

Machine Learning

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Lesson 1.2

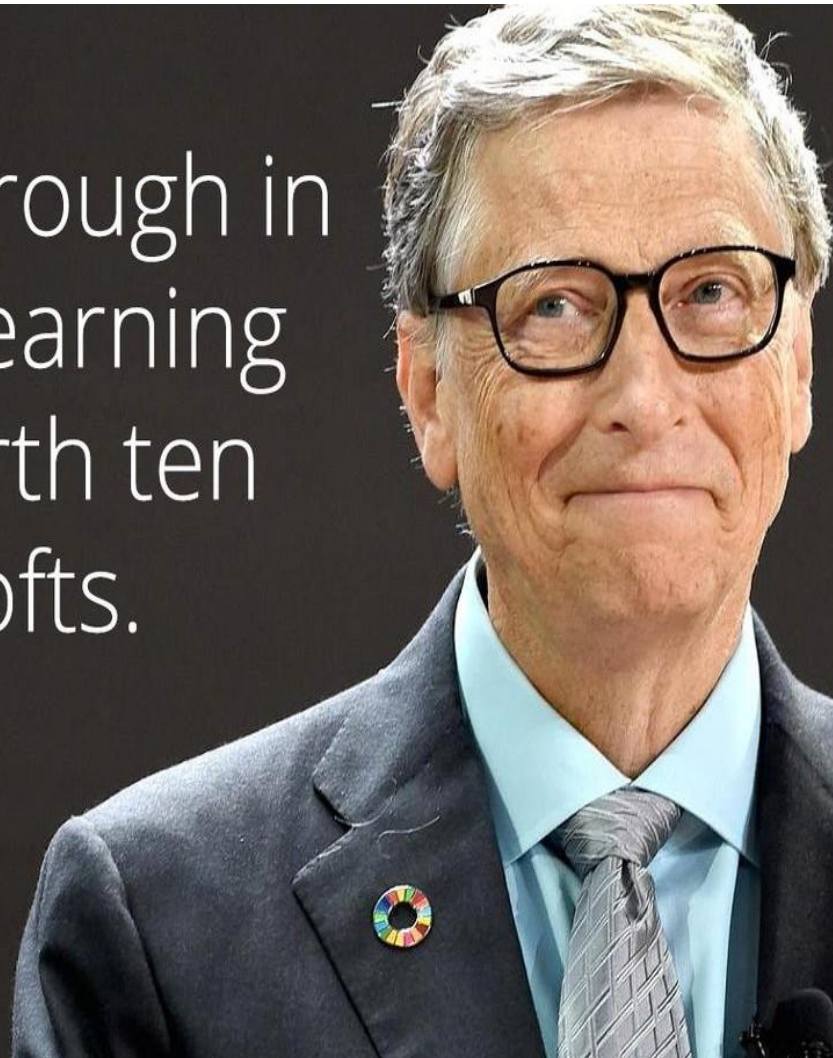
Introduction of Machine Learning

- What is machine learning?
- What are applications of machine learning?
- What software can we use to implement machine learning?

What is Machine Learning

“A Breakthrough in
Machine Learning
will be worth ten
Microsofts.

