WTF is...
Machine Learning?

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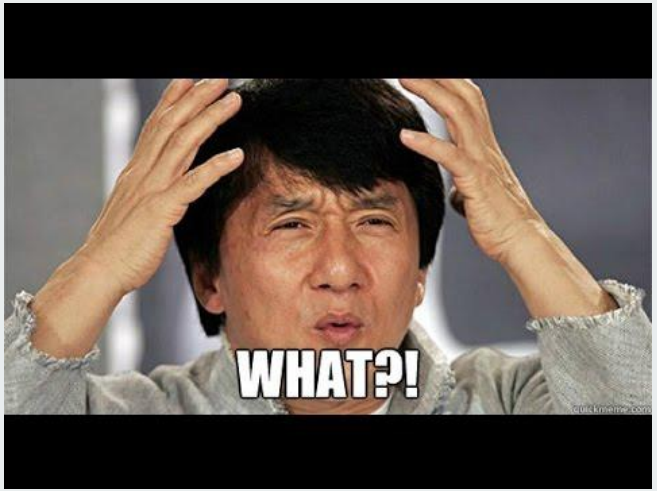

WTF is...
Machine Learning?

Agenda

1. Admin stuff
2. What the f*** is Machine Learning?
3. A Brief History of Machine Learning
4. Breakdown of Machine Learning
5. Supervised Learning
6. Unsupervised Learning
7. Q & A

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1. **Admin stuff**
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Admin stuff

Who we are

Today's session

10:00 - 11:00	This talk
11:00 - 11:15	Coffee break
11:15 - 12:00	Cracking the Love Codes
12:00 - 13:00	Break
13:00 - 14:00	Linear Regression
14:00 - 15:00	Logistic Regression

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1. Administrivia
2. **What the f*** is Machine Learning?**
3. A Brief History of Machine Learning
4. Breakdown of Machine Learning
5. Supervised Learning
6. Unsupervised Learning
7. Q & A

“(...) the question is: How can computers learn to solve problems without being explicitly programmed?”

- (paraphrased) Arthur Samuel, 1959

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Timeli

Least squares
1805

Bayes
Theorem
1812

NEW NAVY DEVICE LEARNS BY DOING

Psychologist Shows Embryo of Computer Designed to Read and Grow Wiser

WASHINGTON, July 7 (UPI) —The Navy revealed the embryo of an electronic computer today that it expects will be able to walk, talk, see, write, reproduce itself and be conscious of its existence.

The embryo—the Weather Bureau's $2,000,000 "704" computer—learned to differentiate between right and left after fifty attempts in the Navy's demonstration for newsmen.

The service said it would use this principle to build the first of its Perceptron thinking machines that will be able to read and write. It is expected to be finished in about a year at a cost of $100,000.

Dr. Frank Rosenblatt, designer of the Perceptron, conducted the demonstration. He said the machine would be the first device to think as the human brain. As do human beings, Perceptron will make mistakes at first, but will grow wiser as it gains experience, he said.

Dr. Rosenblatt, a research psychologist at the Cornell Aeronautical Laboratory, Buffalo, said Perceptrons might be fired to the planets as mechanical space explorers.

Without Human Controls

The Navy said the perceptron would be the first non-living mechanism "capable of receiving, recognizing and identifying its surroundings without any human training or control."

The "brain" is designed to remember images and information it has perceived itself. Ordinary computers remember only what is fed into them on punch cards or magnetic tape.

Later Perceptrons will be able to recognize people and call out their names and instantly translate speech in one language to speech or writing in another language, it was predicted.

Mr. Rosenblatt said in principle it would be possible to build brains that could reproduce themselves on an assembly line and which would be conscious of their existence.

1947

1958 New York Times...

In today's demonstration, the "704" was fed two cards, one with squares marked on the left side and the other with squares on the right side.

Learns by Doing

In the first fifty trials, the machine made no distinction between them. It then started registering a "Q" for the left squares and "O" for the right squares.

