Types of Machine Learning

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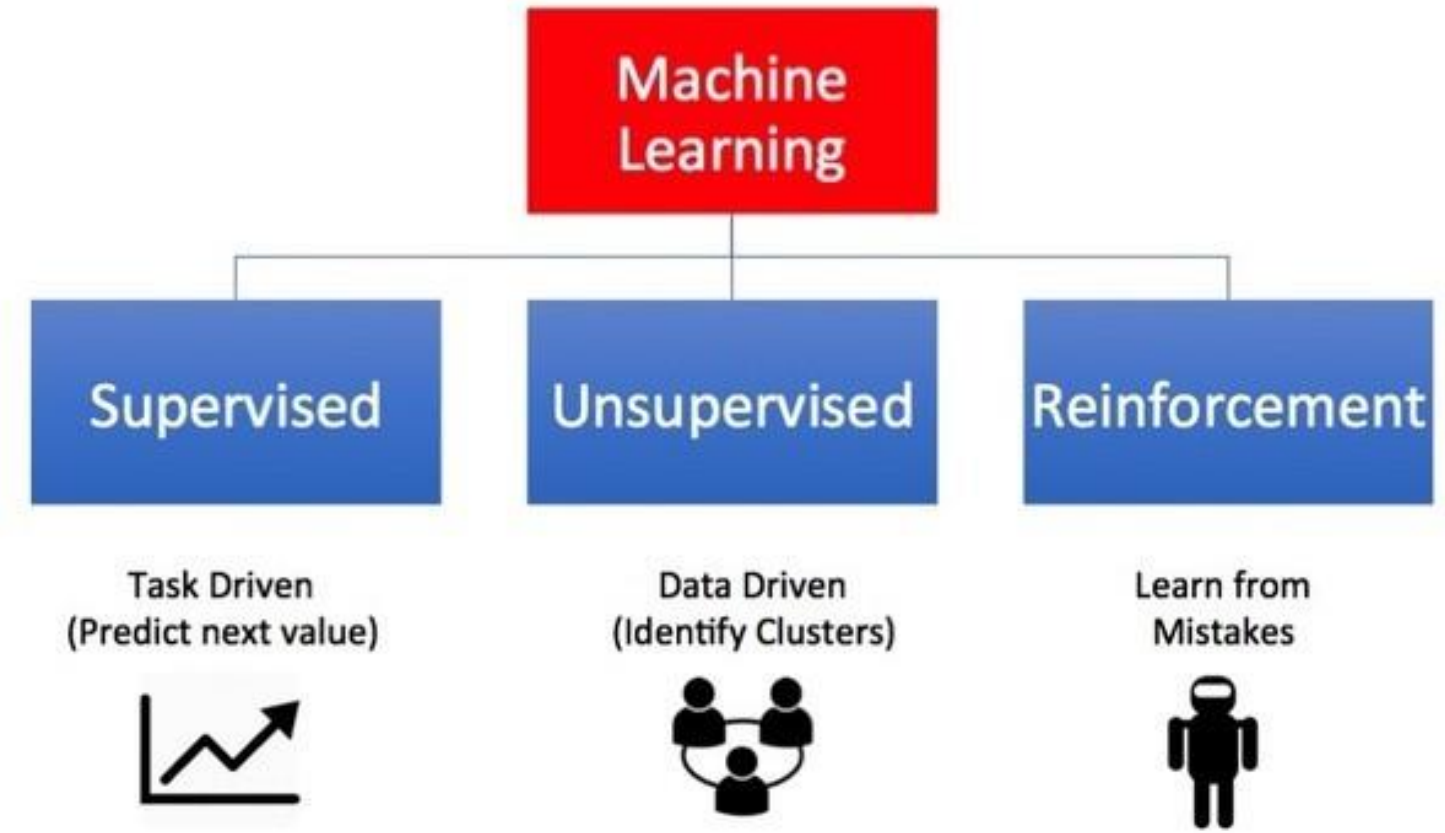
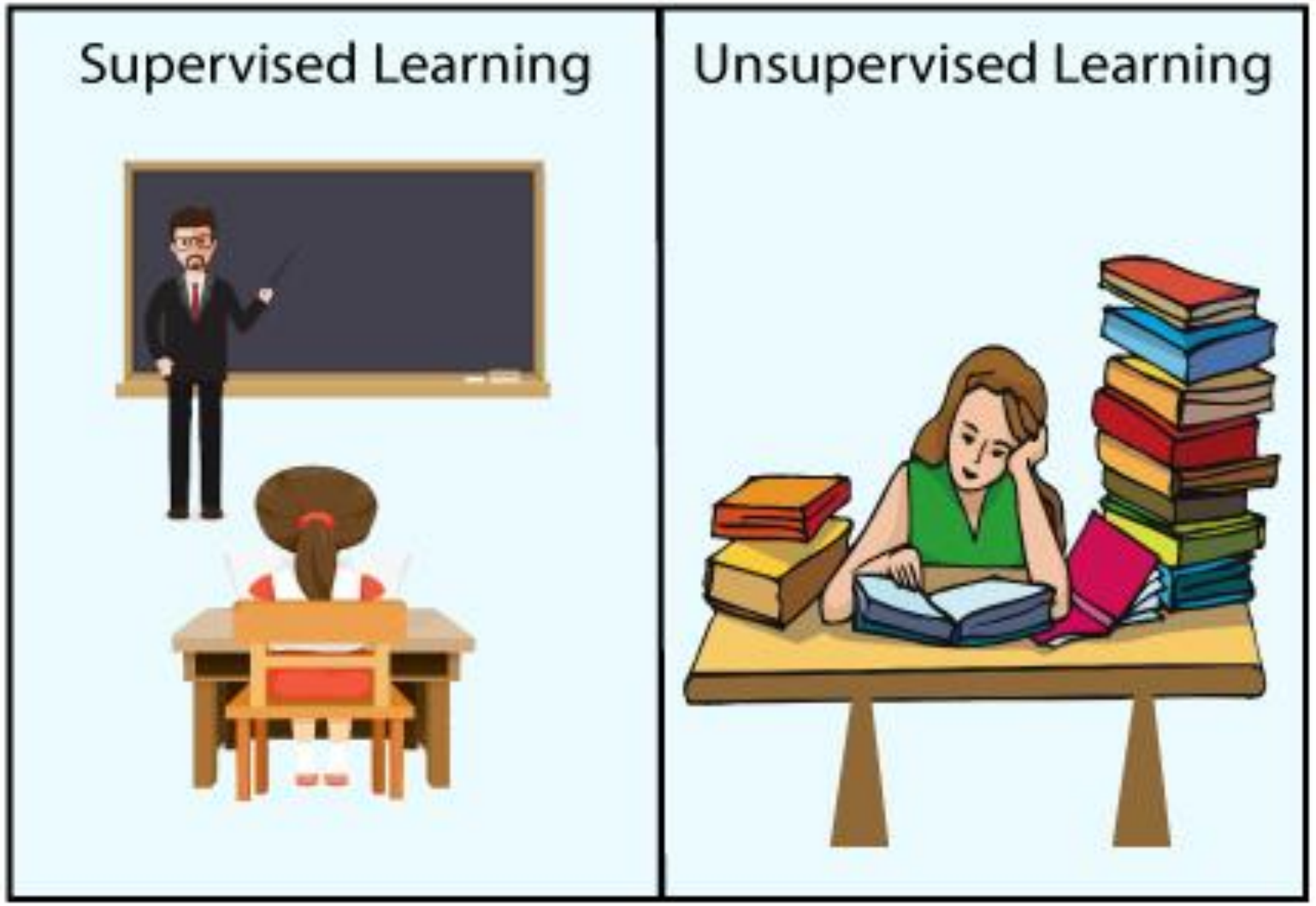
