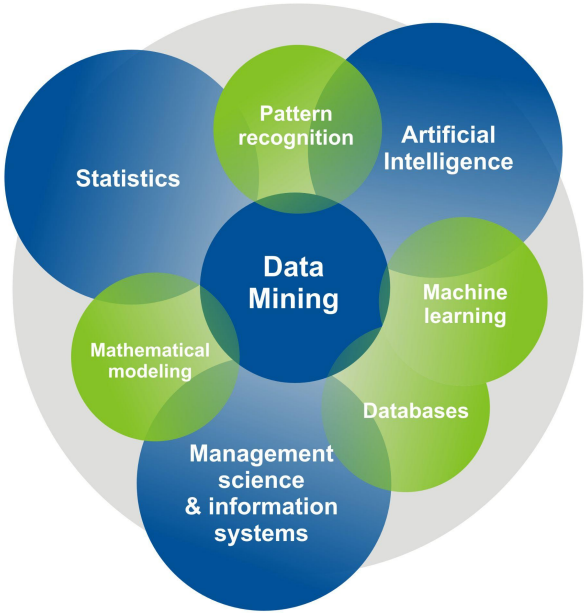
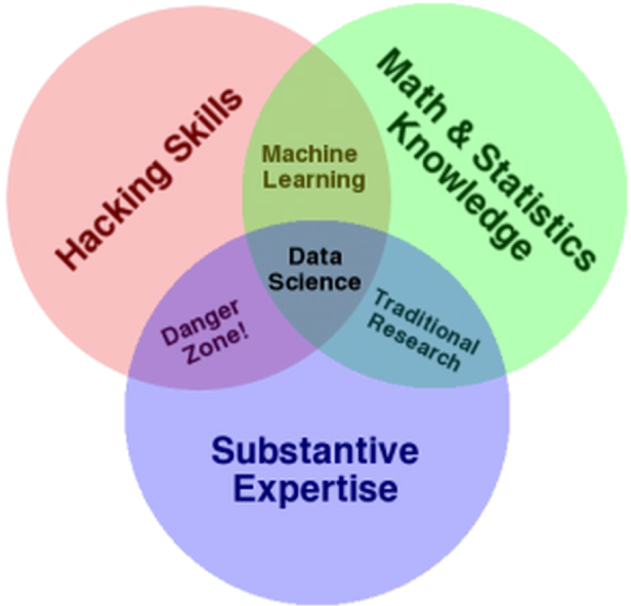
Machine Learning

14 febbraio 2022

What are Data Science, Machine Learning, …?





Human intelligence and human learning

- Before talking about artificial intelligence, we should talk about human intelligence.
- Unfortunately, we don't have a good understanding of how our brain works and how we (humans) learn
- The first attempt to imitate human intelligence dates back to the late 50s with the perceptron by Rosenblatt
- It is the building block of neural networks and deep neural networks

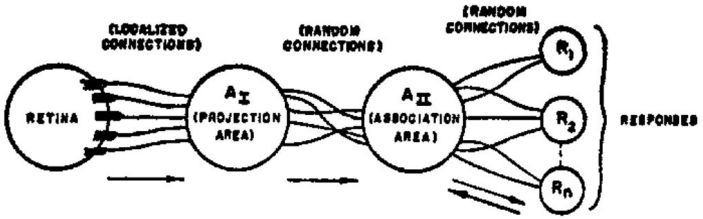


FIG. 1. Organization of a perceptron.

Artificial Intelligence and machine learning

- We don’t have a definition for Artificial Intelligence
- The Turing proposal for the Imitation Game (now known as the Turing Test) is still a yardstick
  - Take a person and a machine put it in separate rooms, hidden to everyone else
  - Take another person to ask questions to both (the machine and the human)
  - If this person fails to identify whose the machine and whose not, then the machine passes the Turing Test
- In other words, *the machine acts like a human*
- Hence, *the machine is intelligent like a human*
- Still far from an AI passing the test
- But… https://www.youtube.com/watch?v=D5VN

