

Introduction to Supervised Learning

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Introduction to Machine Learning (ML) - definitions

- Machine Learning is the field of study that gives the computer the ability to learn without being explicitly programmed.
-- Arthur Samuel (1959)
- A computer program is said to learn from experience E with respect to some class of tasks T and performance measure P , if its performance at tasks in T , as measured by P , improves with experience E .
-- Tom Mitchell (1998)

Machine Learning in our daily lives

Spam Filtering

Web Search

Postal Mail Routing

Fraud Detection

Movie
Recommendations

Vehicle Driver
Assistance

Web Advertisements

Social Networks

Speech Recognition

Three modes of Machine Learning

- **Supervised learning**: data with labels $(x^{(i)}, y^{(i)})$

$$\{(x^{(i)}, y^{(i)})\}_{i=1}^{n_{\text{train}}}$$

- **Unsupervised learning**: data w/o labels $x^{(i)}$

$$\{x^{(i)}\}_{i=1}^{n_{\text{train}}}$$

Supervised

data points have known outcome

Unsupervised

data points have unknown outcome

Types of supervised learning

- Two types:
 - Regression: $y^{(i)} \in \mathbb{R}$
 - Classification: $y^{(i)} \in \{0, 1\}$, $y^{(i)} \in \{\text{'Cat'}, \text{'Dog'}, \text{'Fox'}, \text{'Cow'}\}$