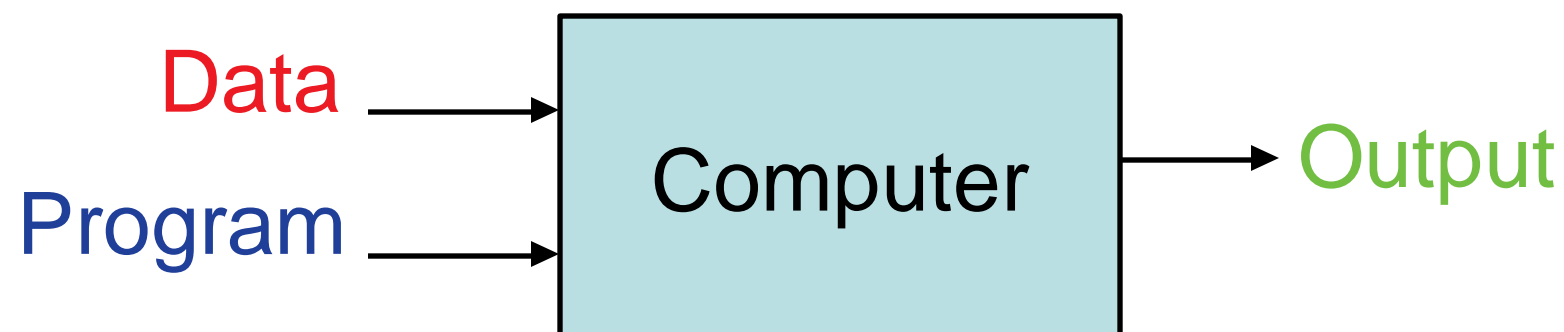
~ Bill Gates



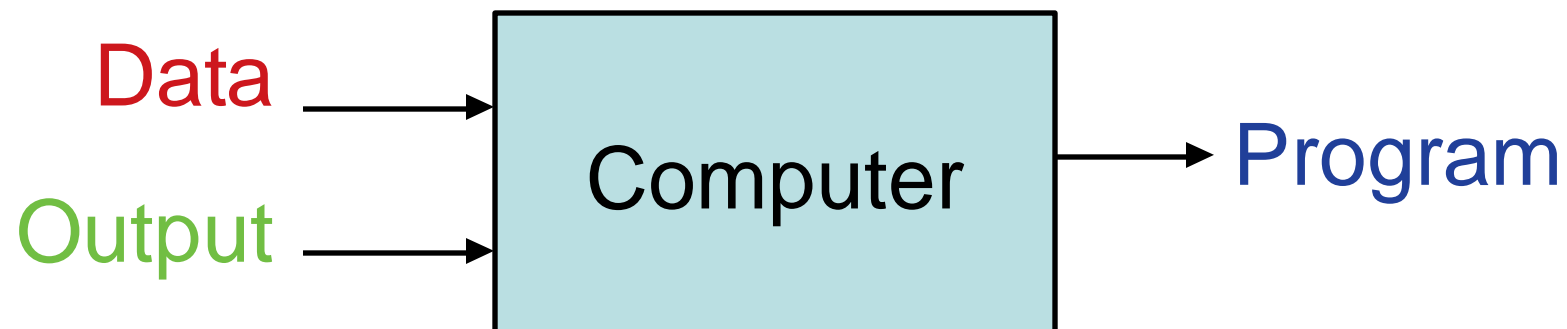
- Machine Learning is getting computers to program themselves.
- If programming is automation, then machine learning is automating the process of automation.
- Machine learning is like farming or gardening. Seeds is the algorithms, nutrients is the data, the gardener is you and plants is the programs.

- **Traditional Programming:** Data and program is run on the computer to produce the output.
- **Machine Learning:** Data and output is run on the computer to create a program. This program can be used in traditional programming.