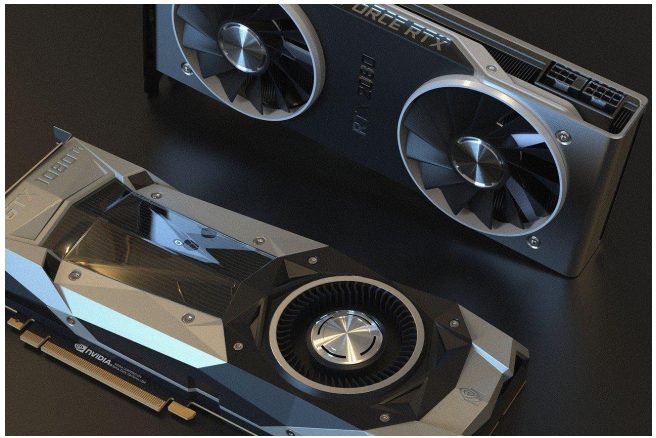
History of Artificial Intelligence

- The imitation game (Turing 1950)
- Perceptron (Rosenblatt 1958)
- Backpropagation algorithm (Rumelhart, Hinton, Williams 1986)
- …
- AlphaGo beats Sedol (human champion) in 2016
- Interesting future to come

See something strange?

Why neural networks have been adopted recently

- All ideas and algorithms were known by the end 80s early 90s
- However, two important things were lacking

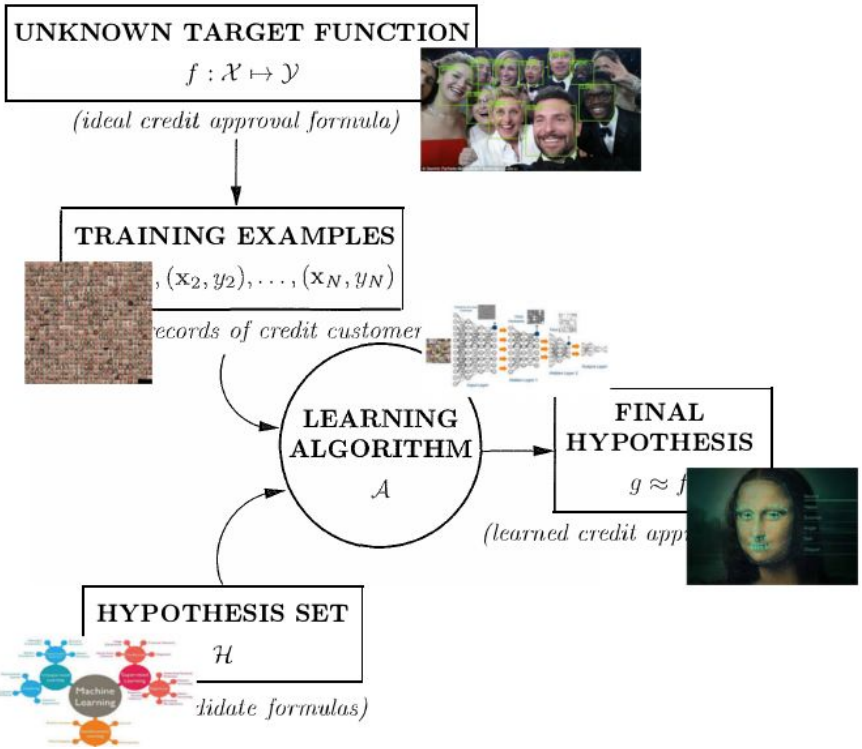


Adequate compute power

Sufficient data

Some (hard) things about ML

How does (technically) learning work



Learning (very technical)

- Given some possible functions (hypotheses)

$$\mathcal{H} = \{h_1(x), h_2(x), \ldots\}$$

- Given some data (random samples from an unknown distribution)

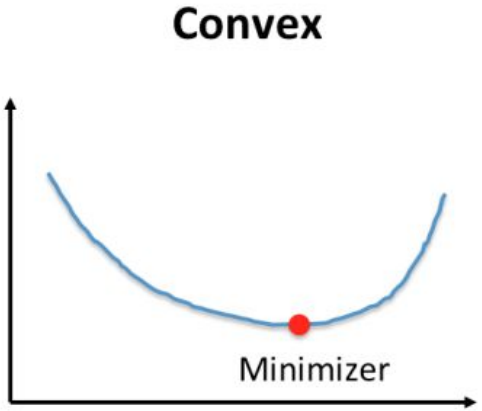
$$(x_1, y_1), (x_2, y_2), \ldots, (x_N, y_N)$$

