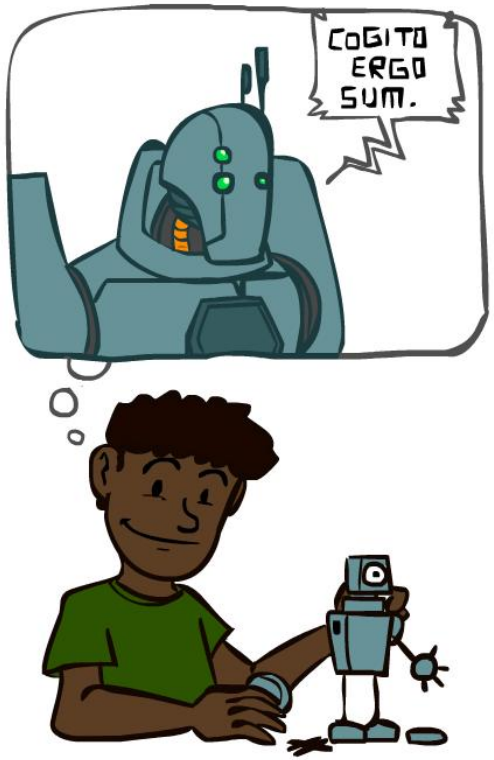
Demo1: pacman-l1.mp4

Textbook

- Russell & Norvig, AI: A Modern Approach

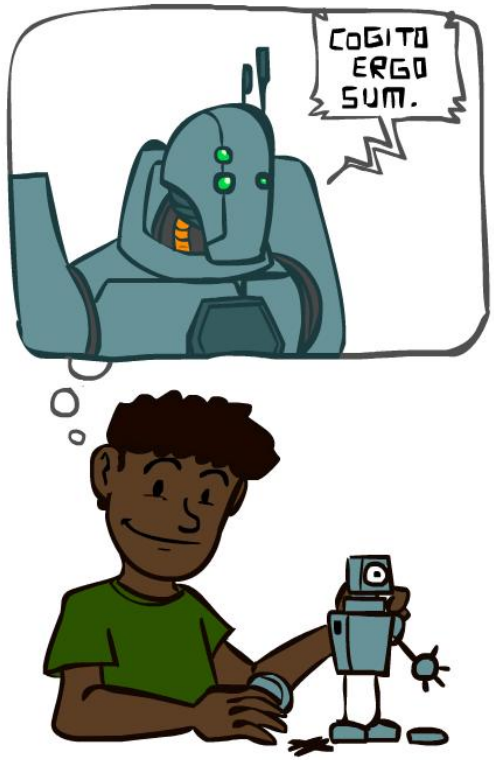


A (Short) History of AI



A (Short) History of AI

- 1940-1950: Early days
  - 1943: McCulloch & Pitts: Boolean circuit model of brain
  - 1950: Turing's "Computing Machinery and Intelligence"
- 1950—70: Excitement: Look, Ma, no hands!
  - 1950s: Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's Geometry Engine
  - 1956: Dartmouth meeting: "Artificial Intelligence" adopted
  - 1965: Robinson's complete algorithm for logical reasoning
- 1970—90: Knowledge-based approaches
  - 1969—79: Early development of knowledge-based systems
  - 1980—88: Expert systems industry booms
  - 1988—93: Expert systems industry busts: "AI Winter"
- 1990—: Statistical approaches
  - Resurgence of probability, focus on uncertainty
  - General increase in technical depth
  - Agents and learning systems… "AI Spring"?
- 2000—: Where are we now?



What Can AI Do?

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

- ✓ Play a decent game of Jeopardy?
- ✓ Win against any human at chess?
- ✓ Win against the best humans at Go?
- ✓ Play a decent game of tennis?
- ✓ Grab a particular cup and put it on a shelf?
- ✗ Unload any dishwasher in any home?
- ? Drive safely along the highway?
- ✗ Drive safely along Telegraph Avenue?
- ✓ Buy a week's worth of groceries on the web?
- ✗ Buy a week's worth of groceries at Berkeley Bowl?
- ? Discover and prove a new mathematical theorem?
- ✗ Perform a surgical operation?
- ✗ Unload a know dishwasher in collaboration with a person?
- ✓ Translate spoken Chinese into spoken English in real time?
- ✓ Write story?
- ✗ Write an intentionally funny story?