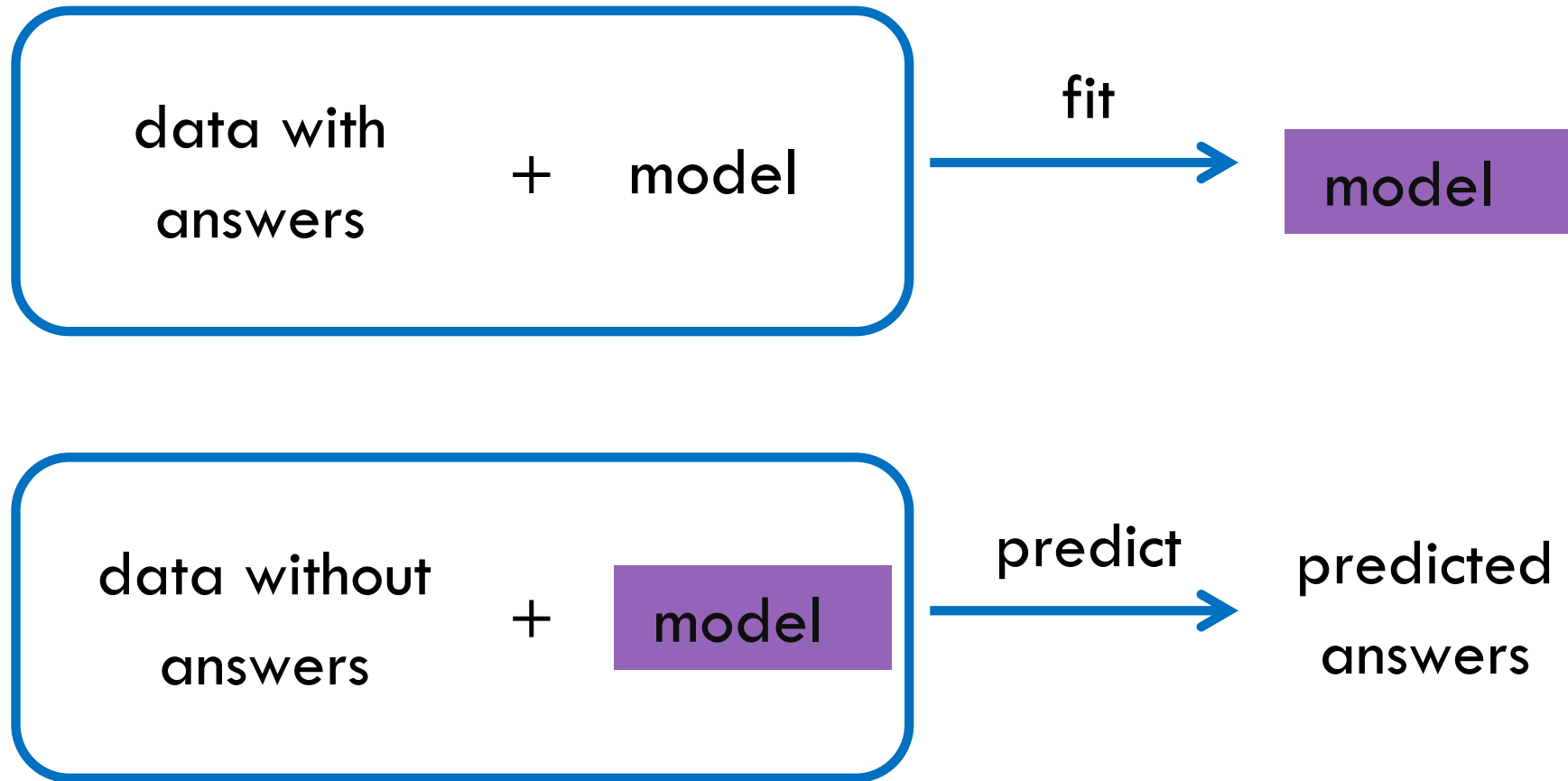
Regression

outcome is continuous (numerical)