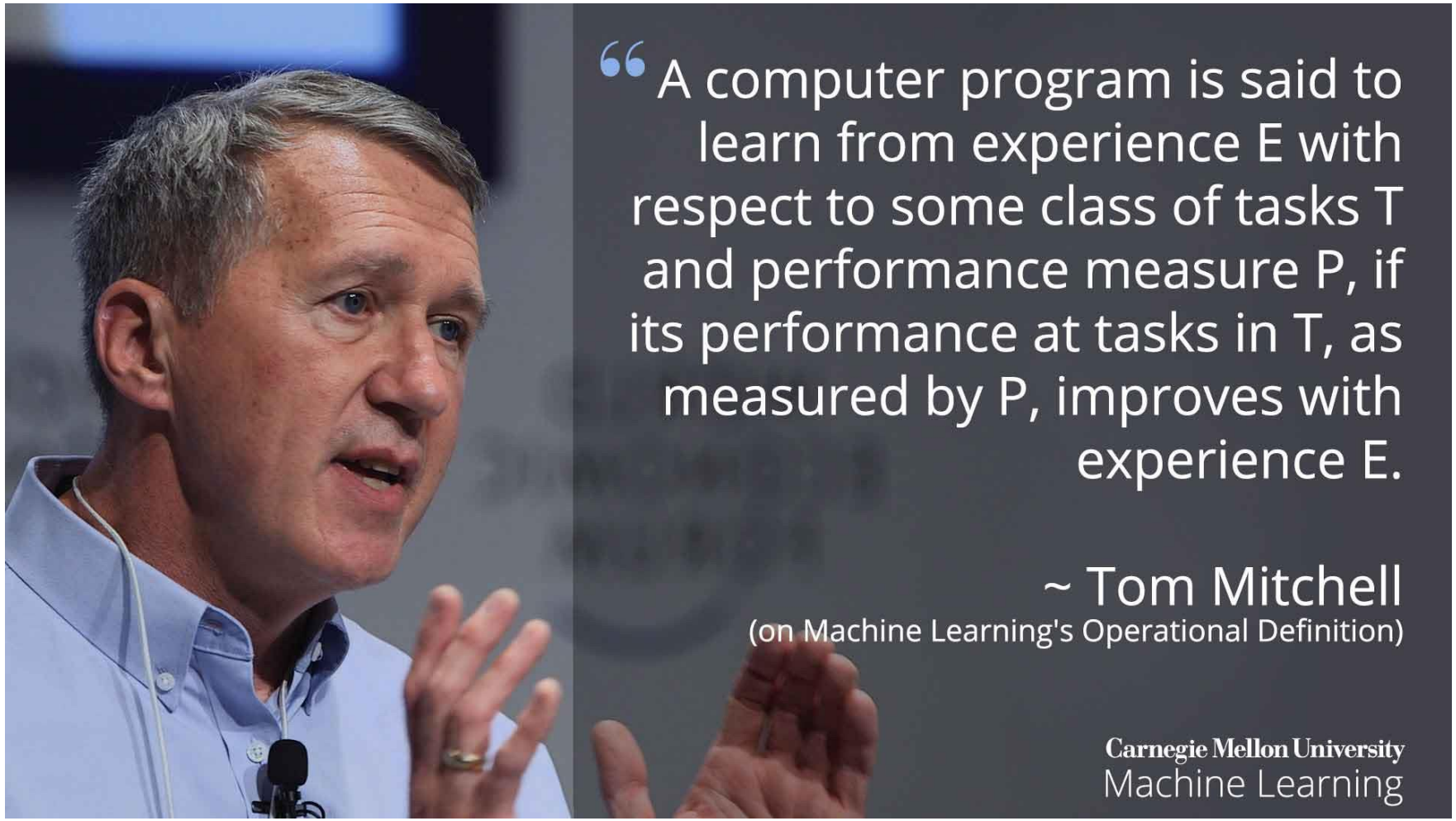
Types of Machine Learning