. e4 c6 2. d4 d5 3. Nc3 dxe4

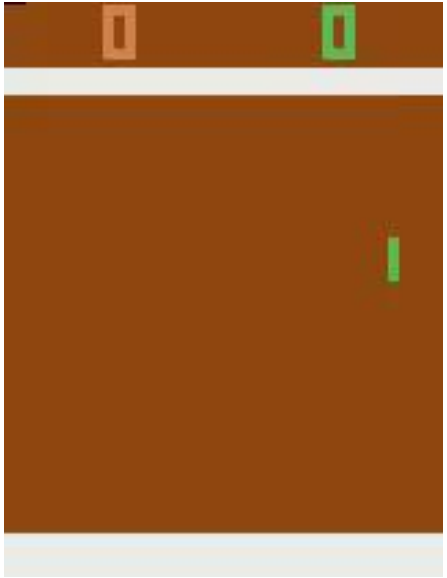
Game Agents

- Classic Moment: May, '97: Deep Blue vs. Kasparov
  - First match won against world champion
  - “Intelligent creative” play
  - 200 million board positions per second
  - Humans understood 99.9 of Deep Blue's moves
  - Can do about the same now with a PC cluster
- 1996: Kasparov Beats Deep Blue
  “I could feel --- I could smell --- a new kind of intelligence across the table.”
- 1997: Deep Blue Beats Kasparov
  “Deep Blue hasn't proven anything.”

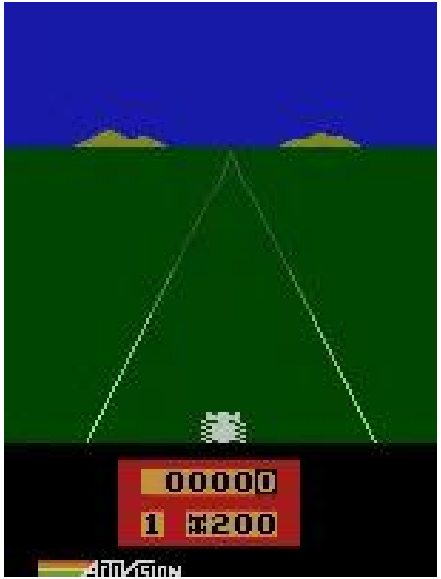
Text from Bart Selman, image from IBM’s Deep Blue pages

Game Agents

- Reinforcement learning



Pong

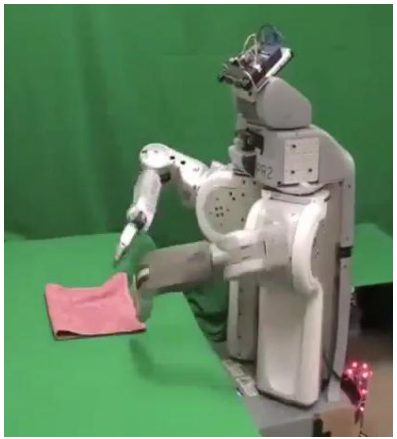


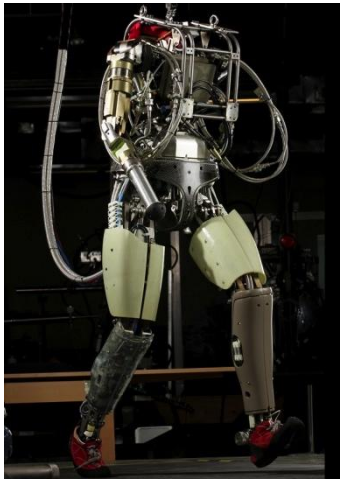
Enduro

Robotics

Demo 1: ROBOTICS – soccer.avi
Demo 2: ROBOTICS – soccer2.avi
Demo 3: ROBOTICS – gcar.avi
Demo 4: ROBOTICS – laundry.avi
Demo 5: ROBOTICS – petman.avi

- Robotics
  - Part mech. eng.
  - Part AI
  - Reality much harder than simulations!
- Technologies
  - Vehicles
  - Rescue
  - Help in the home
  - Lots of automation…
- In this class:
  - We ignore mechanical aspects
  - Methods for planning
  - Methods for control