Dr. Rosenblatt said he could explain why the machine learned only in highly technical terms. But he said the computer had undergone a "self-[illegible] change in the wiring [illegible]

The first Percep[illegible] have about 1,000 "association cells" [illegible] electrical impulses from an eye-like scanning device with 400 photo-cells. The human brain has 10,000,000,000 responsive cells, including 100,000,000 connections with the eyes.

TD Gammon
1989

Cats on Youtube
2012

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A motivating example.

Here’s a little puzzle:

- What brightens your life every day?
- What’s always there for you?
- What’s good for every occasion and mood?
- What if there was something, or someone that would always know what to show you?


NETFLIX
Browse
Kids
DVD
Trending Now
NETFLIX
THE SINNER
GET HARD
SALVATION
Rick and Morty
NETFLIX ORIGINAL
SINNER
98% Match
15
1 Season
Watch Season Now
mother inexplicably stabs a stranger to death, a sympathetic detective struggles to unlock the mystery buried in her missing memories.
Starring: Jessica Biel, Bill Pullman, Christopher Abbott, Abby Miller, Dohn Norwood
Creator: Derek Simonds
Genres: TV Shows, US TV Shows, US TV Dramas
MY LIST

Imagine a world without ML.

How would you accomplish this task?

- Random number
- Programming logic
- Global recommendations
- Human slave

Components of Machine Learning

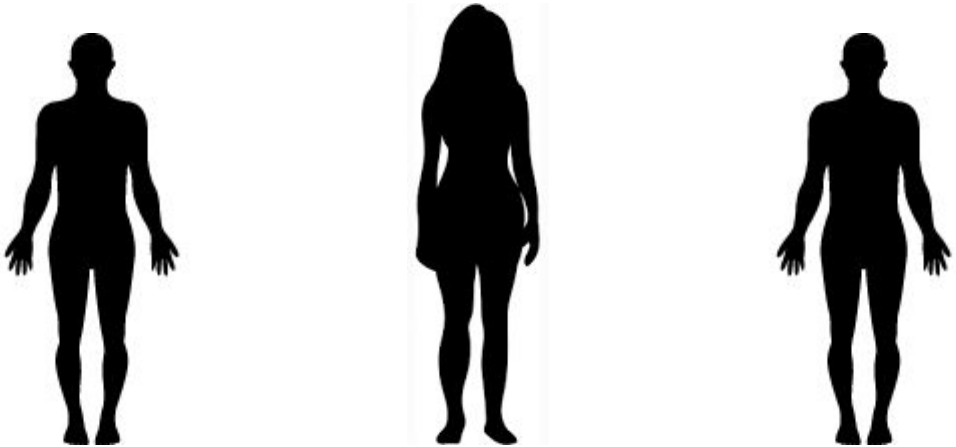
Why and when should you use Machine Learning?

- Problem does not have an explicit solution.
- There is some pattern you can leverage.
- You have data
- … and computing power

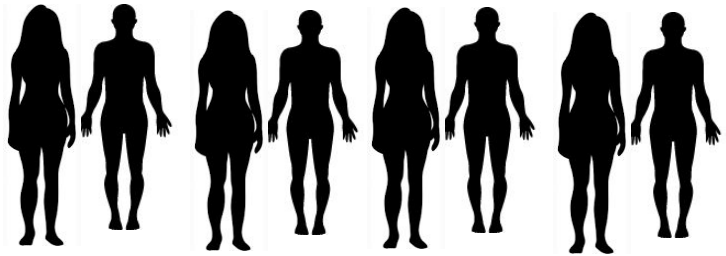
age ?