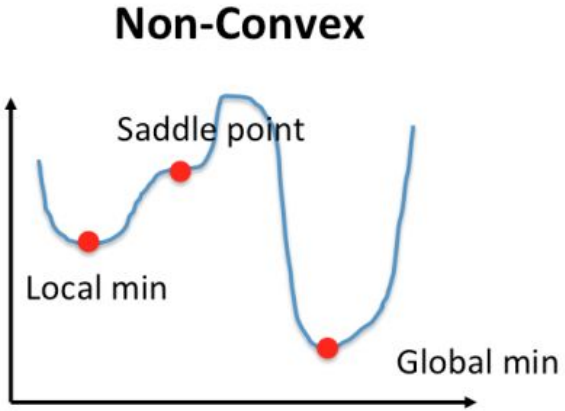
- Given a measure of how bad (error/loss) we a function describes (models) the data

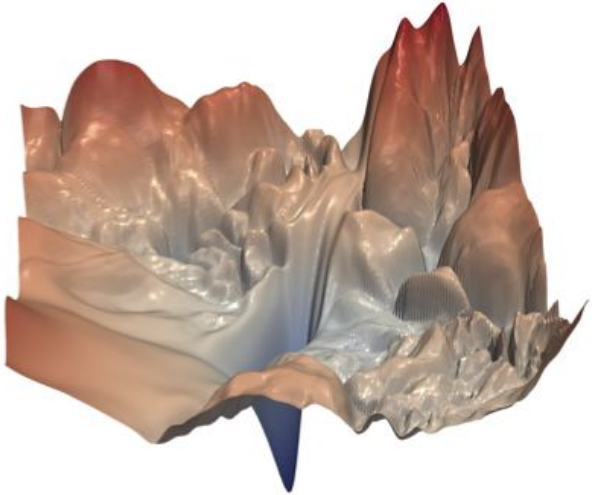
$$\sum_{i=1}^{N} |h(x_i) - y_i|$$

- Run an algorithm (learning algorithm) that finds among the hypotheses, the best (smallest error) function $h(x)$

Finding the minimum error sounds easy?







Types of learning

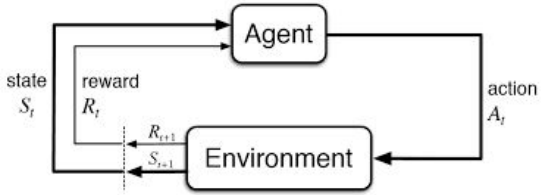
- Supervised learning

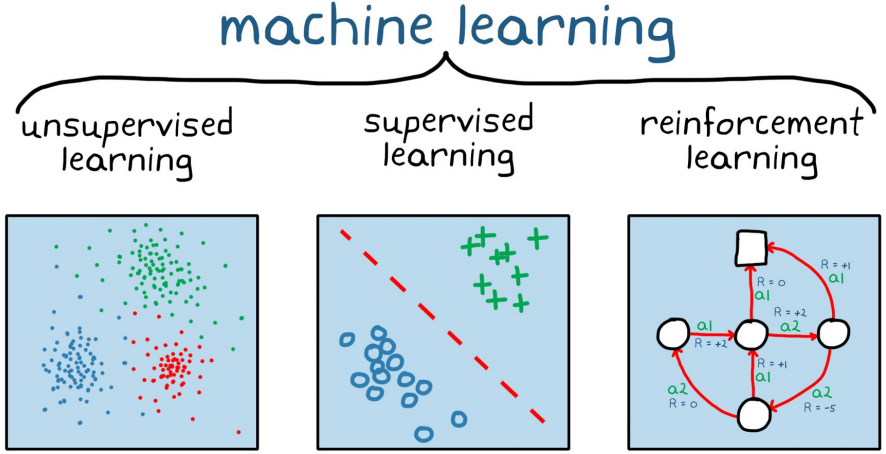
  $(x_1, y_1), (x_2, y_2), \ldots, (x_N, y_N)$

- Unsupervised learning

  $x_1, x_2, \ldots, x_N$

- Reinforced learning





How to prepare an exam (e.g., Cisco, driving license)