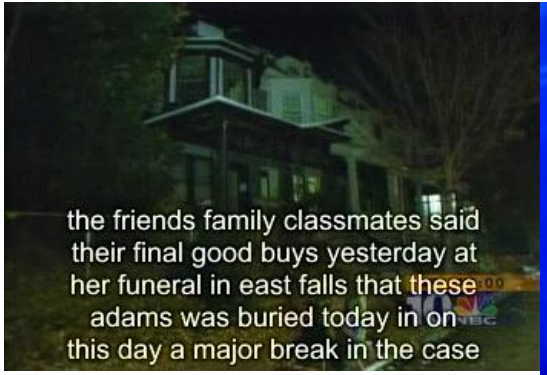




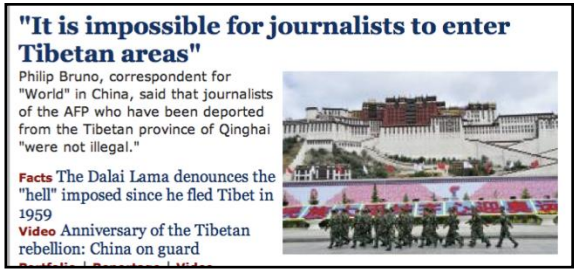
Images from UC Berkeley, Boston Dynamics, RoboCup, Google

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



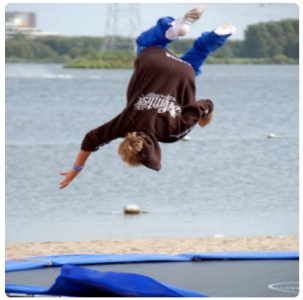
  - Web search
  - Text classification, spam filtering, etc…

Computer Vision

"man in black shirt is playing guitar."

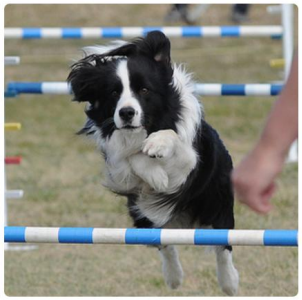
"construction worker in orange safety vest is working on road."

"two young girls are playing with lego toy."



"boy is doing backflip on wakeboard."

"girl in pink dress is jumping in air."



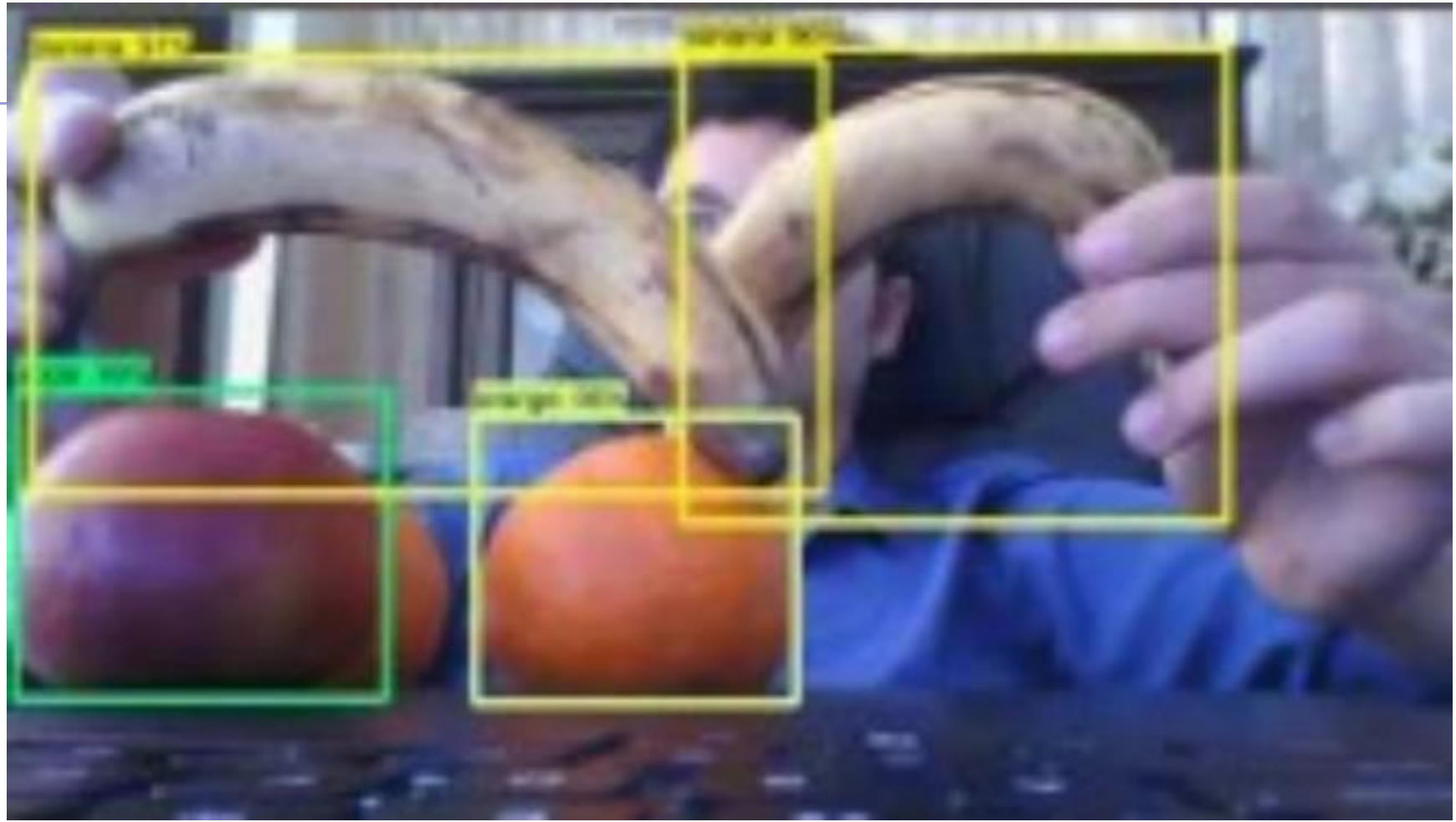
"black and white dog jumps over bar."