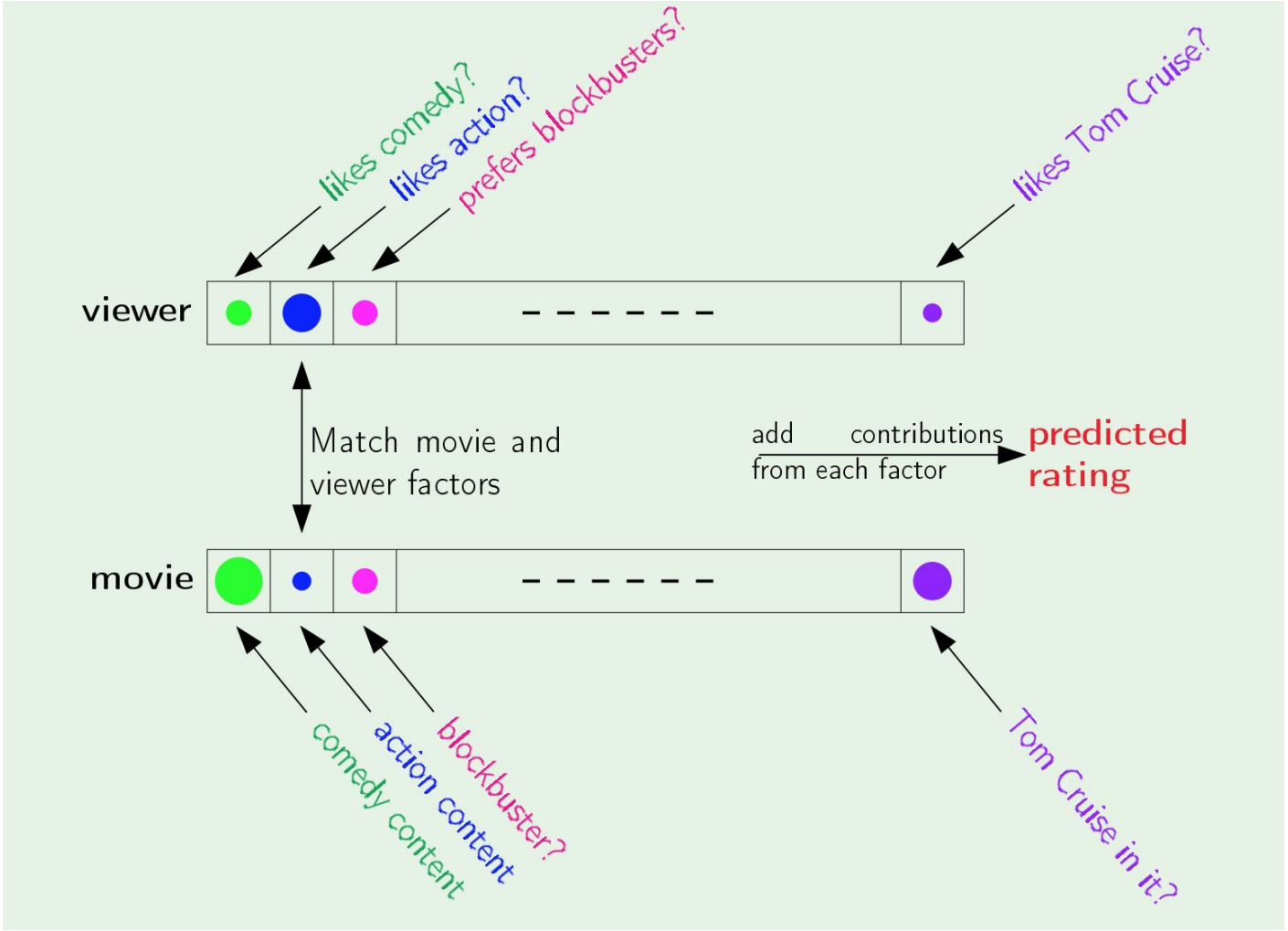
Location ?

- Time of day
- Day of week
- Has watched 5 action movies
- etc.



sex ?




likes comedy?
likes action?
prefers blockbusters?
likes Tom Cruise?
viewer
Match movie and viewer factors
add contributions from each factor
predicted rating
movie
comedy content
action content
blockbuster?
Tom Cruise in it?