Learn by heart few questions and answers, hoping for the best

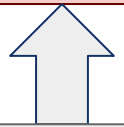
Underfitting

Learn the ideas and the concepts through examples

Correct

Learn by heart all the questions and answers

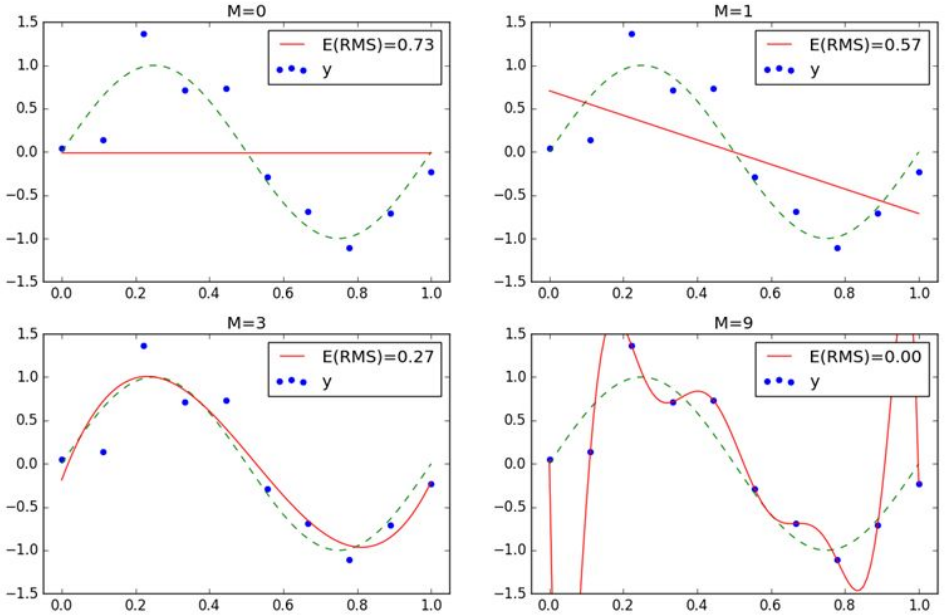
Overfitting



This is a huge problem in machine learning

Just to have an idea

- The green curve is the "true" one
- The blue points are the examples
- The red curve is the learned curve
- We see examples of
  - Underfitting (top)
  - Overfitting (bottom right)
  - Satisfactory fit (bottom left)



Machine Learning needs a lot of data

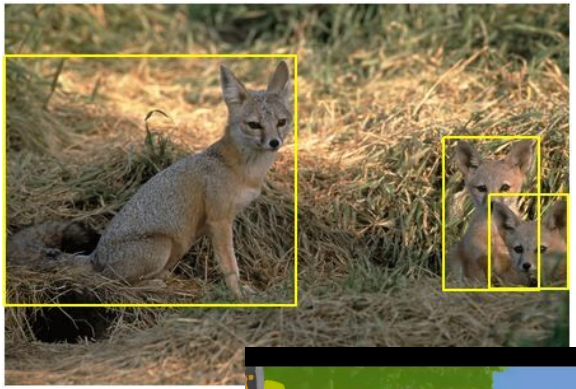
- The number of samples *N* must be thousands or millions
- Deep learning needs even more data
- With few examples there is high risk of overfitting
- Recall: the ML revolution didn’t start until a deluge of data became available
- Guess who supply all such data?

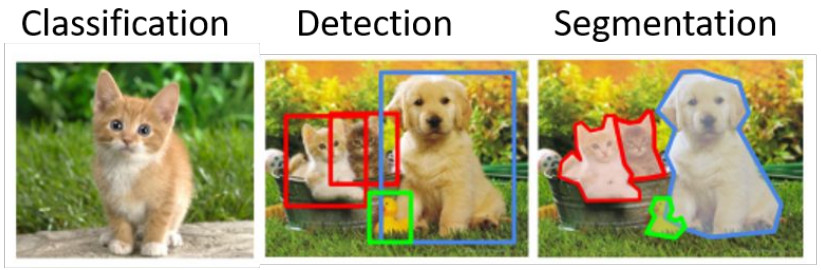
Very interesting, but…

- Nowadays, writing ML code is “easy”
- For example see https://towardsdatascience.com/image-segmentation-with-six-lines-0f-code-acb870a462e8
- You need to use libraries…
- Mostly Python

What is ML good for?