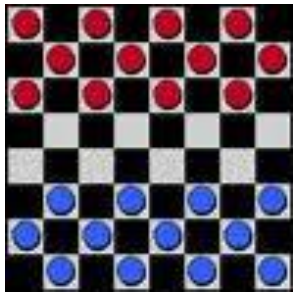

Supervised Learning
Unsupervised Learning

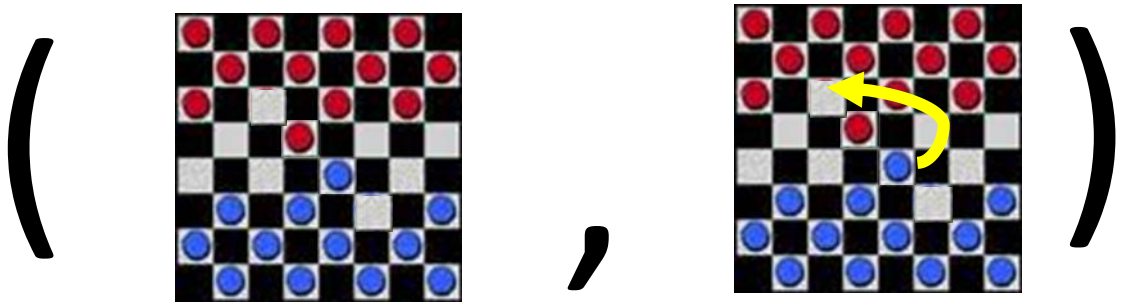


Source: Machine Learning Department at Carnegie Mellon

Examples

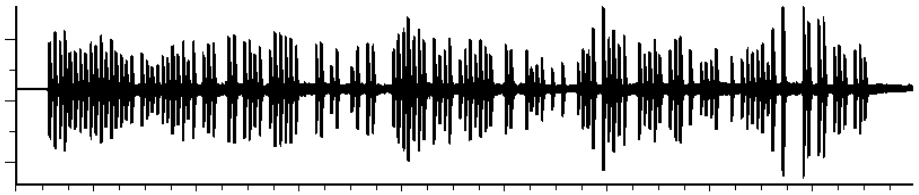
- *Games*
  - T : Play checkers
  - P: % games won
  - E: Combinations <board, optimal play>



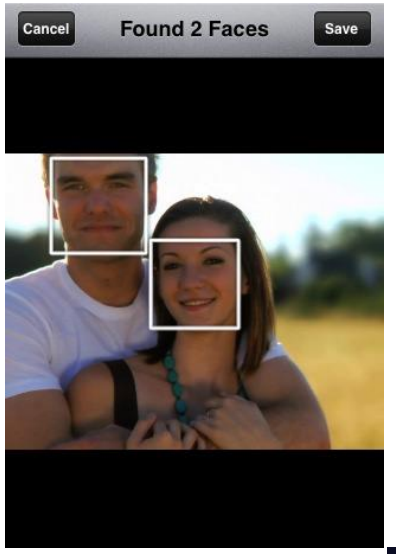


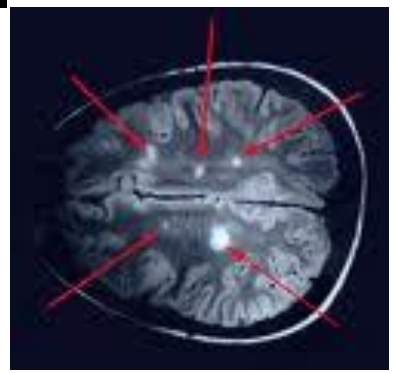
- *Natural Language Processing*

- T: Recognize words
- P: % of words recognized correctly
- E: Pairs <wave form, word>

( , *House*)

- *Image Recognition*





  - T: Recognize objects in images
  - P: % of objects recognized correctly
  - E: Pairs <images, name of the object>

( , ***House***)

Decisions of a learning program

- 1.- What to learn?
- 2.- What experience do you use?
- 3.- Which representation to use?
- 4.- What algorithm to use?

