

Machine Learning

Introduction

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<http://www.carlhenrik.com>



\$20 Off Baby Coupon



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- *"My daughter got this in the mail!. She's still in high school, and you're sending her coupons for baby clothes and cribs? Are you trying to encourage her to get pregnant?"*



\$20 Off Baby Coupon

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- "*I had a talk with my daughter, It turns out there's been some activities in my house I haven't been completely aware of. She's due in August. I owe you an apology*"

"artificial intelligence is our biggest existential threat"
– Elon Musk, The Guardian Oktober 2014

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*"I agree with Elon Musk and some others on this and
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– Bill Gates, January 2015

"artificial intelligence is our biggest existential threat"

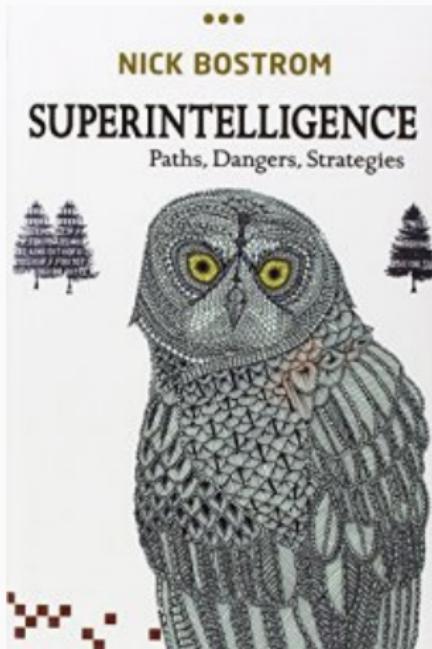
– Elon Musk, The Guardian Oktober 2014

*"I agree with Elon Musk and some others on this and
don't understand why some people are not concerned."*

– Bill Gates, January 2015

*"Artificial intelligence could wipe out humanity when it
gets too clever as humans will be like ants."*

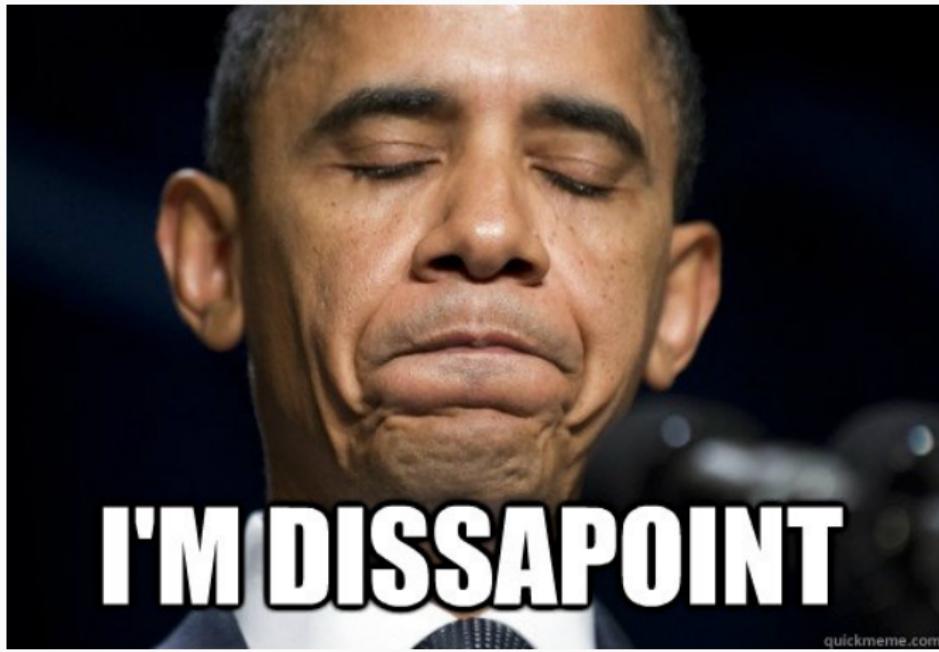
– Prof. Steven Hawking, The Independent, October 2015



Nick Bostrom







I'M DISSAPPOINT

quickmeme.com

Work



- 1990
- 36.0×10^9 USD
- 1.2 million

Work



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- 2014
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- 137 thousand

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11% of the Detroit workforce is generating 30 times as much wealth in SF



