

# Introduction to machine learning course

## Lecture 1: Introduction and presentation of the course

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## Before we start

I'd like to know a little bit more about you

- ▶ Short presentation: Name, occupation, ...
- ▶ Background in machine learning?
- ▶ Background in programming?
- ▶ Background in mathematics?
- ▶ Expectations from the course (if any)?

Please send me an email so that I have your contact:

`alexis.zubiolo@gmail.com`

All the material will be available on my personal GitHub:

`https://github.com/azubiolo/itstep`

# Outline

- ▶ What machine learning is, what it is not
- ▶ A few practical examples
  - ▶ classification
  - ▶ regression
- ▶ Goals and presentation of the course
- ▶ Questions and answers

# What is machine learning?

A simple example. . .



How to filter spam emails **automatically**?

# Machine learning paradigm

Goal: Build algorithms that can

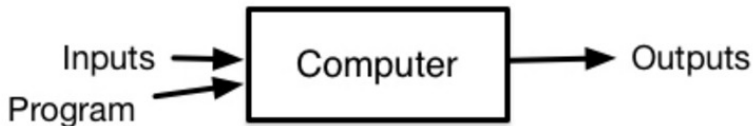
- ▶ **learn** from data
- ▶ **make predictions** on (new) data

# Machine learning paradigm

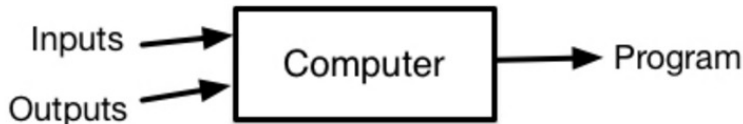
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## Traditional Programming



## Machine Learning



# Main components of machine learning

- ▶ Mathematics
  - ▶ Linear algebra
  - ▶ Calculus
  - ▶ Numerical optimization
- ▶ Statistics, probability theory
- ▶ Computer science

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In the course, we will review these aspects.

**Prerequisites:** I will assume

- ▶ Some knowledge in computer science (understand: at least **a language you are comfortable with**)
- ▶ You do not pass out when you see a mathematical formula



## Example 1: Regression

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Example: **Estimate the price** of an apartment

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living area (m <sup>2</sup> )	price (1000's euros)
50	30
76	48
26	12
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living area (m <sup>2</sup> )	price (1000's euros)
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61	?

Linear model:  $\text{price} = \mathbf{a} \times \text{area} + \mathbf{b}$

Problem: optimal values for **a** and **b**?

# Regression

More data for a richer model:

living area (m <sup>2</sup> )	# bedrooms	price (1000's euros)
50	1	30
76	2	48
26	1	12
102	3	90
61	2	?

**Linear model:**  $\text{price} = \mathbf{a} \times \text{area} + \mathbf{b} \times \# \text{ bedrooms} + \mathbf{c}$

**Problem:** Optimal values for **a**, **b** and **c**?

**Remark:** More data does not always imply a better model

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- ▶ Object recognition in images or videos
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  - ▶ (example) output: **face** or **not a face**

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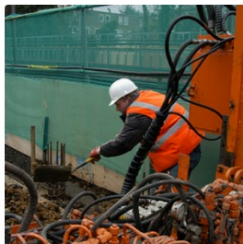
- ▶ Spam filtering
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  - ▶ output: **spam** or **not spam**
- ▶ Object recognition in images or videos
  - ▶ input: image or video
  - ▶ (example) output: **face** or **not a face**
- ▶ Image classification/description
  - ▶ input: image
  - ▶ output: image **description** or **label** (apple, car, ...)



# Automated image description generation



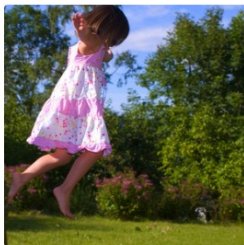
"man in black shirt is playing guitar."



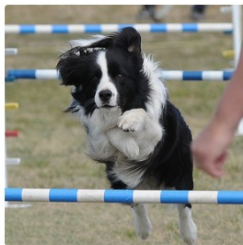
"construction worker in orange safety vest is working on road."



"two young girls are playing with lego toy."



"girl in pink dress is jumping in air."



"black and white dog jumps over bar."



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

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- ▶ ...

# The course

Goals:

- ▶ Introduce **main concepts** of machine learning
- ▶ **Implement** these concepts in Python (Scikit-learn)

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## Practical information:

- ▶ ~ **10 60-90 min sessions** on Thursdays 6:30pm
- ▶ Starting with a few lectures about the main concepts followed by lab sessions where you implement these concepts
- ▶ All material will be available on GitHub

<https://github.com/azubiololo/itstep>



# Course outline (attempt)

- ▶ **Mathematical background**

- ▶ Linear algebra (vector, matrices and operations)
- ▶ Derivatives (gradient, Hessian matrix)
- ▶ Convexity

- ▶ **Mathematical formalization in ML**

- ▶ Linear regression (least squares)
- ▶ Logistic regression, support vector machines (SVM)

- ▶ **Optimization in machine learning**

- ▶ Gradient descent
- ▶ Stochastic vs. batch methods
- ▶ Second-order methods

- ▶ **Model combination**

- ▶ **Model validation**

**Note:** This is a first estimation. I will adapt to your needs and how fast things go.

## About programming languages

For the practical sessions, I will be using python with jupyter.

`http://jupyter.org/`

If you prefer another language, feel free to use it. Remember that I assume some programming knowledge.

Thank you! Questions?

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