In a **supervised learning** model, the algorithm learns on a labeled data set, that is, the desired output is given

In a **unsupervised learning** model, the training dataset is a collection of examples without a specific desired outcome or correct answer

Data set for supervised learning

Attributes

Clasification

Instances / examples

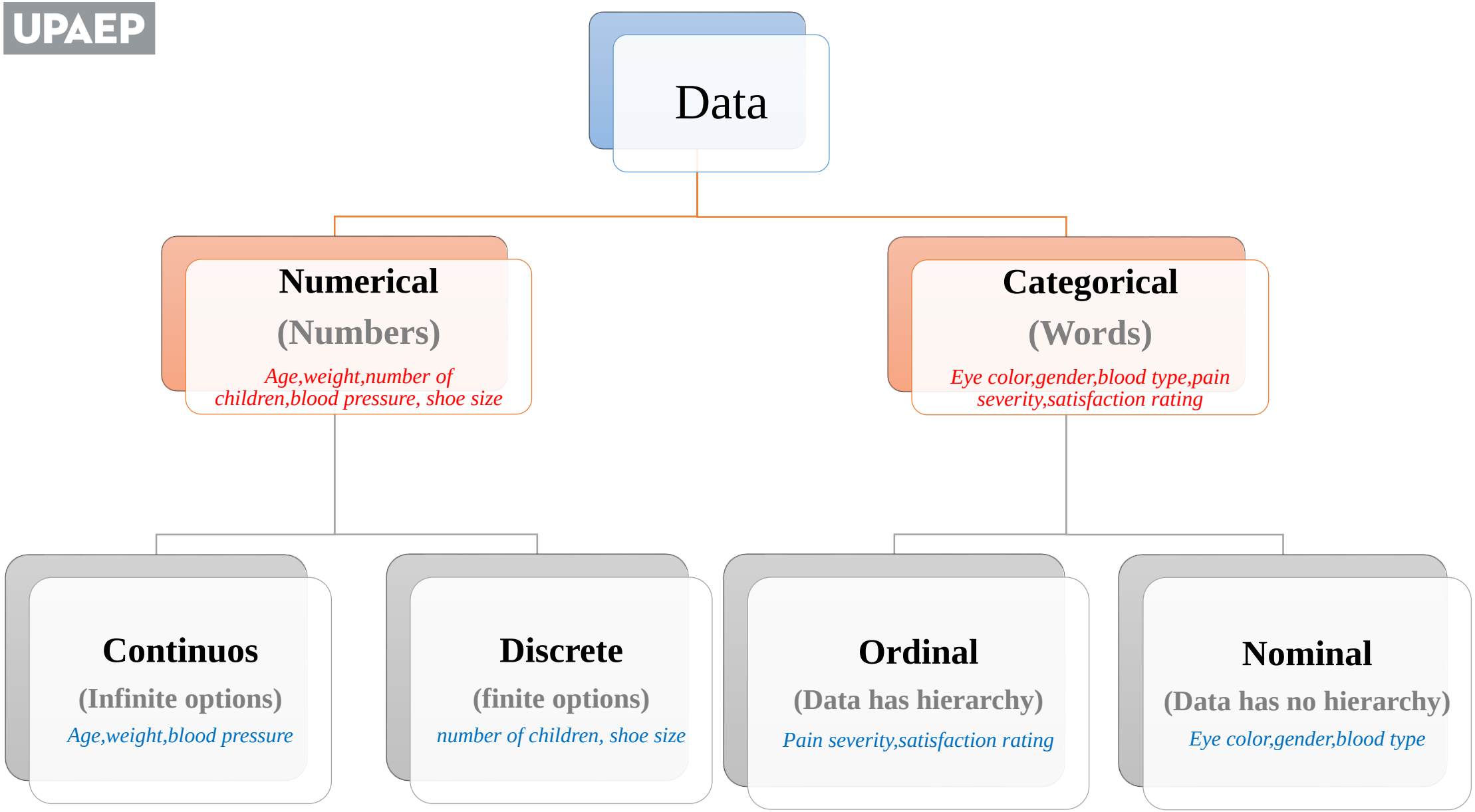
No	Age	Spectacle-prescript	Astigmatism	Tear-prod-rate	Contact-lenses
1	young	myope	no	reduced	none
2	young	myope	no	normal	soft
3	young	myope	yes	reduced	none
4	young	myope	yes	normal	hard
5	young	hypermetrope	no	reduced	none
6	young	hypermetrope	no	normal	soft
7	young	hypermetrope	yes	reduced	none
8	young	hypermetrope	yes	normal	hard
9	pre-presbyopic	myope	no	reduced	none
10	pre-presbyopic	myope	no	normal	soft
11	pre-presbyopic	myope	yes	reduced	none
12	pre-presbyopic	myope	yes	normal	hard
13	pre-presbyopic	hypermetrope	no	reduced	none
14	pre-presbyopic	hypermetrope	no	normal	soft
15	pre-presbyopic	hypermetrope	yes	reduced	none