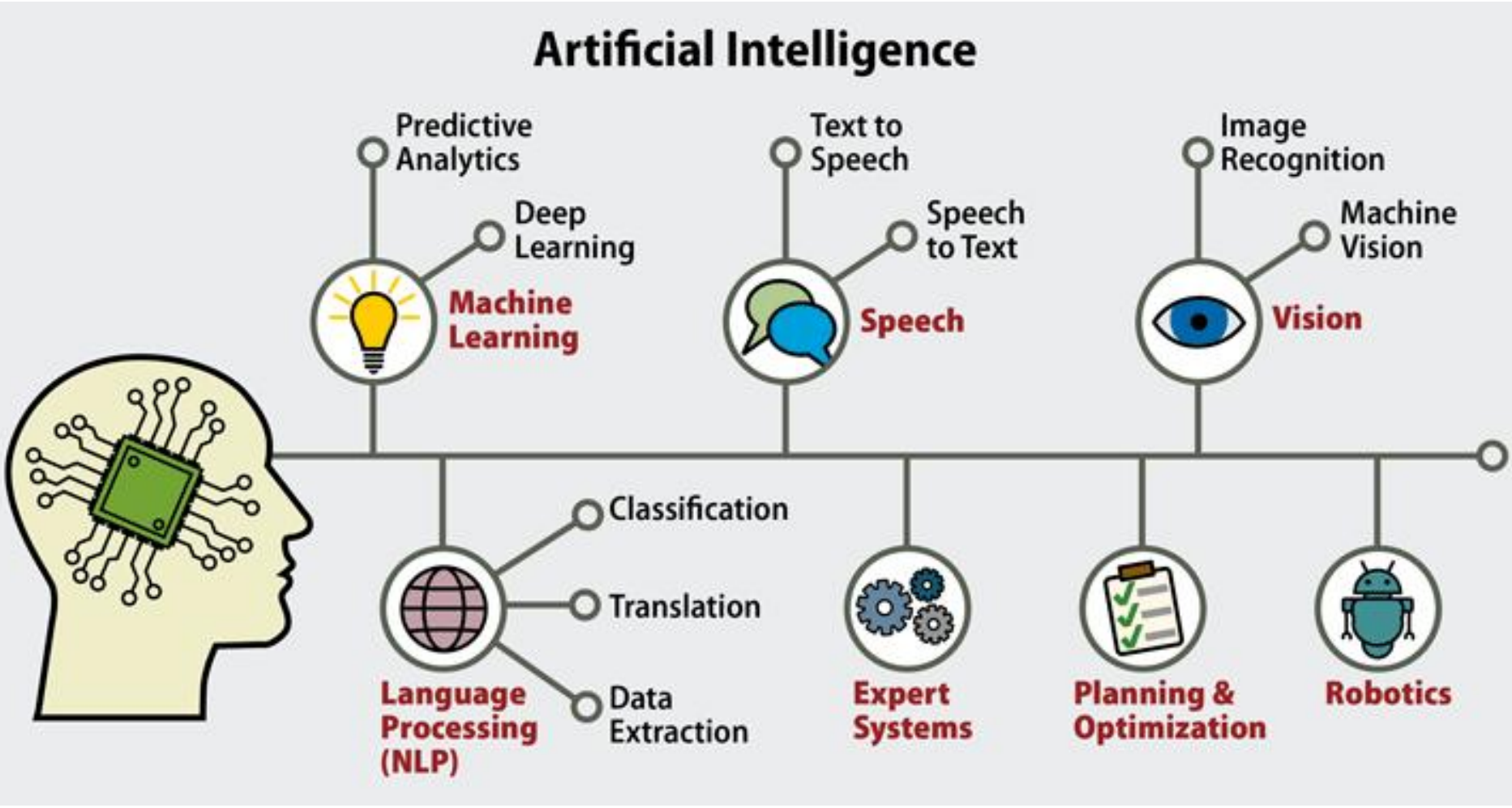
"young girl in pink shirt is swinging on swing."