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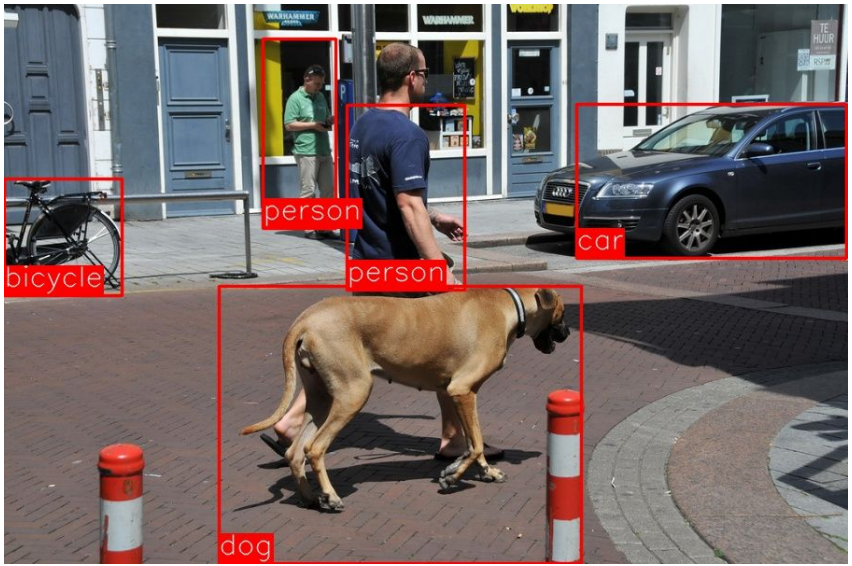
Supervised Learning