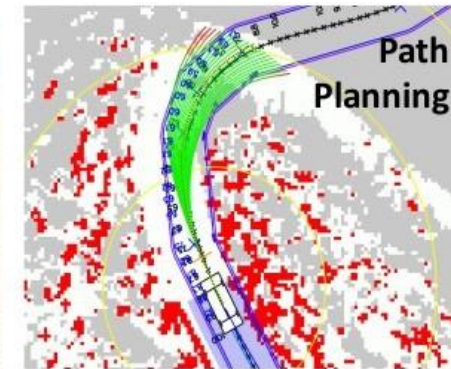
Traditional Programming



Machine Learning



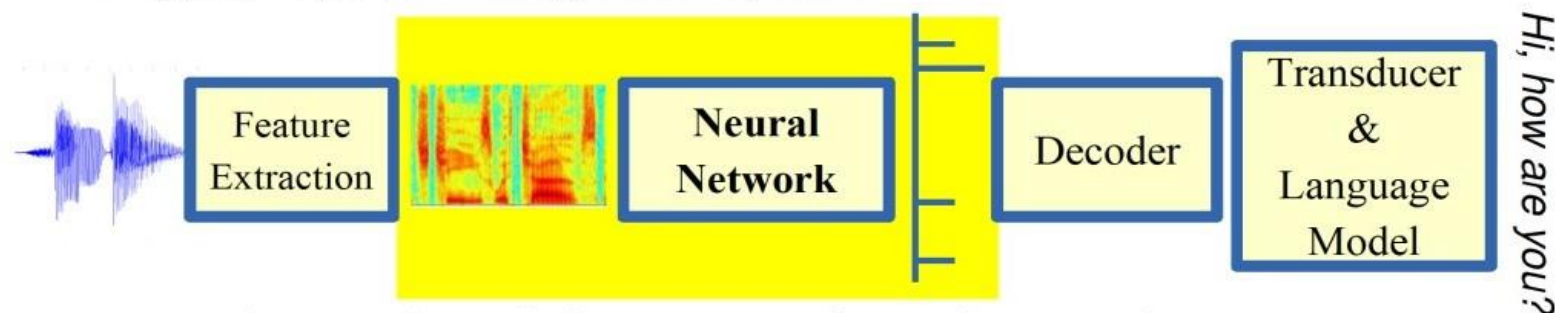
Autonomous Car Technology



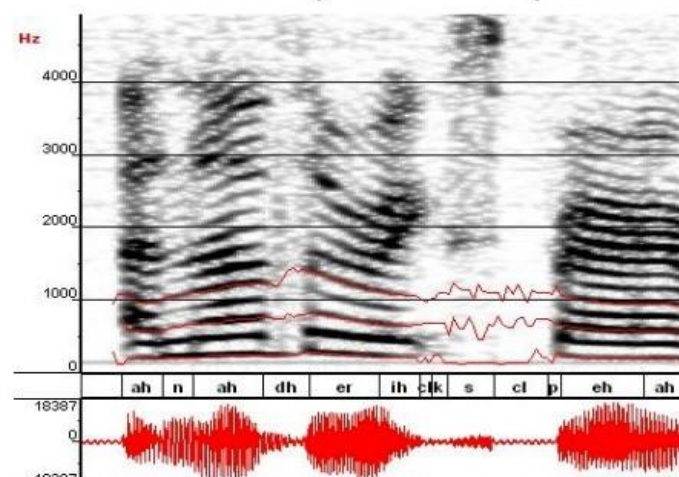
Images and movies taken from Sebastian Thrun's multimedia website.

Machine Learning in Automatic Speech Recognition

A Typical Speech Recognition System



ML used to predict phone states from the sound spectrogram



Deep learning has state-of-the-art results

# Hidden Layers	1	2	4	8	10	12
Word Error Rate %	16.0	12.8	11.4	10.9	11.0	11.1

Baseline GMM performance = 15.4%

[Zeiler et al. "On rectified linear units for speech recognition" ICASSP 2013]



Labradoodles, or Fried Chicken?

We can use Machine Learning
to classify these images!

- Finance
- Space Exploration
- Robotics
- Information Extraction
- Social Networks
- Machine Translation
- Image Captioning
- Product Recommendation
- Speech Recognition
- Personalisation
- Video Repair



- Other examples of your own?

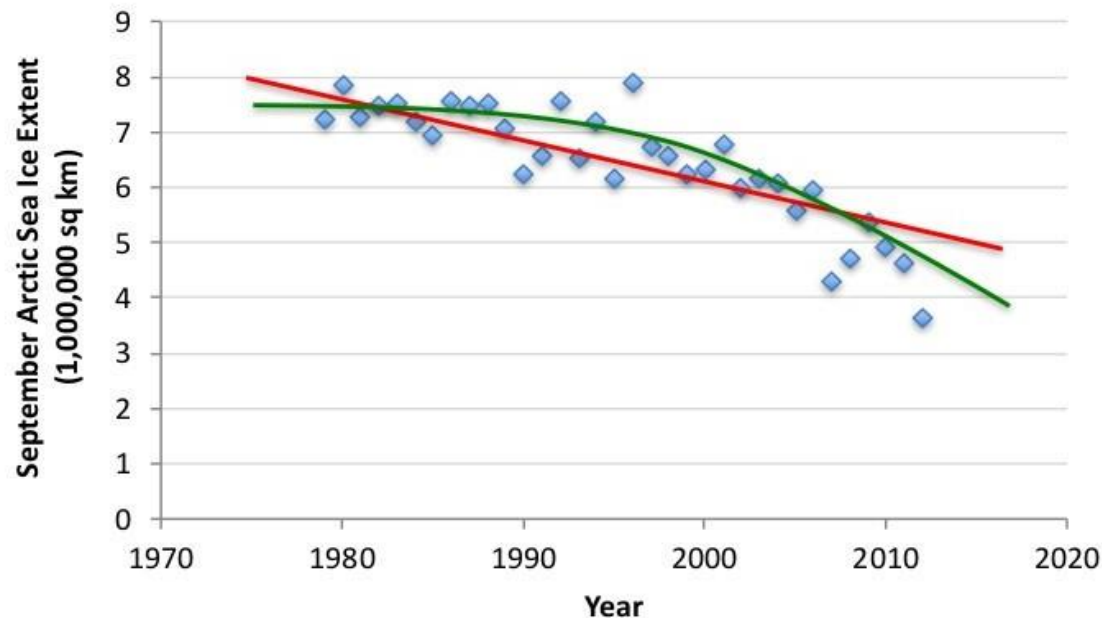
Find a machine learning application you like!