Data set for unsupervised learning

Attributes

Instances / examples

No	Age	Spectacle-prescript	Astigmatism	Tear-prod-rate
1	young	myope	no	reduced
2	young	myope	no	normal
3	young	myope	yes	reduced
4	young	myope	yes	normal
5	young	hypermetrope	no	reduced
6	young	hypermetrope	no	normal
7	young	hypermetrope	yes	reduced
8	young	hypermetrope	yes	normal
9	pre-presbyopic	myope	no	reduced
10	pre-presbyopic	myope	no	normal
11	pre-presbyopic	myope	yes	reduced
12	pre-presbyopic	myope	yes	normal
13	pre-presbyopic	hypermetrope	no	reduced
14	pre-presbyopic	hypermetrope	no	normal
15	pre-presbyopic	hypermetrope	yes	reduced


Data
Numerical
(Numbers)
Age,weight,number of children,blood pressure, shoe size
Categorical
(Words)
Eye color,gender,blood type,pain severity,satisfaction rating
Continuos
(Infinite options)
Age,weight,blood pressure
Discrete
(finite options)
number of children, shoe size
Ordinal
(Data has hierarchy)
Pain severity,satisfaction rating
Nominal
(Data has no hierarchy)
Eye color,gender,blood type

Classification

No	Age	Spectacle-prescript	Astigmatism	Tear-prod-rate	Contact-lenses
1	young	myope	no	reduced	none
2	young	myope	no	normal	soft
3	young	myope	yes	reduced	none
4	young	myope	yes	normal	hard
5	young	hypermetrope	no	reduced	none
6	young	hypermetrope	no	normal	soft
7	young	hypermetrope	yes	reduced	none

Association

TId	Items
1	Bread, Milk
2	Bread, Diaper, Beer, Eggs
3	Milk, Diaper, Beer, Coke
4	Bread, Milk, Diaper, Beer
5	Bread, Milk, Diaper, Coke