Image recognition and applications



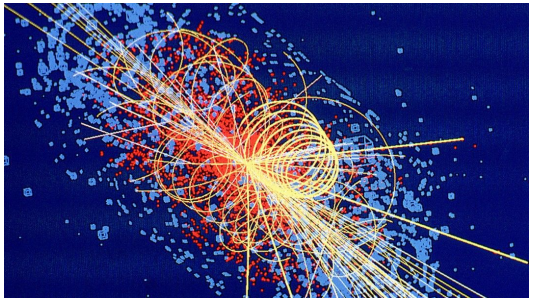


REVIEW

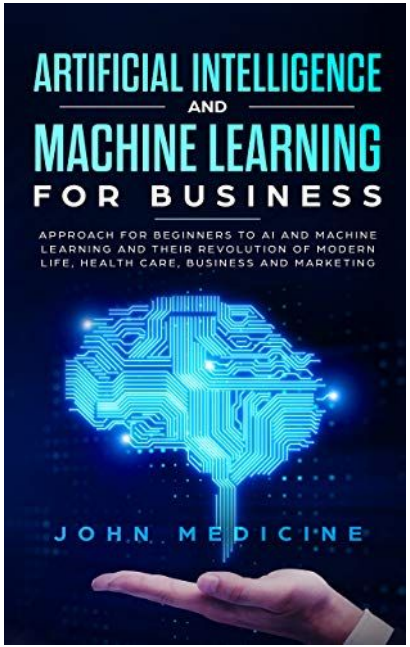
https://doi.org/10.1038/s41586-018-0361-2

Machine learning at the energy and intensity frontiers of particle physics

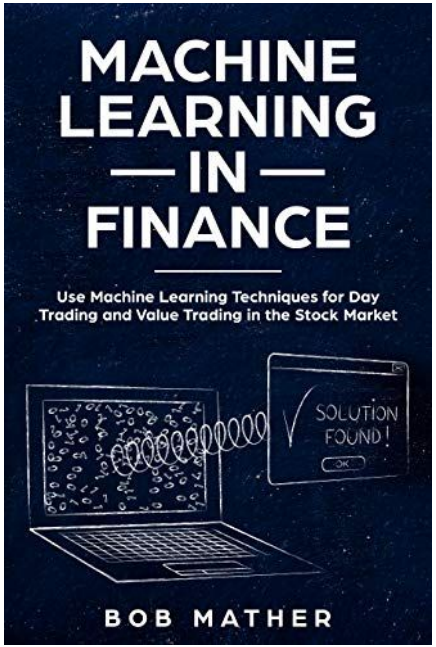
Alexander Radovic[1]*, Mike Williams[2]*, David Rousseau[3], Michael Kagan[4], Daniele Bonacorsi[5,6], Alexander Himmel[7], Adam Aurisano[8], Kazuhiro Terao[4] & Taritree Wongjirad[9]



Economy


ARTIFICIAL INTELLIGENCE
AND
MACHINE LEARNING
FOR BUSINESS
APPROACH FOR BEGINNERS TO AI AND MACHINE LEARNING AND THEIR REVOLUTION OF MODERN LIFE, HEALTH CARE, BUSINESS AND MARKETING
JOHN MEDICINE

