# Machine Learning

Machine learning is the science of getting computers to act without being explicitly programmed.

- **Learn** from data;

- **Improve** performance with **experience**;

- There are multiple types of machine learning:

    - **Supervised learning**;
    - **Unsupervised learning**;
    - **Self-supervised learning**;
    - **Reinforcement learning**;
    - **Active learning**.

Steps of a machine learning:

1. Formulate the problem;

2. Collect and clean the data;

3. Learn a model;

4. Evaluate the model.

## Notation

- **Input**: $x \in X$;

- **Output**: $y \in Y$;

## Types of Learning

- **Supervised learning**: pairs $(x, y)$ are provided at training time;

    - **Classification** - binary or multi-class;
    - **Regression**;

- **Unsupervised learning**: only $x$ is provided at training time;

  - **Clustering**;
  - **Pattern mining**;
  - **Dimensionality reduction**;

- **Self-supervised learning**: $x$ is provided at training time, but it is generated from $y$;

- **Reinforcement learning**: the agent interacts with the environment and receives rewards;

- **Active learning**: the learner can query the teacher to obtain the label of a data point.