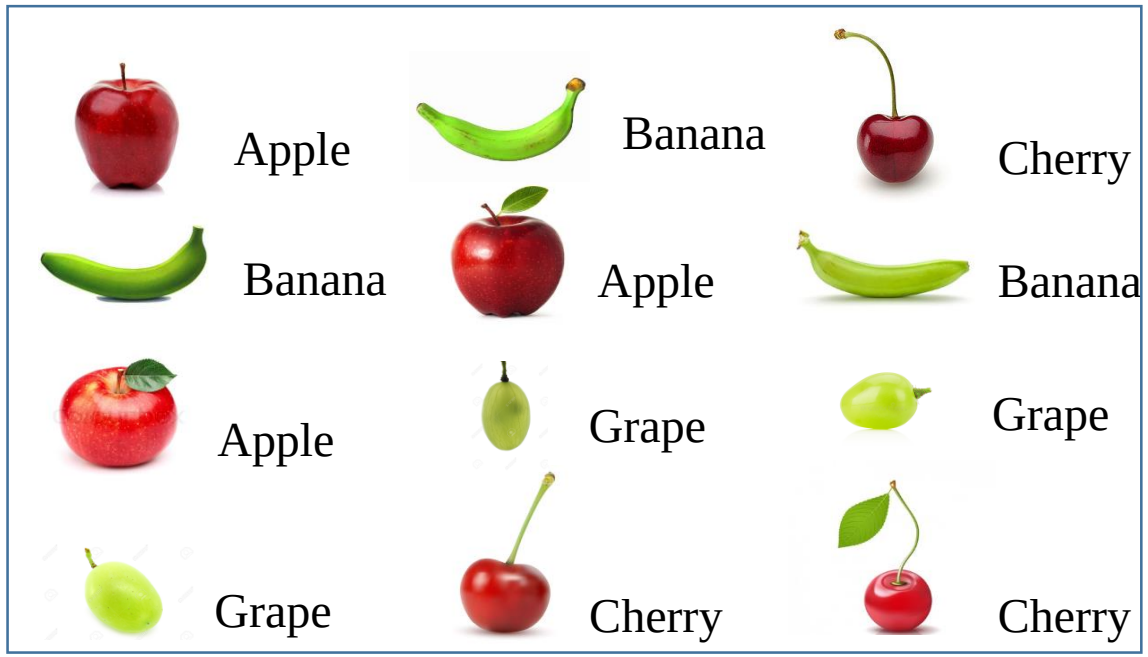
Clustering / Segmentation

No	Age	Spectacle-prescript	Astigmatism	Tear-prod-rate
1	young	myope	no	reduced
2	young	myope	no	normal
3	young	myope	yes	reduced
4	young	myope	yes	normal
5	young	hypermetrope	no	reduced
6	young	hypermetrope	no	normal
7	young	hypermetrope	yes	reduced