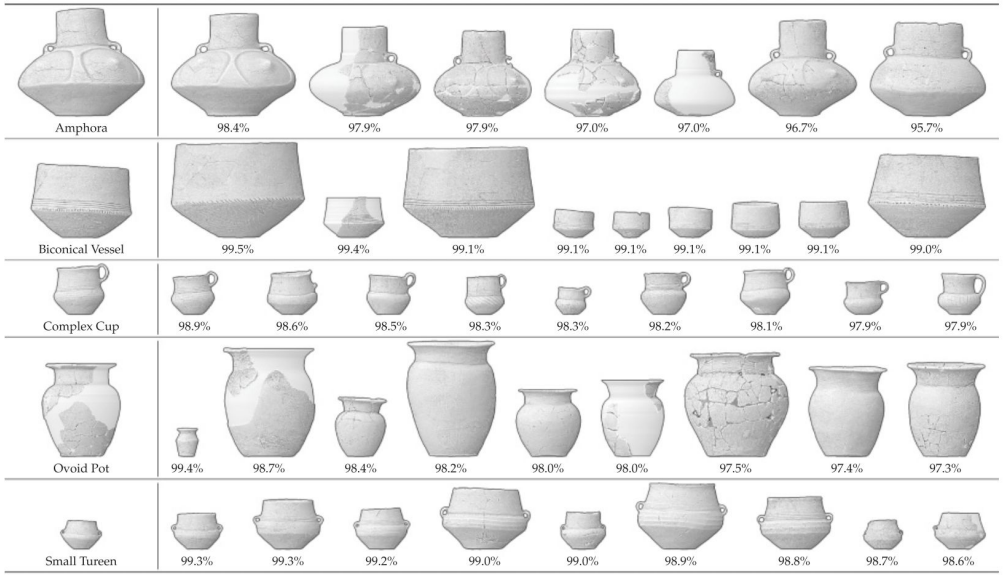

BUSINESS
INTELLIGENCE
1 BUSINESS PERFORMENCE MANAGEMENT
2 DATA GOVERNANCE
3 BUSINESS INTELLIGENCE PROGRAM
4 DATA ARCHITECTURE
5 DATA WAREHOUSING & LAKING
6 DATA INTEGRATION


MACHINE LEARNING IN FINANCE
Use Machine Learning Techniques for Day Trading and Value Trading in the Stock Market
SOLUTION FOUND!
OK
BOB MATHER

Archeology

Machine Learning Based Typology Development in Archaeology

CHRISTIAN HÖRR, Chemnitz University of Technology
ELISABETH LINDINGER, Archaeological Heritage Office of Saxony
GUIDO BRUNNETT, Chemnitz University of Technology



Climate change and Sustainable development

Climate Change AI

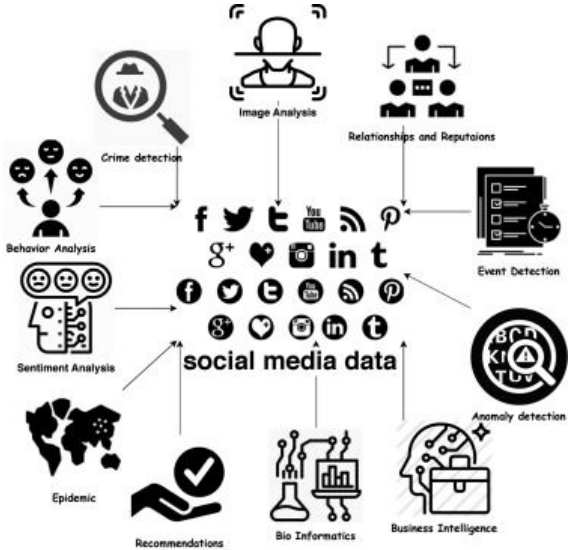
AI for Good

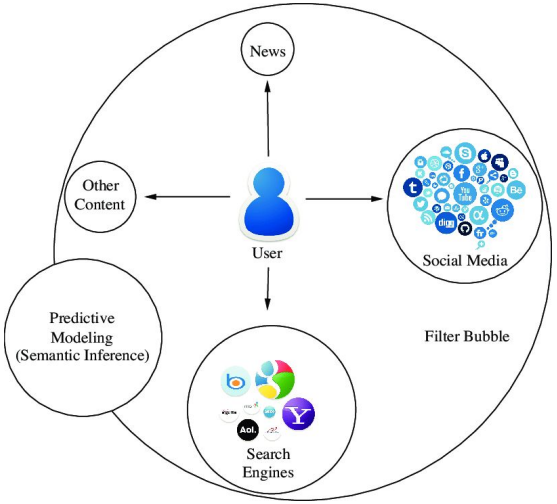
Plastic classification via in-line hyperspectral camera analysis and unsupervised machine learning

Martin L. Henriksen [a], Celine B. Karlsen [a], Pernille Klarskov [b], Mogens Hinge [a,*]

[a] *Plastic and Polymer Engineering, Department of Biological and Chemical Engineering, Aarhus University, Aabogade 40, DK-8200, Aarhus N, Denmark*
[b] *Terahertz Photonics, Department of Electrical and Computer Engineering, Aarhus University, Finlandsgade 22, DK-8200, Aarhus N, Denmark*

Of course, social media and the filter bubble





It’s your turn now…