Object Detection



Face Recognition

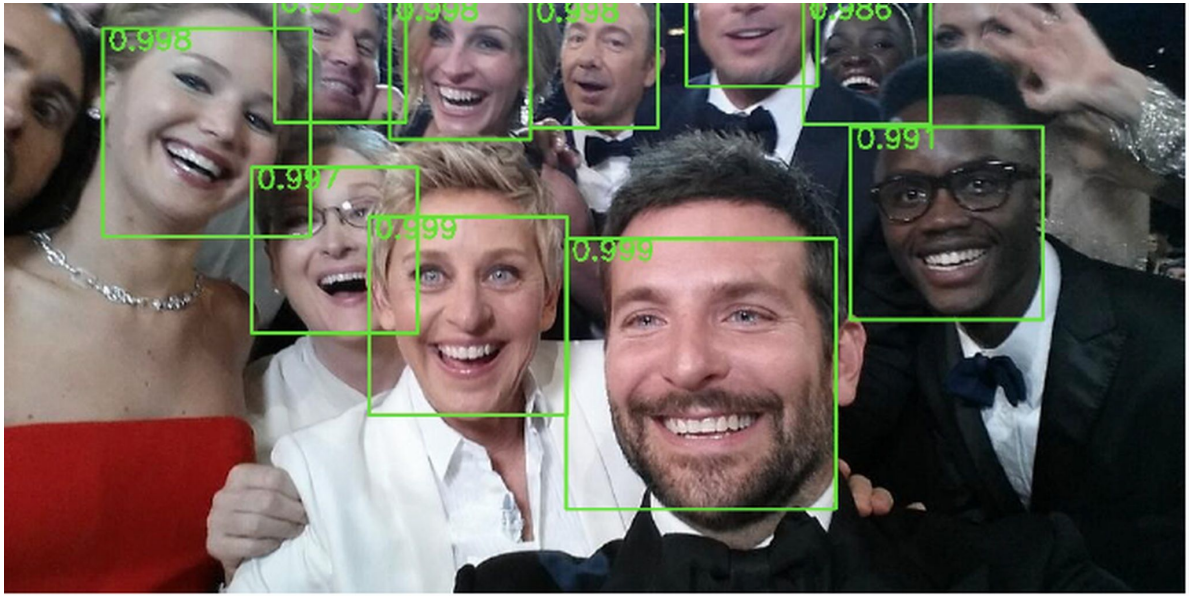


Image Captioning

a laptop computer sitting on top of a wooden desk

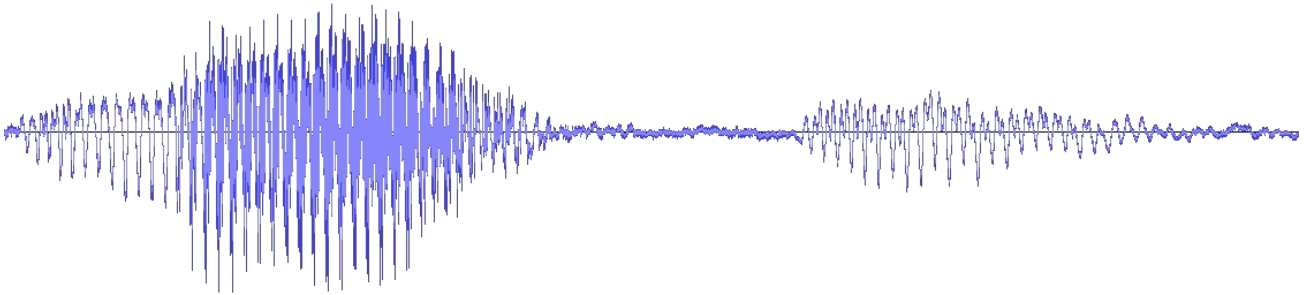
a laptop computer sitting on top of a wooden desk

a red fire hydrant sitting on the side of a road

a man sitting on a bench in a field

http://cs.stanford.edu/people/karpathy/deepimagesent/

Speech Recognition



Hotdog or Not

Given an image, tell me whether it's an image of a hotdog or not.

https://play.google.com/store/apps/details?id=com.seefoodtechnologies.nothotdog

Ingredients

- A lot of labelled data
- A lot of computing power

A Lot of Labelled Data

Hotdog

Hotdog

Not

Hotdog

Not

. . .

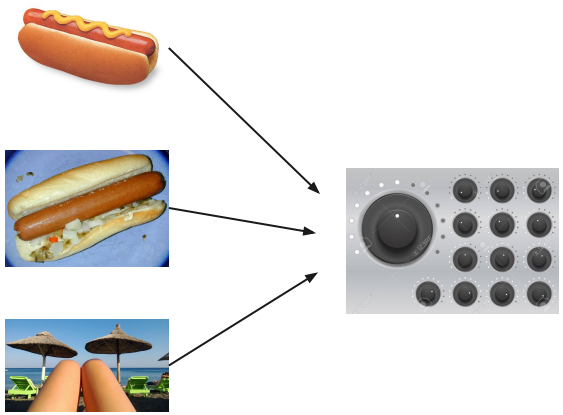
A Lot of Computing Power

Recipe

- Optimization of a parameterized function (a.k.a turning knobs)

Turning Knobs

Input	Hypothesis function/ machine with knobs	Output of machine	Correct output	Numerical cost
		*Not*	Hotdog	1
x	f_θ	$f_\theta(x)$	y	$\mathrm{C}(f_\theta(x), y)$

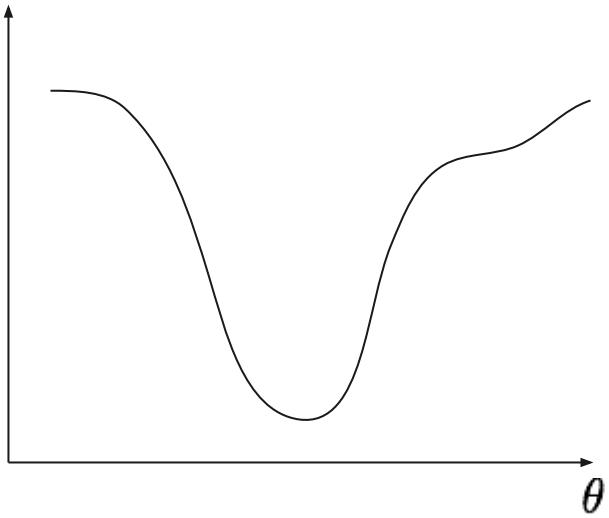


	Not	Hotdog	1
	Not	Hotdog	1
	Not	Not	0
⋮	⋮	⋮	⋮
$x^{(i)}$	$f_\theta(x^{(i)})$	$y^{(i)}$	$\sum_i C(f_\theta(x^{(i)}), y^{(i)})$