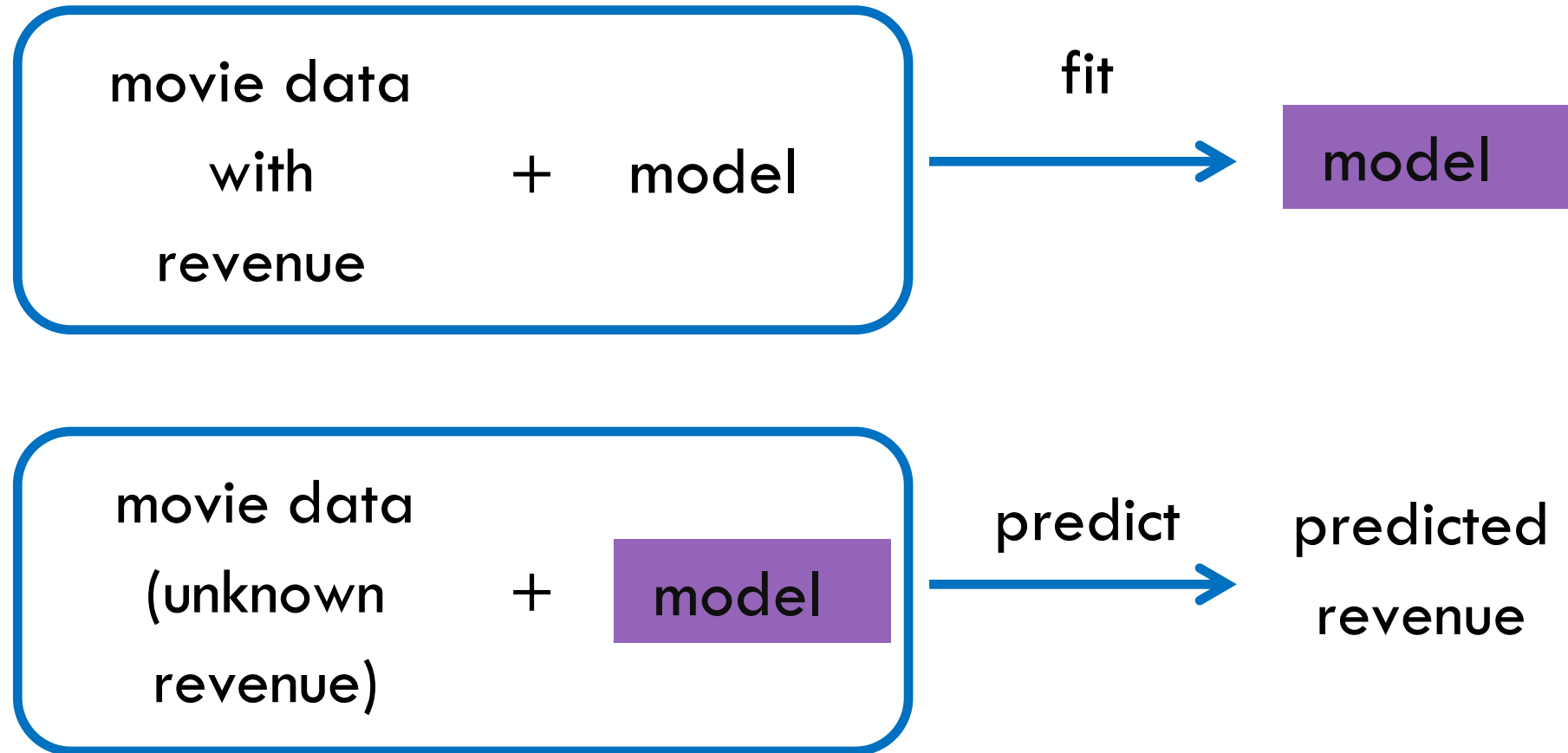
Classification

outcome is a category

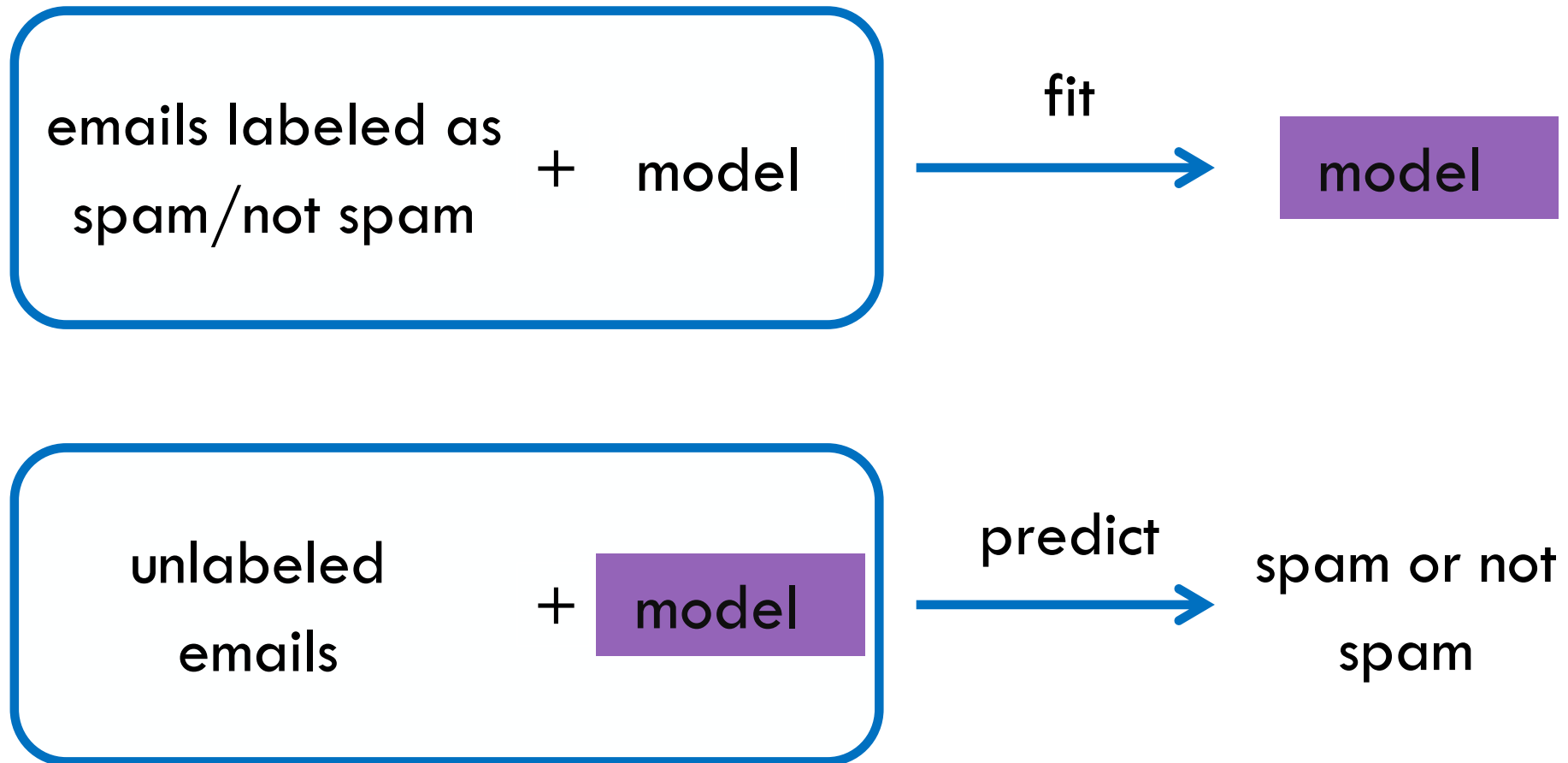
Supervised learning overview



Regression: numeric answers

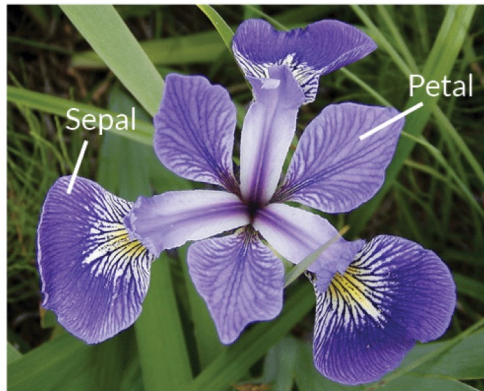


Classification: categorical answers



Notations

- $x^{(i)}$: input variable, input features
- $y^{(i)}$: output variable, target variable
- $\{(x^{(i)}, y^{(i)})\}_{i=1}^{n_{\text{train}}}$: training set