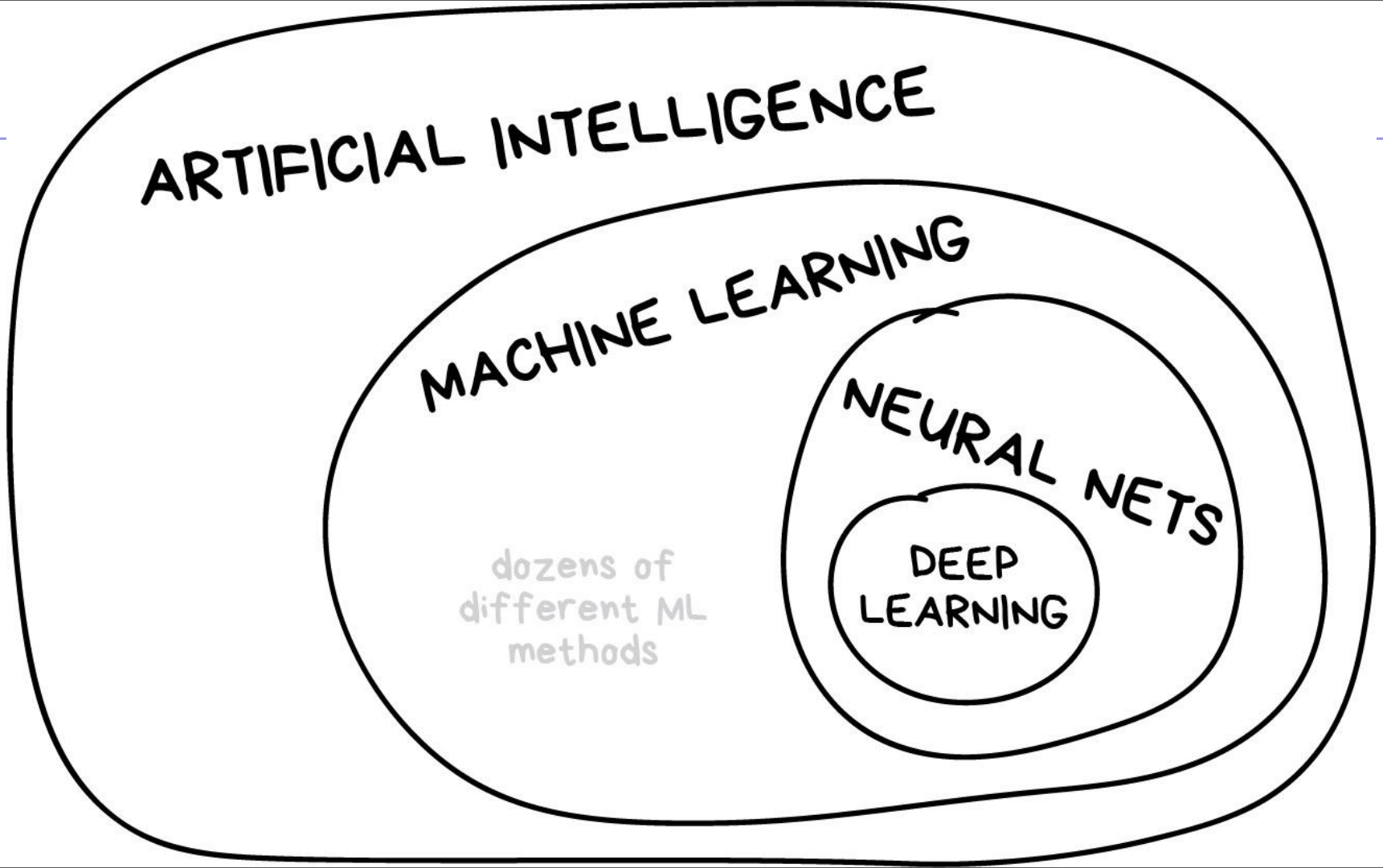
"man in blue wetsuit is surfing on wave."