Machine Learning

Introductions



This is what I do

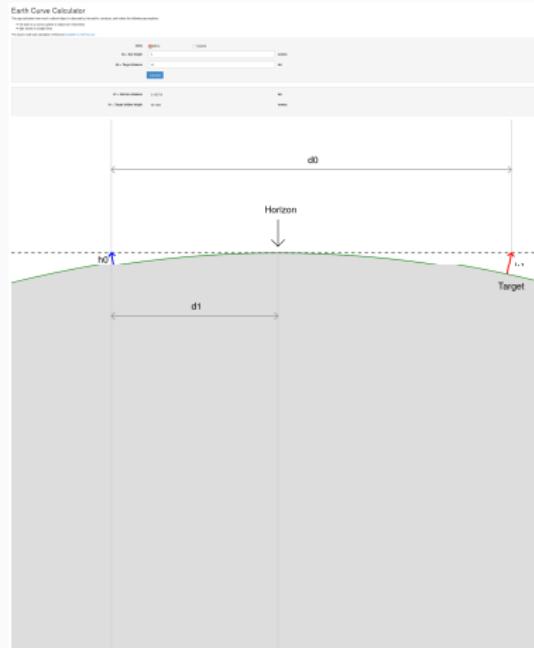










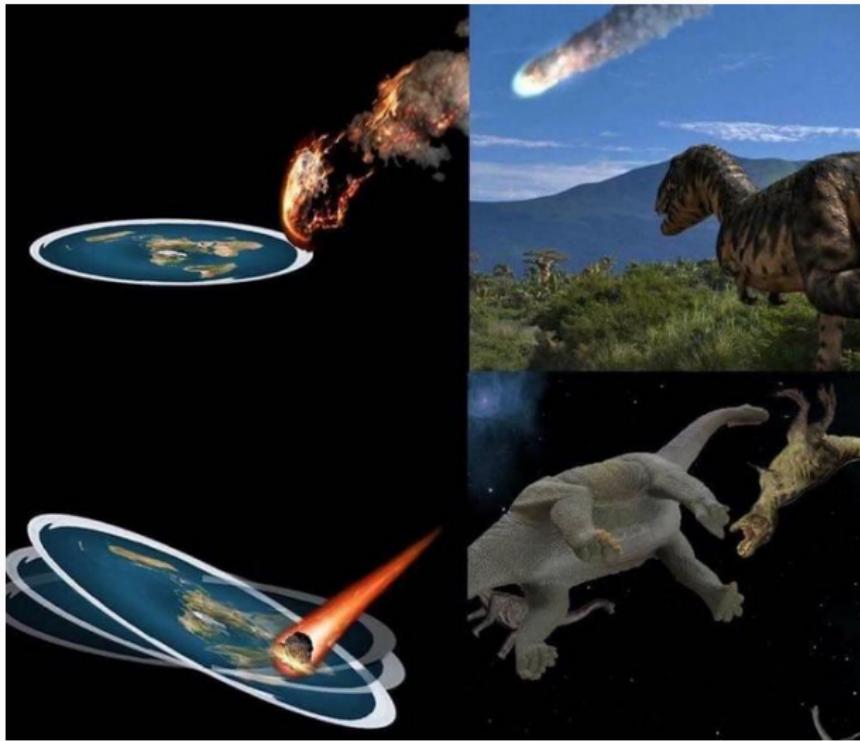


Distance to horizon 6.2km

Hidden height 125.6m





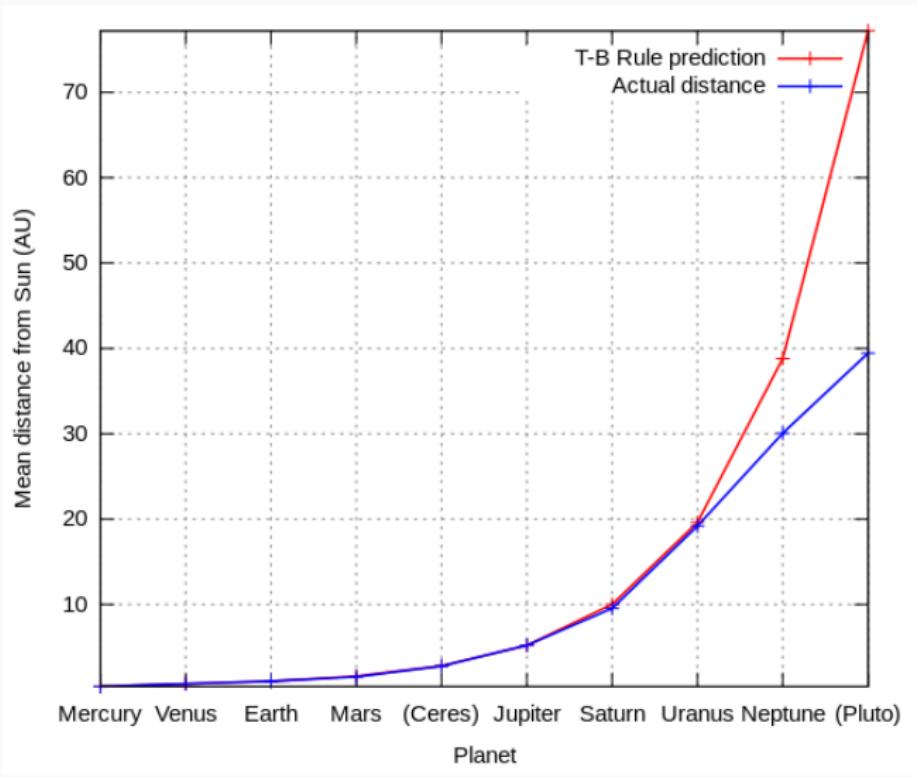


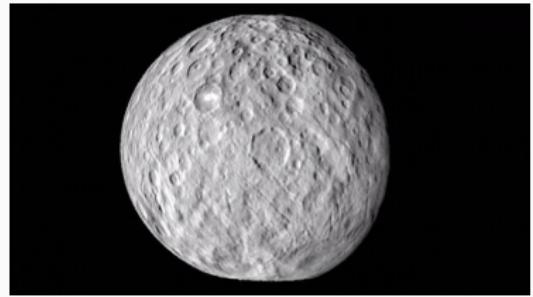


Inductive Reasoning

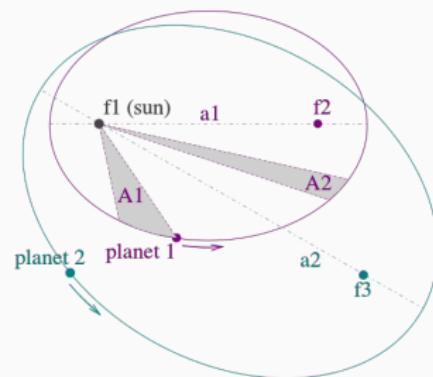
"In inductive inference, we go from the specific to the general. We make many observations, discern a pattern, make a generalization, and infer an explanation or a theory"