Iris Versicolor



Iris Setosa

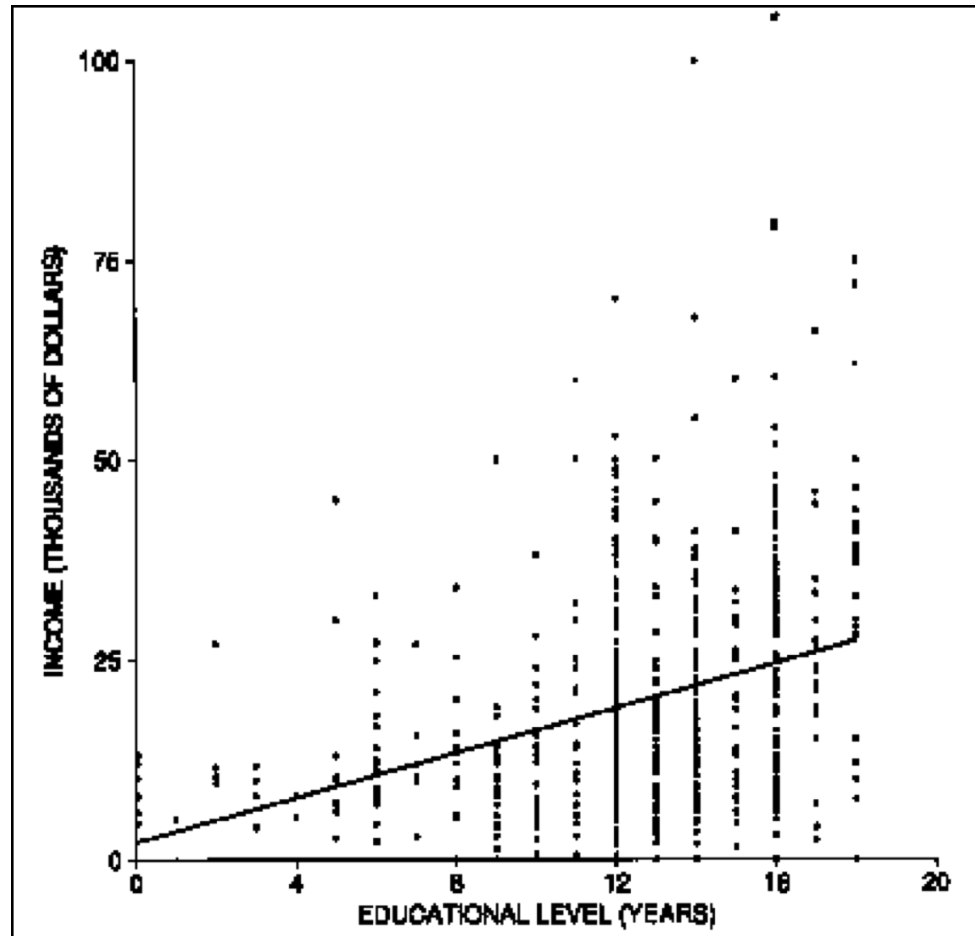


Iris Virginica

sepal length	sepal width	petal length	petal width	species
6.7	3.0	5.2	2.3	virginica
6.4	2.8	5.6	2.1	virginica
4.6	3.4	1.4	0.3	setosa
6.9	3.1	4.9	1.5	versicolor
4.4	2.9	1.4	0.2	setosa
4.8	3.0	1.4	0.1	setosa
5.9	3.0	5.1	1.8	virginica
5.4	3.9	1.3	0.4	setosa
4.9	3.0	1.4	0.2	setosa
5.4	3.4	1.7	0.2	setosa

Introduction to Machine Learning (ML) -- examples

- Example 5: regression



Notations

- One more notation:
 - $h_{\theta}(x)$ or $h(x; \theta)$: hypothesis, (parameterized) model, (parameterized) function

Summary

- Given the training set, $\{(x^{(i)}, y^{(i)})\}_{i=1}^{n_{\text{train}}}$, we want to learn a model (specifically, model parameters) that provides a mapping from $x^{(i)}$ to $y^{(i)}$