Optimizing a Parameterized Function

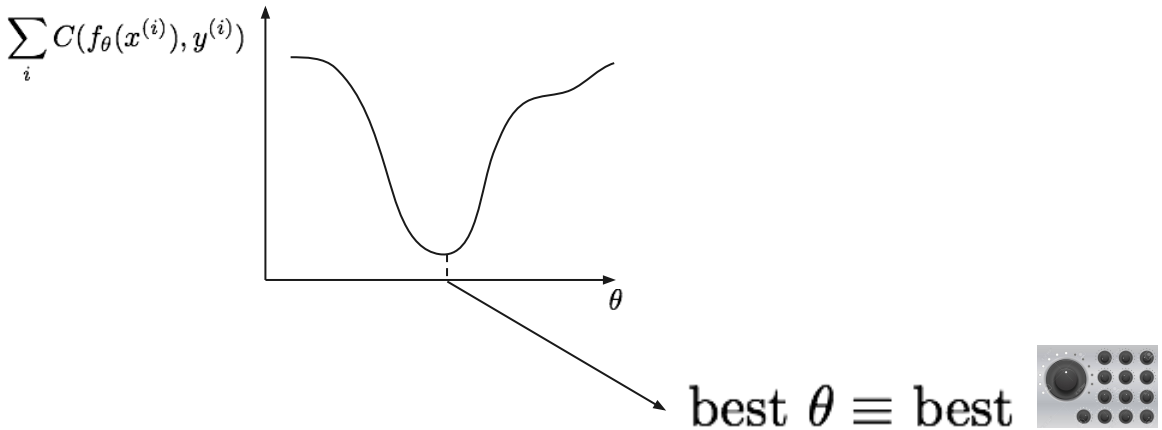
(a.k.a. Turning Knobs)

$$\sum_i C(f_\theta(x^{(i)}), y^{(i)})$$



Optimizing a Parameterized Function

(a.k.a. Turning Knobs)



secret sauce: gradient descent

Deep Learning Model

= Artificial Neural Network

= Deep Neural Network

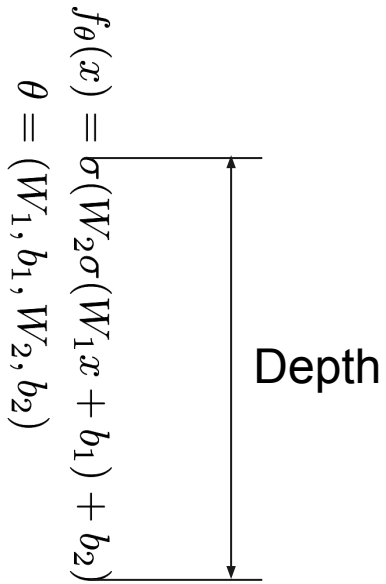
...

= Parameterized (non-linear) Function

An Example of a Deep Learning Model

$$f_\theta(x) = \sigma(W_2\sigma(W_1x + b_1) + b_2)$$
$$\theta = (W_1, b_1, W_2, b_2)$$