– Wassertheil-Smoller

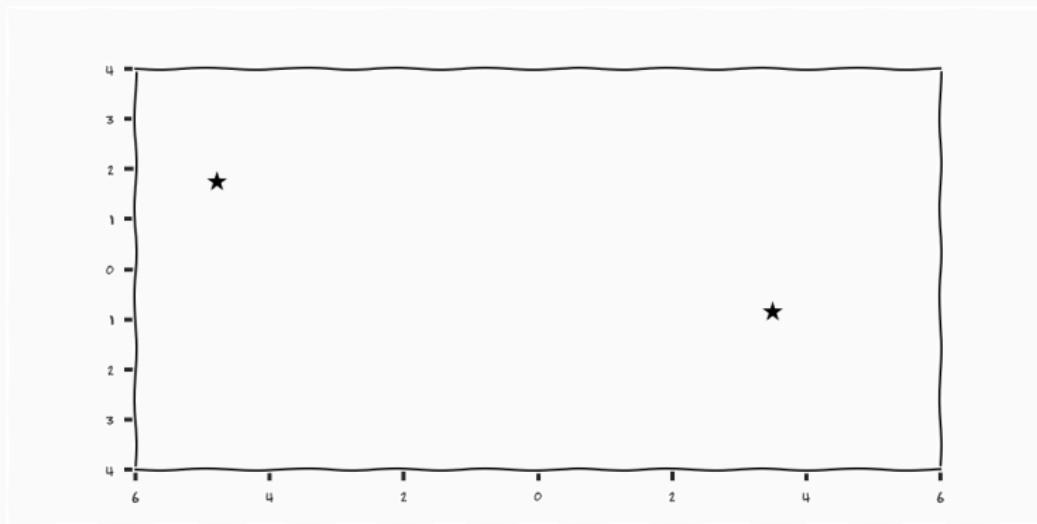




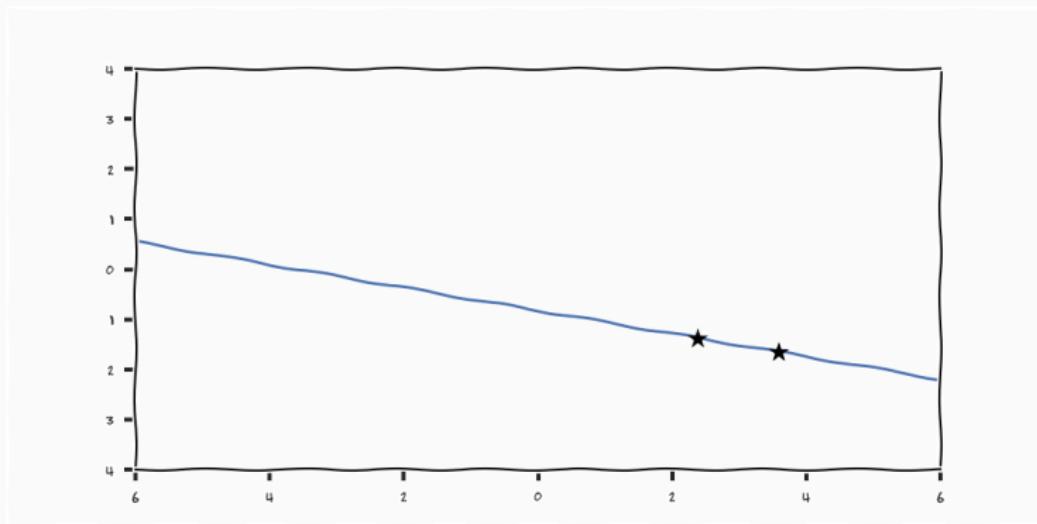
Keplers Law's



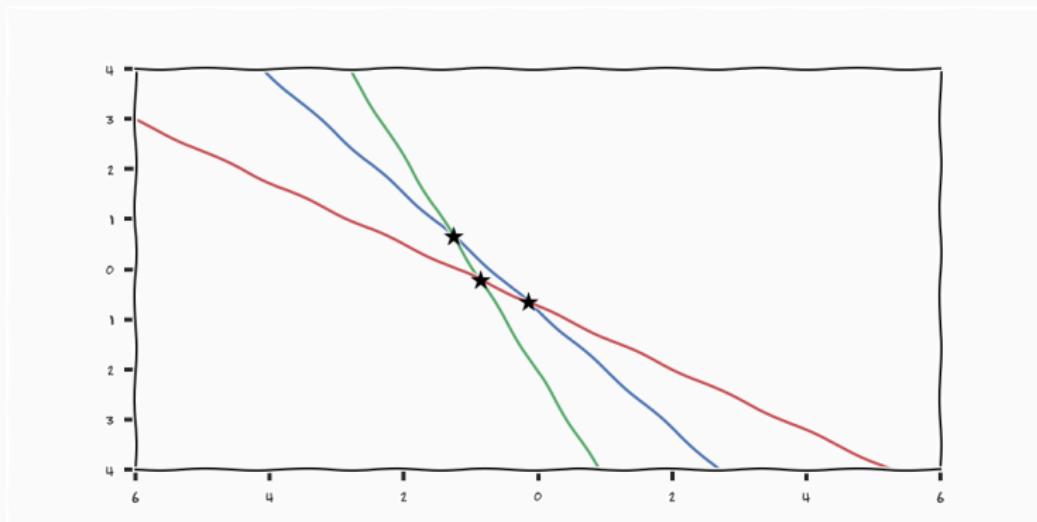
Data



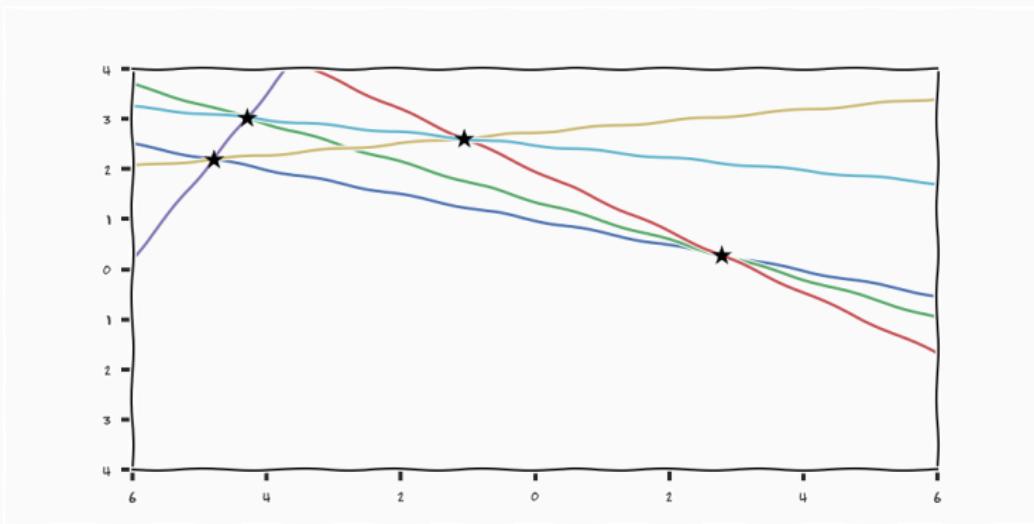
Model



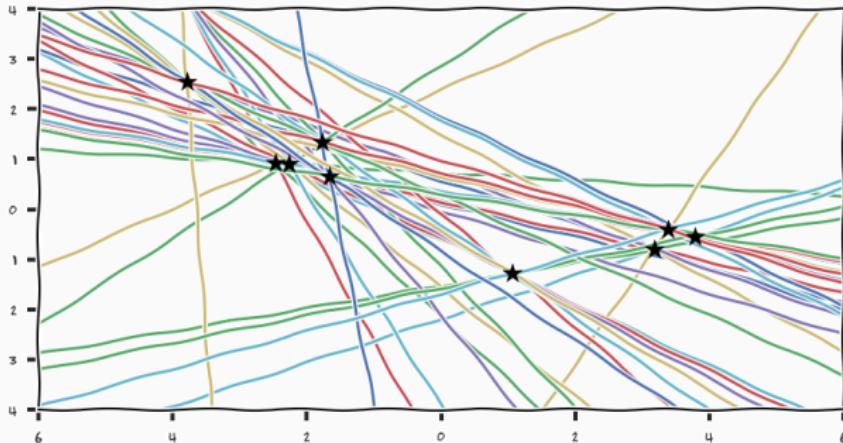
Model



Model



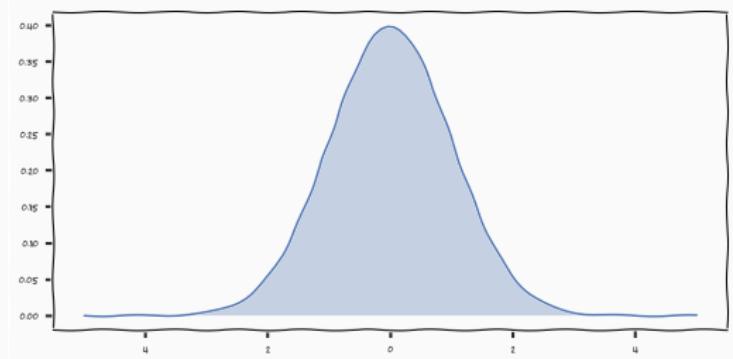
Model



Gauss



Model



$$\text{measurement} = \text{truth} + \epsilon$$

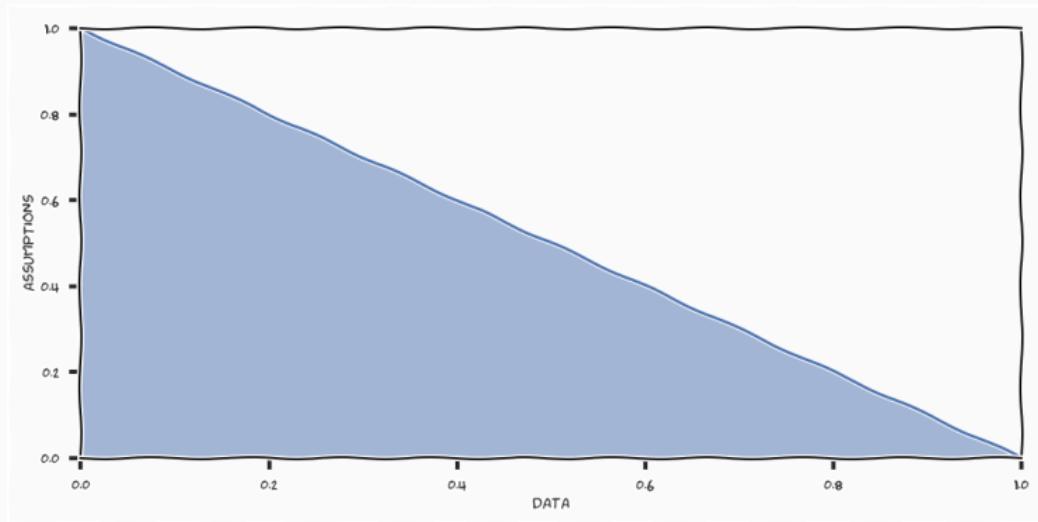
$$\epsilon \sim \mathcal{N}(0, I)$$

Inductive reasoning