Karpathy & Fei-Fei, 2015; Donahue et al., 2015; Xu et al, 2015; many more

COMPUTER VISION
WITH MASK R-CNN




Artificial Intelligence
Predictive Analytics
Deep Learning
Machine Learning
Text to Speech
Speech to Text
Speech
Image Recognition
Machine Vision
Vision
Classification
Translation
Data Extraction
Language Processing (NLP)
Expert Systems
Planning & Optimization
Robotics


ARTIFICIAL INTELLIGENCE
MACHINE LEARNING
NEURAL NETS
DEEP LEARNING
dozens of different ML methods

CLASSICAL MACHINE LEARNING

Data is pre-categorized or numerical

SUPERVISED

Predict a category

CLASSIFICATION

«Divide the socks by color»

Predict a number

REGRESSION

«Divide the ties by length»

Data is not labeled in any way

UNSUPERVISED

Divide by similarity

CLUSTERING

«Split up similar clothing into stacks»

DIMENSION REDUCTION (generalization)

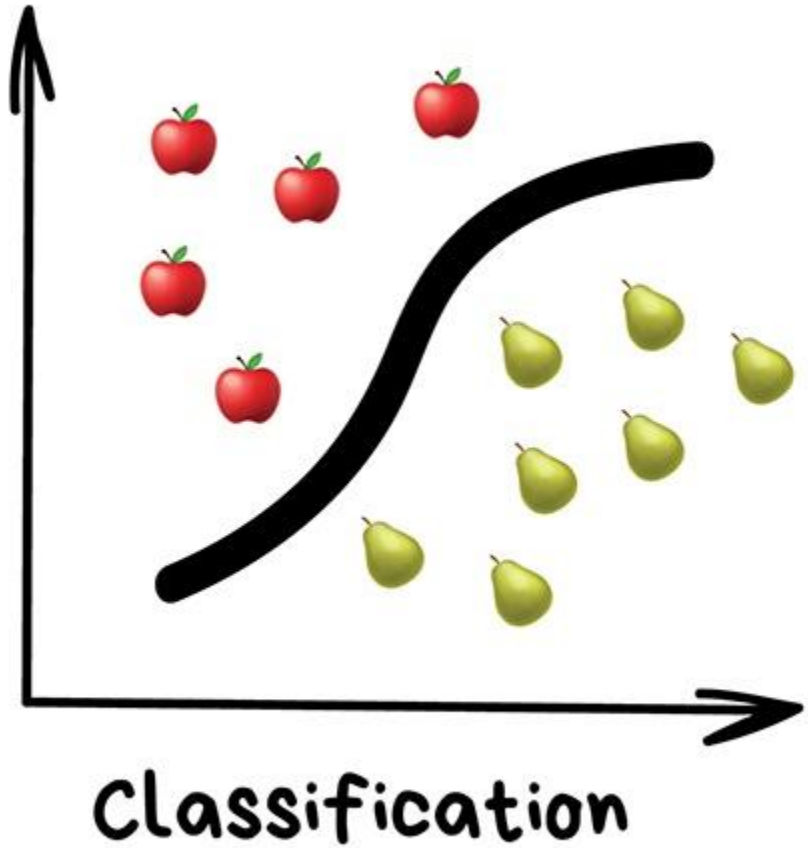
«Make the best outfits from the given clothes»