An Example of a Deep Learning Model

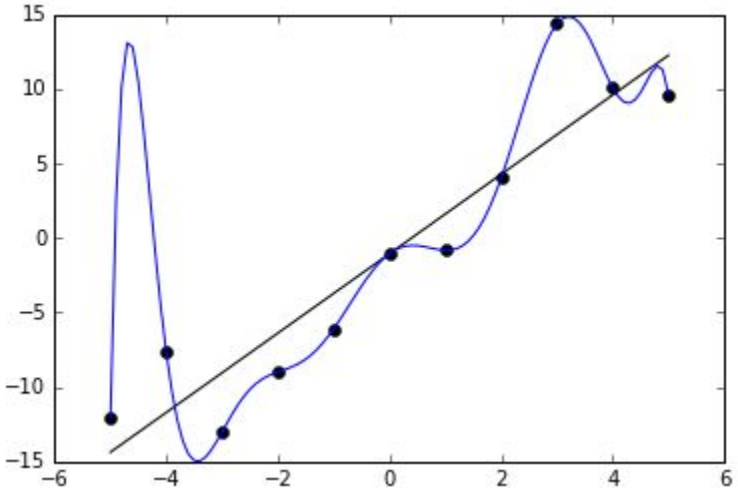


Fine Print?

- A lot of labelled data
- Generalization
- Bias
- Not knowing what you don’t know
- Adversarial examples

A Lot of Labelled Data

Generalization



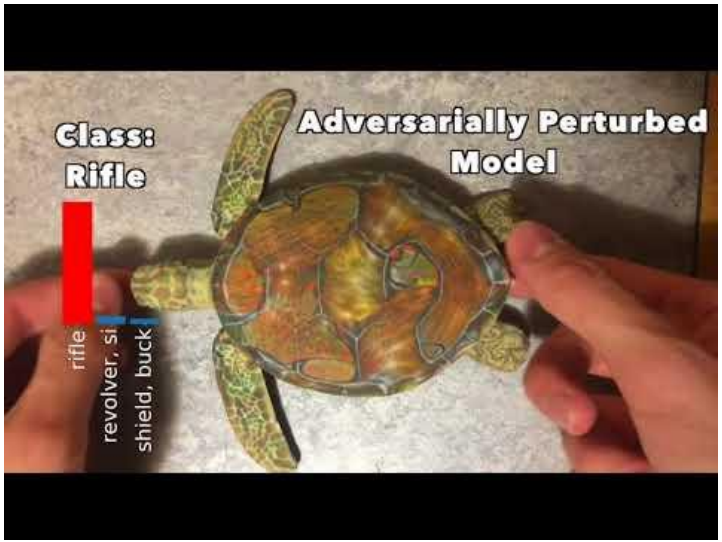
Bias

http://uk.businessinsider.com/microsoft-deletes-racist-genocidal-tweets-from-ai-chatbot-tay-2016-3