Unlike deductive arguments, inductive reasoning allows for the possibility that the conclusion is false, even if all of the premises are true.¹

¹https://en.wikipedia.org/wiki/Inductive_reasoning

Data





- 16, 1066, 1456, 1531, 1607 and 1682

Halley's Comet



- In 1705 predicted 1758
- Died 1742

The digital age

- 90% of all *stored* information was created the last two years

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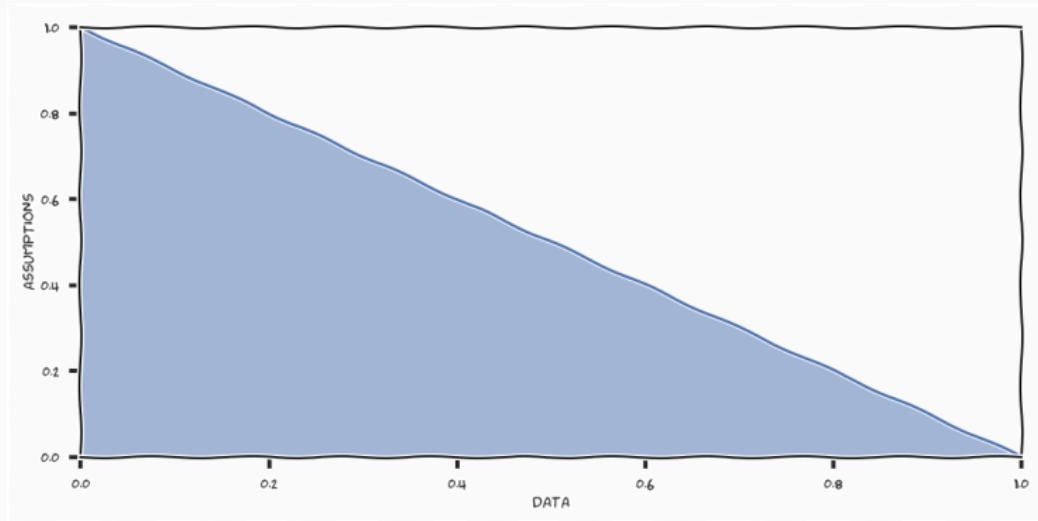
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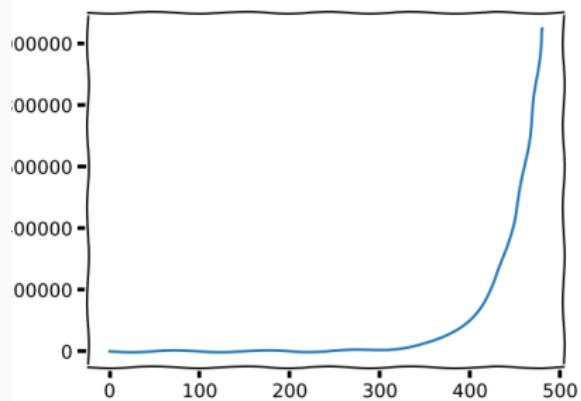
The digital age

- 90% of all *stored* information was created the last two years
- Every other day we create as much *stored* information that was created during the whole human civilisation till the year 2003
- We create 10^{19} bytes of "data" every day
- *more facts that are beyond grasp*

Data



Compute



The perfect storm



Machine Learning

Model

$$p(y|\theta)p(\theta)$$

- A statistical description of the world that you can "hallucinate"/generate data from
- An abstraction or simplification of the world