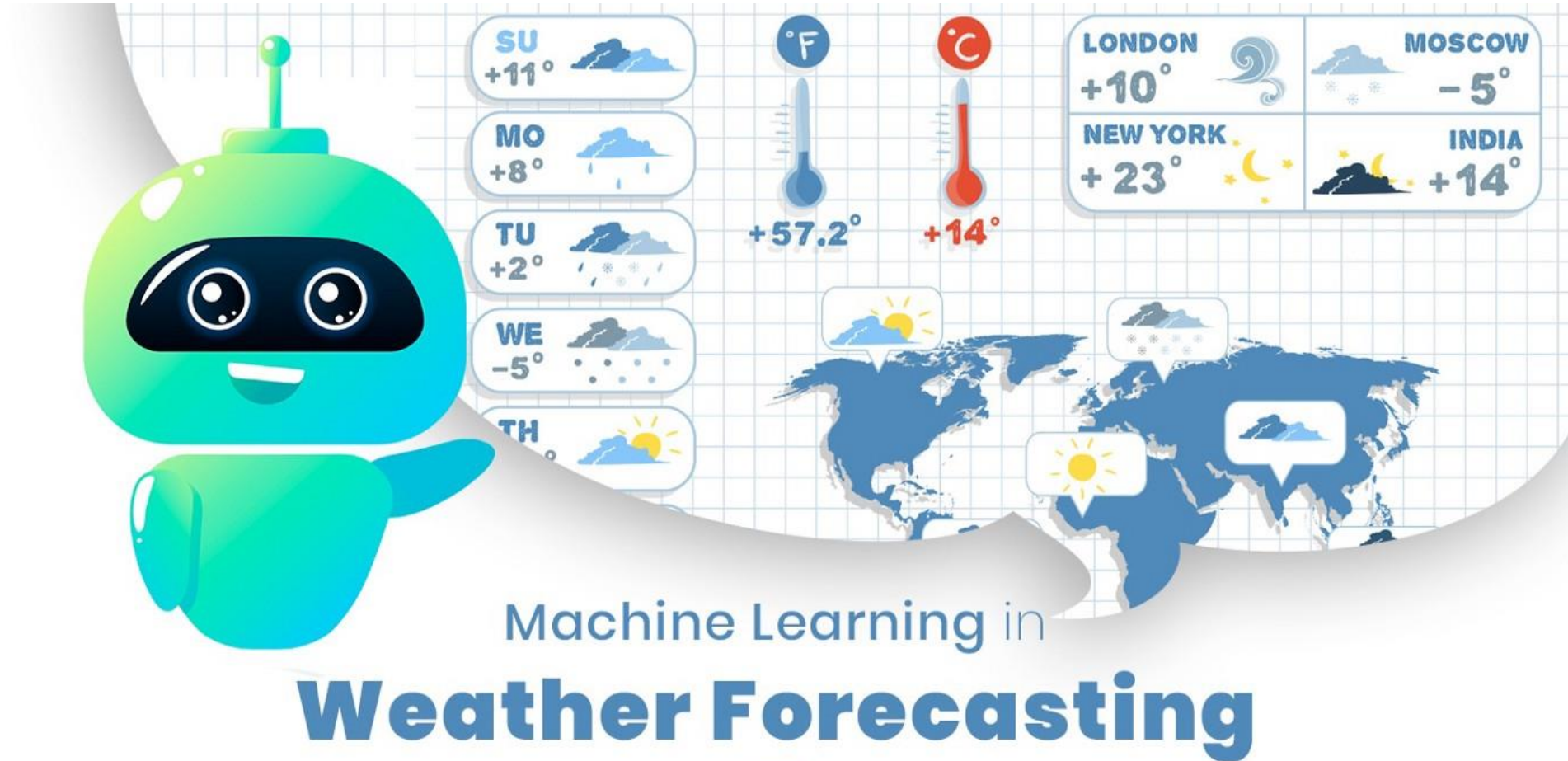


- **Supervised (inductive) learning**
 - Training data includes desired outputs
- **Unsupervised learning**
 - Training data does not include desired outputs
- **Semi-supervised learning**
 - Training data includes a few desired outputs
- **Reinforcement learning**
 - Rewards from sequence of actions

