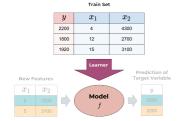
Introduction to Machine Learning

ML-Basics Learner





Learning goals

- Know formal definition of learner
- Understand that a learner receives training data and outputs the best model from H.

SUPERVISED LEARNING EXAMPLE

Imagine we want to investigate how working conditions affect productivity of employees.

- It is a **regression** task since the target *productivity* is continuous.
- We collect data about worked minutes per week (productivity), how many people work in the same office as the employee in question, and the employee's salary.

	Features x		Target y	
	People in Office (Feature 1) x_1	Salary (Feature 2) x_2	Worked Minutes Week (Target Variable)	
(4	4300€ 🗼	2220	
$n=3$ $\left\langle ight.$	y 12	2700 €	1800	
\downarrow	5	3100 €	1920	*
$x_1^{(2)}$	p=2		$x_2^{(1)}$	$y^{(3)}$



SUPERVISED LEARNING EXAMPLE /2

How could we construct a model from these data?

We could investigate the data manually and come up with a simple, hand-crafted rule such as:

- The baseline productivity of an employee with salary 3000 and 7 people in the office is 1850 minutes.
- A decrease of 1 person in the office increases productivity by 30.
- An increase of the salary by 100 increases productivity by 10.

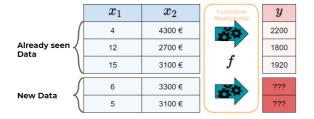
⇒ Obviously, this is neither feasible nor leads to a good model.



IDEA OF SUPERVISED LEARNING

Goal: Identify the functional relationship that maps features to target.

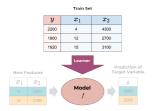
- **Supervised** learning means we use *labeled* data to learn model *f*.
- Later, we use model *f* to predict *y* for new *unlabeled* data.





LEARNER DEFINITION

- Algorithm for finding f is called learner / learning algorithm / inducer.
- ullet The learner is our means of picking the best element from the hypothesis space ${\cal H}$ for given training data.
- Formally, it maps training data $\mathcal{D} \in \mathbb{D}$ (plus a vector of **hyperparameter** control settings $\lambda \in \Lambda$) to a model:



$$\mathcal{I}: \mathbb{D} \times \Lambda \to \mathcal{H}$$

Practically, we often construct a mapping

$$\mathcal{I}: \mathbb{D} \times \Lambda \to \Theta$$



LEARNER DEFINITION / 2

In pseudo-code:

- ullet Learner gets a hypothesis space of parametrized functions ${\cal H}.$
- User passes data set $\mathcal{D}_{\text{train}}$ and control settings λ .
- Learner sets parameters such that model fits data best.
- ullet Optimal parameters $\hat{ heta}$ or function $\hat{ heta}$ is returned for later usage.