Bristol City

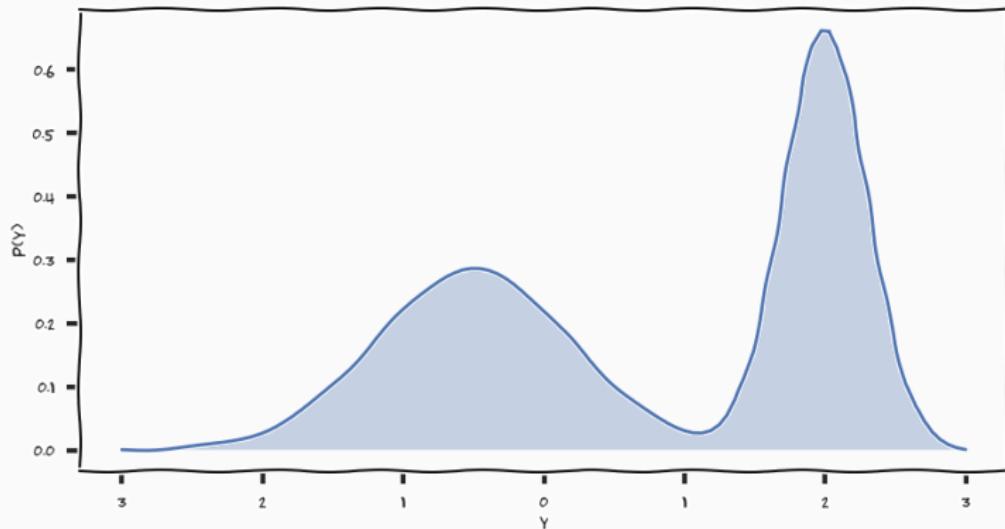


Bristol City



$y = \text{Bristol Goals} - \text{Opponent Goals}$

Belief



The Season

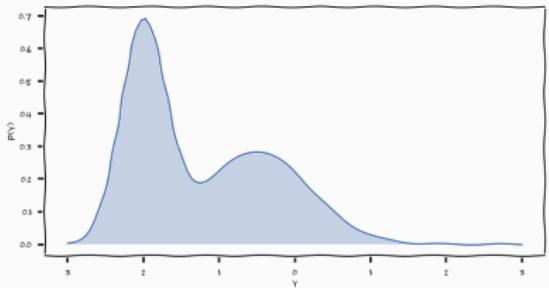
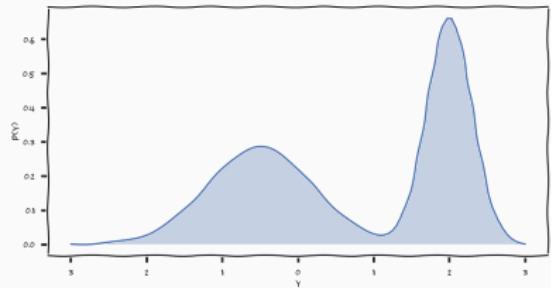
- Bristol City vs. Nottingham 1-1
- Bolton vs. Bristol City 2-2
- Bristol City vs. Plymouth 0-1
- Bristol City vs. Middlesbrough 0-2

Learning is inference

$$p(\theta|y) = \frac{p(y|\theta)p(\theta)}{p(y)}$$

- how can we update our belief/assumption in the presence of data/examples/observations