Find hidden dependencies

Identify sequences

ASSOCIATION

«Find what clothes I often wear together»


Classification

THE SIMPLEST SPAM-FILTER

(used until 2010)

good letters

672 times

«KITTY»

13 times

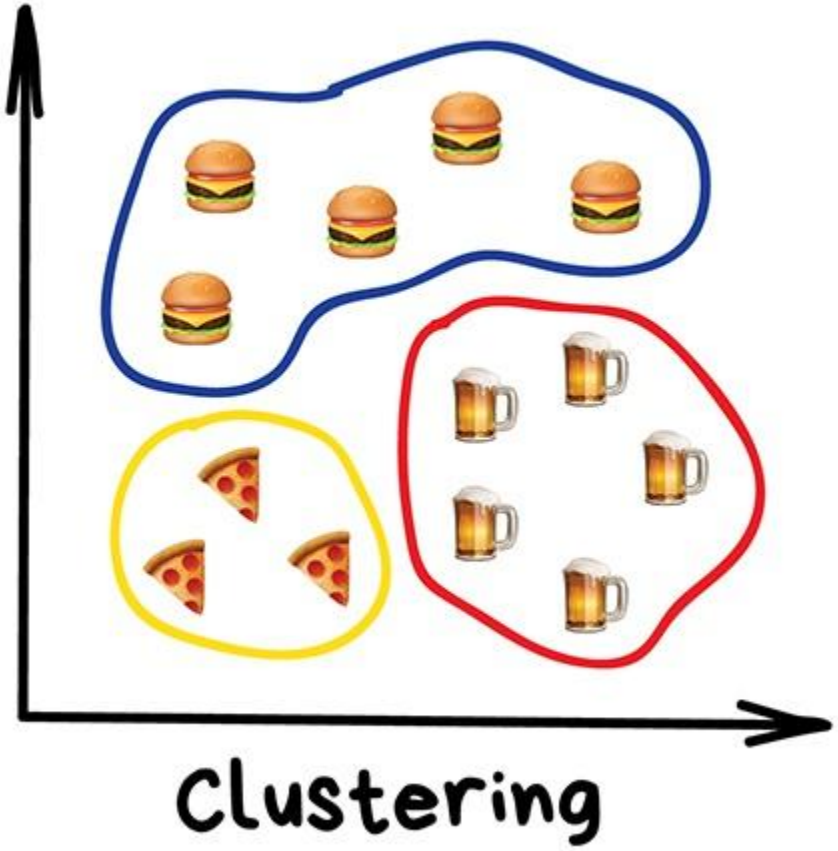
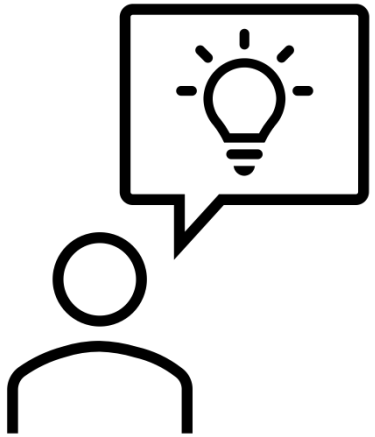
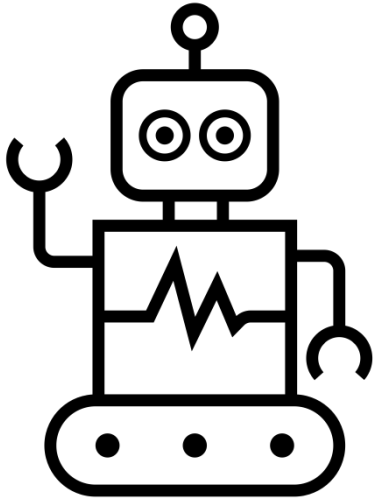
spam letters

$$P(A|B) = \frac{P(B|A)\,P(A)}{P(B)}$$

BAYES' THEOREM

NOT SPAM

NAIVE BAYES


Clustering