Not Knowing What You Don't Know

https://www.theregister.co.uk/2017/06/20/tesla_death_crash_accident_report_ntsb/

Adversarial Examples



https://www.youtube.com/watch?v=XaQu7kkQBPc

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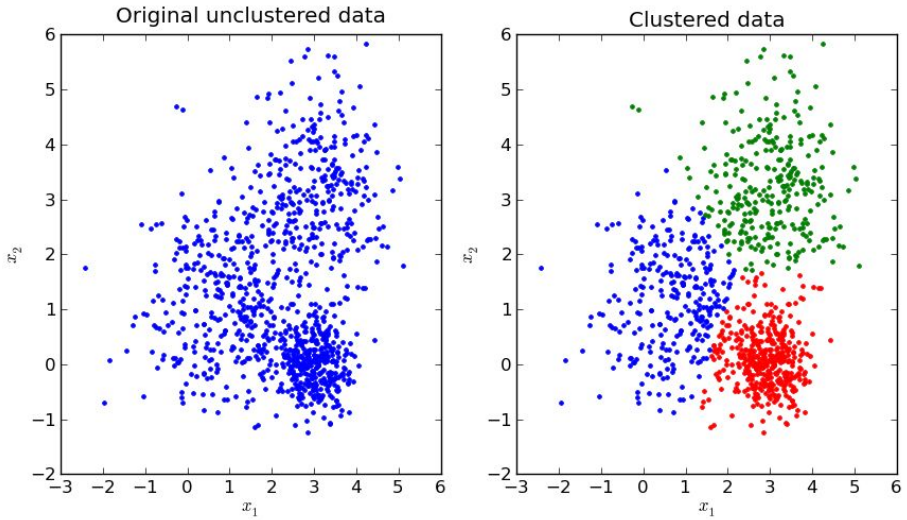
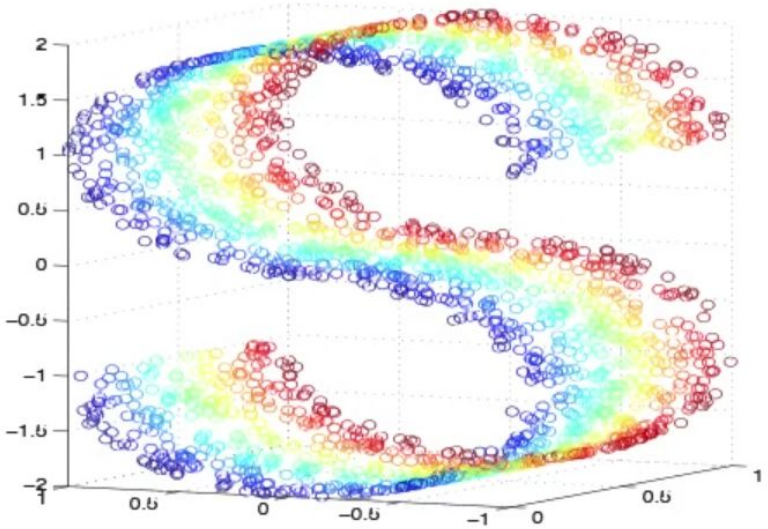
Unsupervised Learning

Clustering



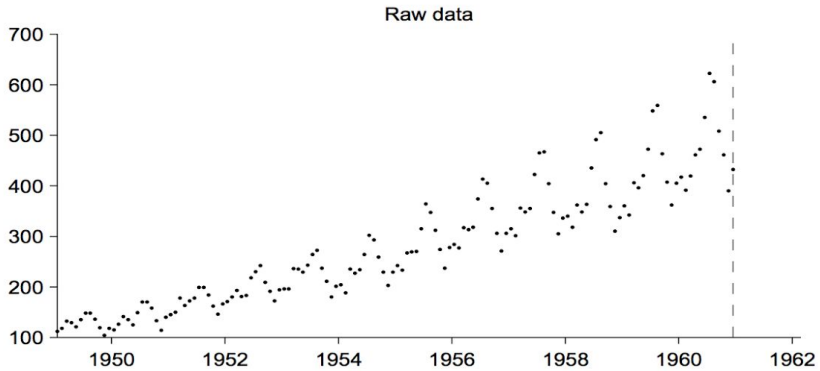
Source: https://www.quora.com/What-is-the-difference-between-K-means-and-the-mixture-model-of-Gaussian/answer/Sourav-Chatterjee-4

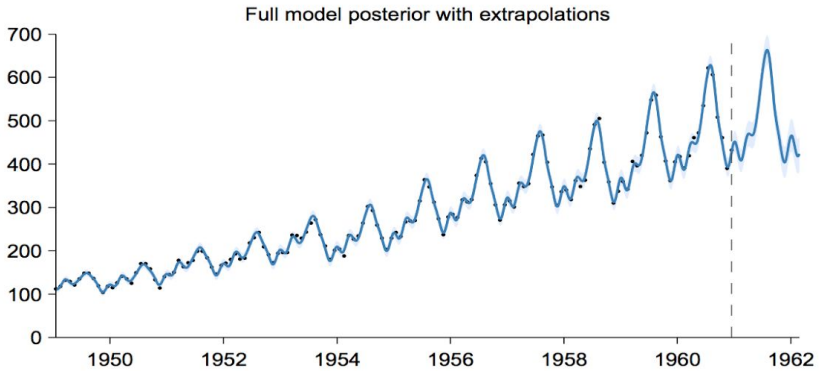
Dimensionality Reduction



https://www.youtube.com/watch?v=QEq96wib5tw

Time-Series Prediction





http://automaticstatistician.com/

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Questions?

Thank you!