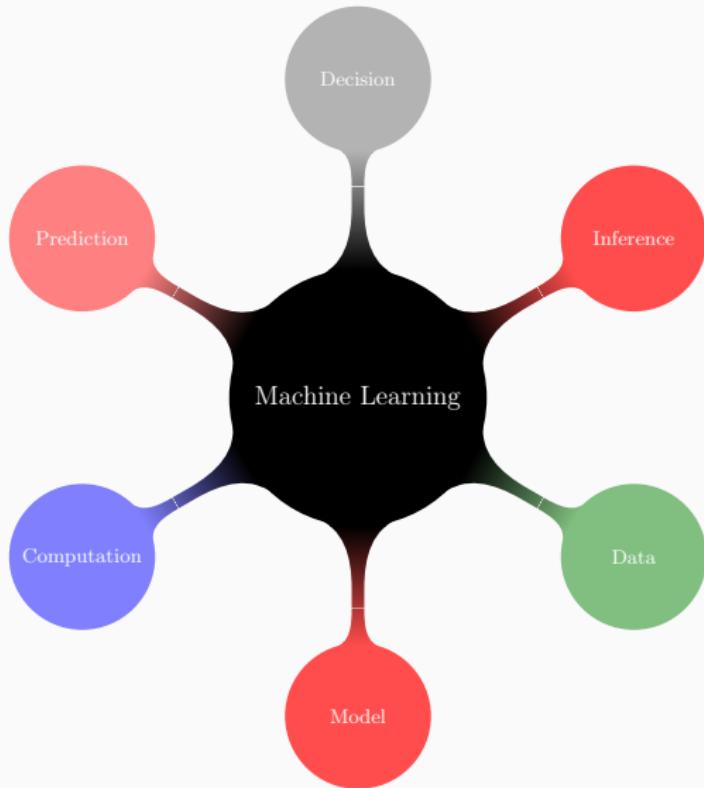
Bristol City



Assumptions is intelligence



Machine Learning



Society



Machine Learning and Society



Machine Learning and Society



Ethnography



Kate Byron

Kate Byron

COMS30007

Lectures

Part I (3 lectures)

- What is learning
- Basic probability

Part II (8 lectures)

- modelling
- mathematical formulation of assumptions

Lectures

Part III (3 lectures)

- Inference
- How do we fit models to data?
- Three different approaches

Part IV (5 lectures)

- Summary of unit
- Material outside the assessed material
- Practical machine learning

Lectures

summary.pdf

- Summary of each lecture
- Concepts you should know
- Equations that are key

Questions



reddit

<http://www.reddit.com/r/coms30007/>

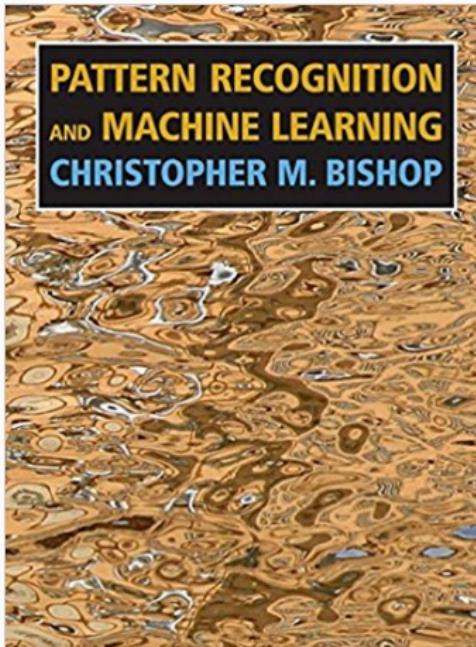
Tuesday 17-18

Webpage

<http://carlhenrik.com/COMS30007/>



The Book [1]



Bishop, C. M., Pattern recognition and machine learning
(information science and statistics) (2006)

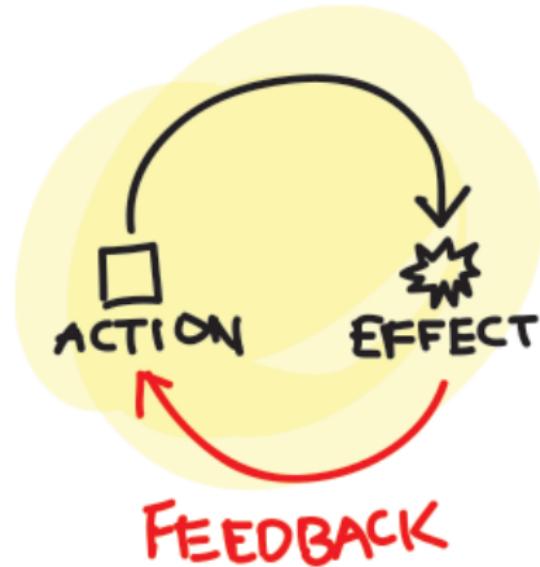
Assignments

- **Modelling** 35%
 - Linear regression
 - Non-linear & non-parametric regression
 - Unsupervised learning
 - Evidence
- **Inference** 15%
 - sampling/stochastic inference
 - variational inference
 - amortised inference

Labs



Feedback



Exam

- Multiple choice
- understanding
- conceptual aspects
- 50% of grade

Summary

Summary

- Learning can only be done by assumptions
- Machine learning is the science for making "handles" to incorporate assumptions
- We will learn mathematical formulations of assumptions
- We will learn mathematical tools for updating assumptions from data
 - *this is learning*

eof

References

 Christopher M. Bishop.

*Pattern Recognition and Machine Learning (Information
Science and Statistics).*

Springer-Verlag New York, Inc., Secaucus, NJ, USA, 2006.