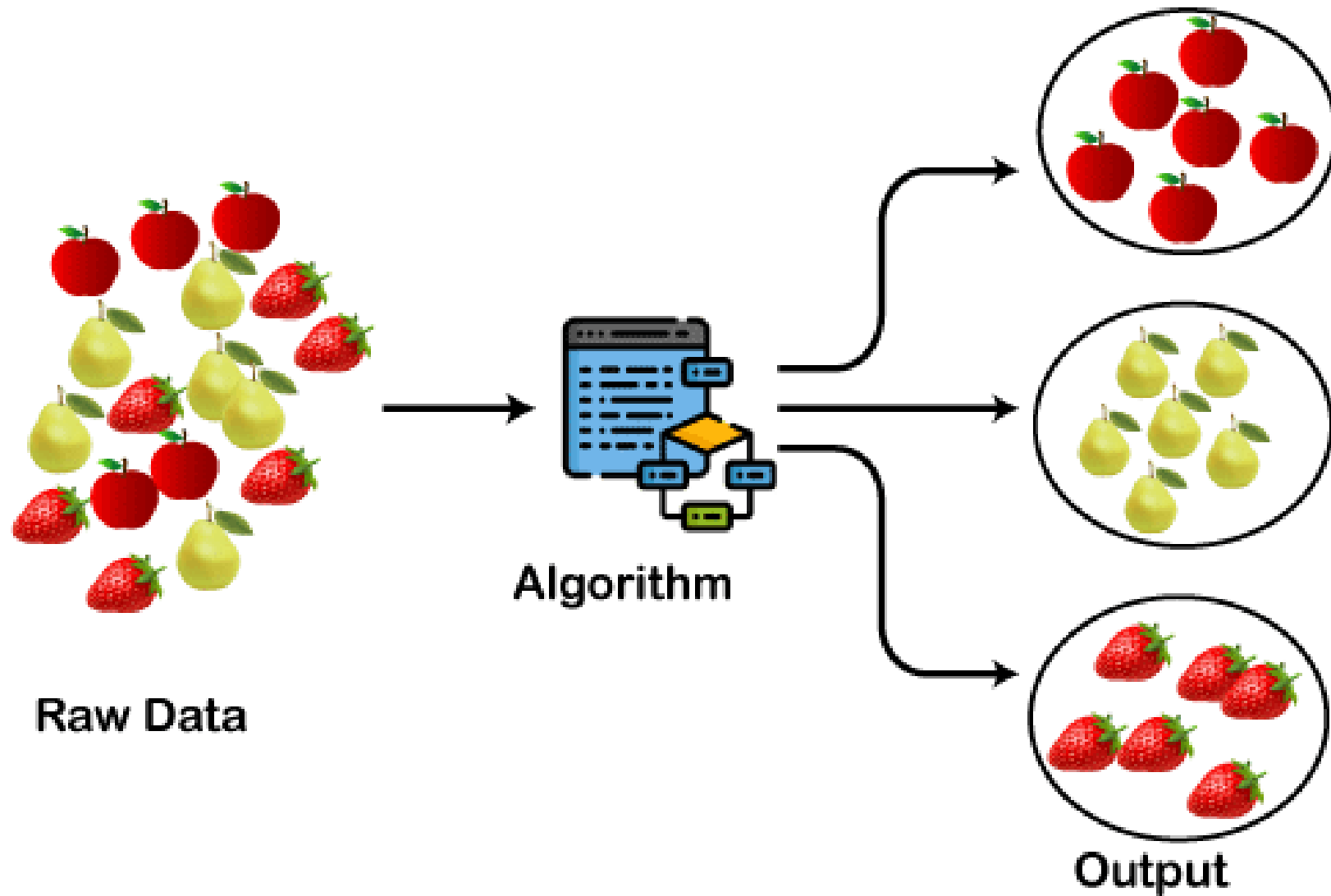
Supervised Learning: Regression

- Given $(x_1, y_1), (x_2, y_2), \dots, (x_n, y_n)$
- Learn a function $f(x)$ to predict y given x
 - y is real-valued == regression



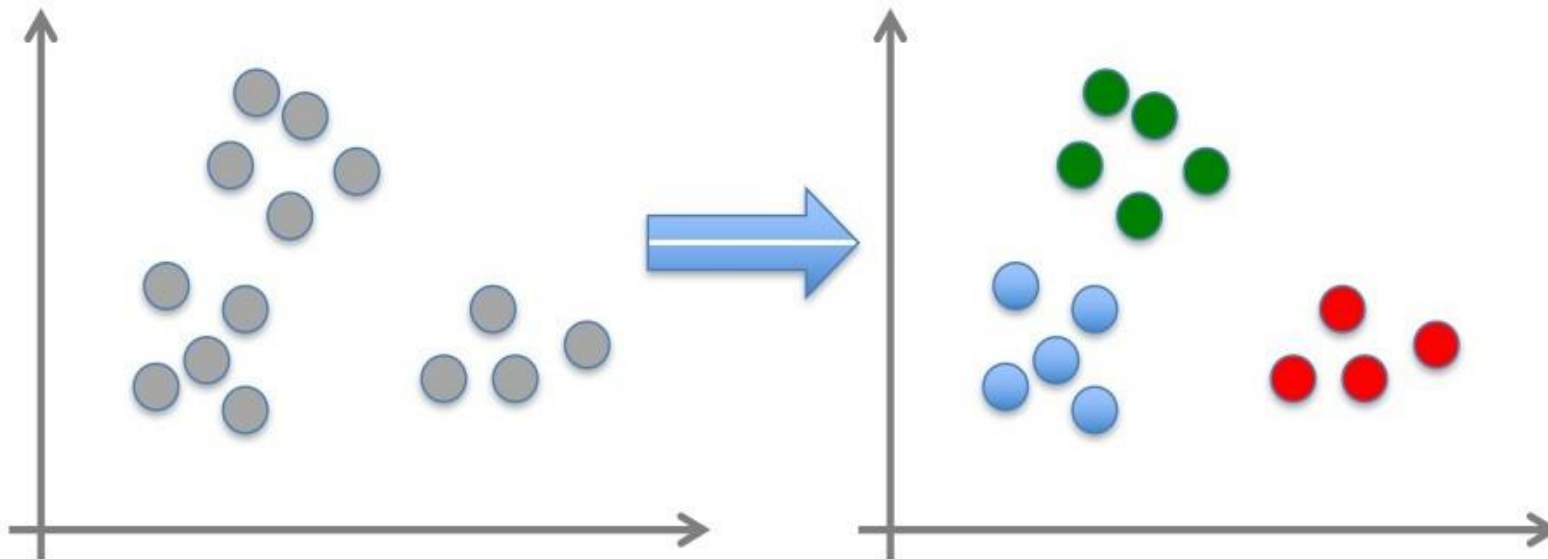


Types of Machine Learning: Example



Unsupervised Learning

- Given x_1, x_2, \dots, x_n (without labels)
- Output hidden structure behind the x 's
 - E.g., clustering





We mainly use Python in this module