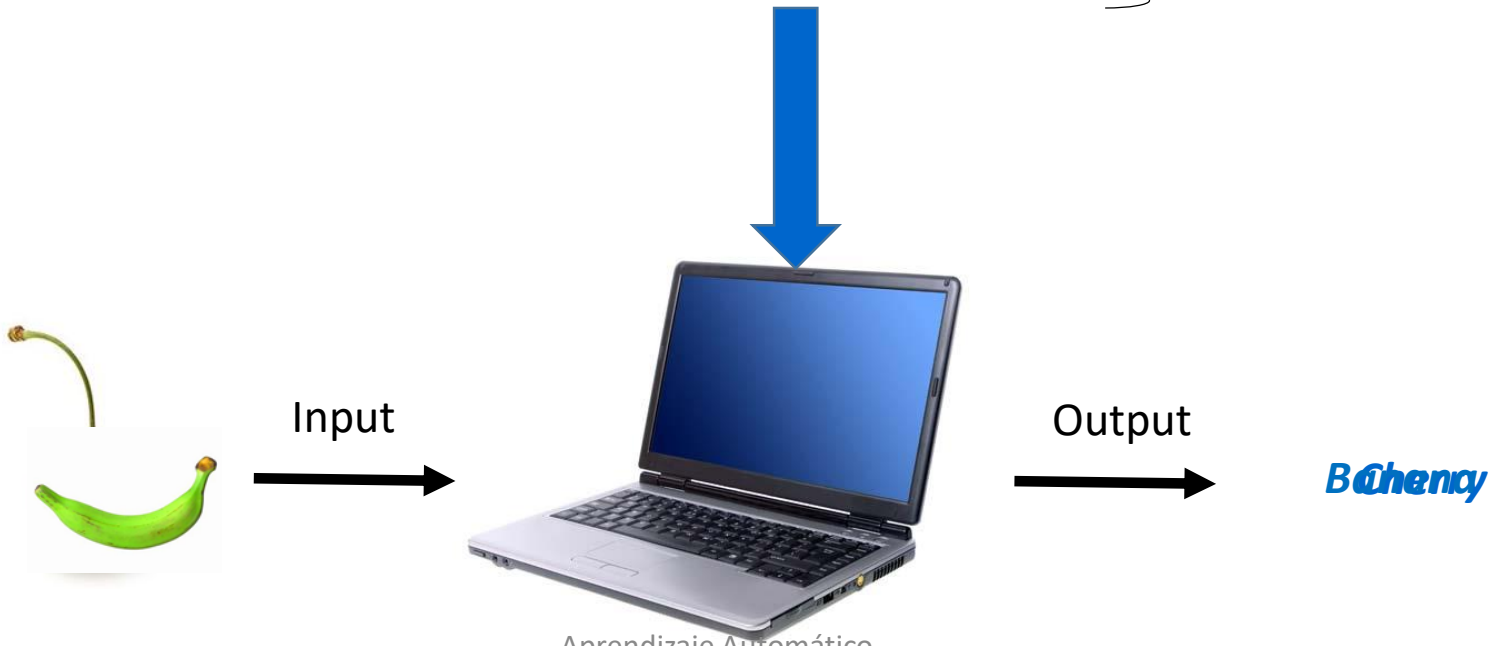
Regression

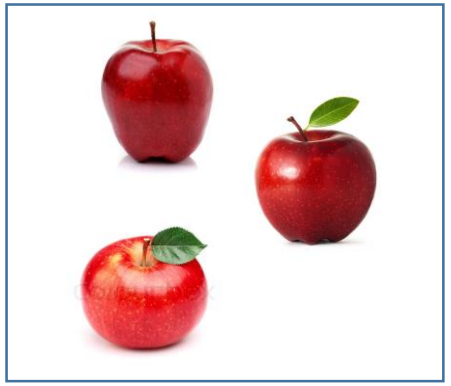
Year	Month	Interest_Rate	Unemployment_Rate	Stock_Index_Price
2017	12	2.75	5.3	1464
2017	11	2.5	5.3	1394
2017	10	2.5	5.3	1357
2017	9	2.5	5.3	1293
2017	8	2.5	5.4	1256
2017	7	2.5	5.6	1254
2017	6	2.5	5.5	1234
2017	5	2.25	5.5	1195
2017	4	2.25	5.5	1159
2017	3	2.25	5.6	1167

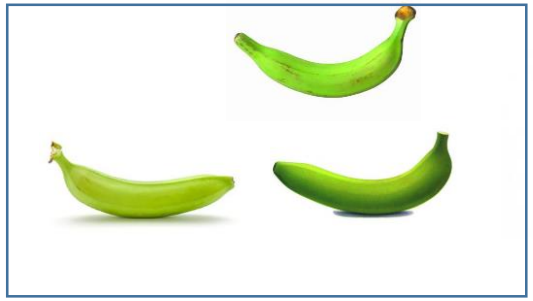
Supervised Learning

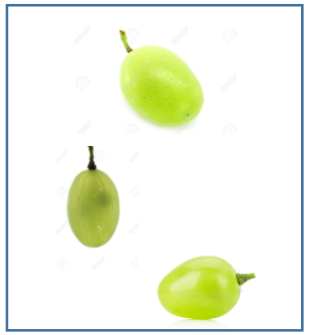


Training Set





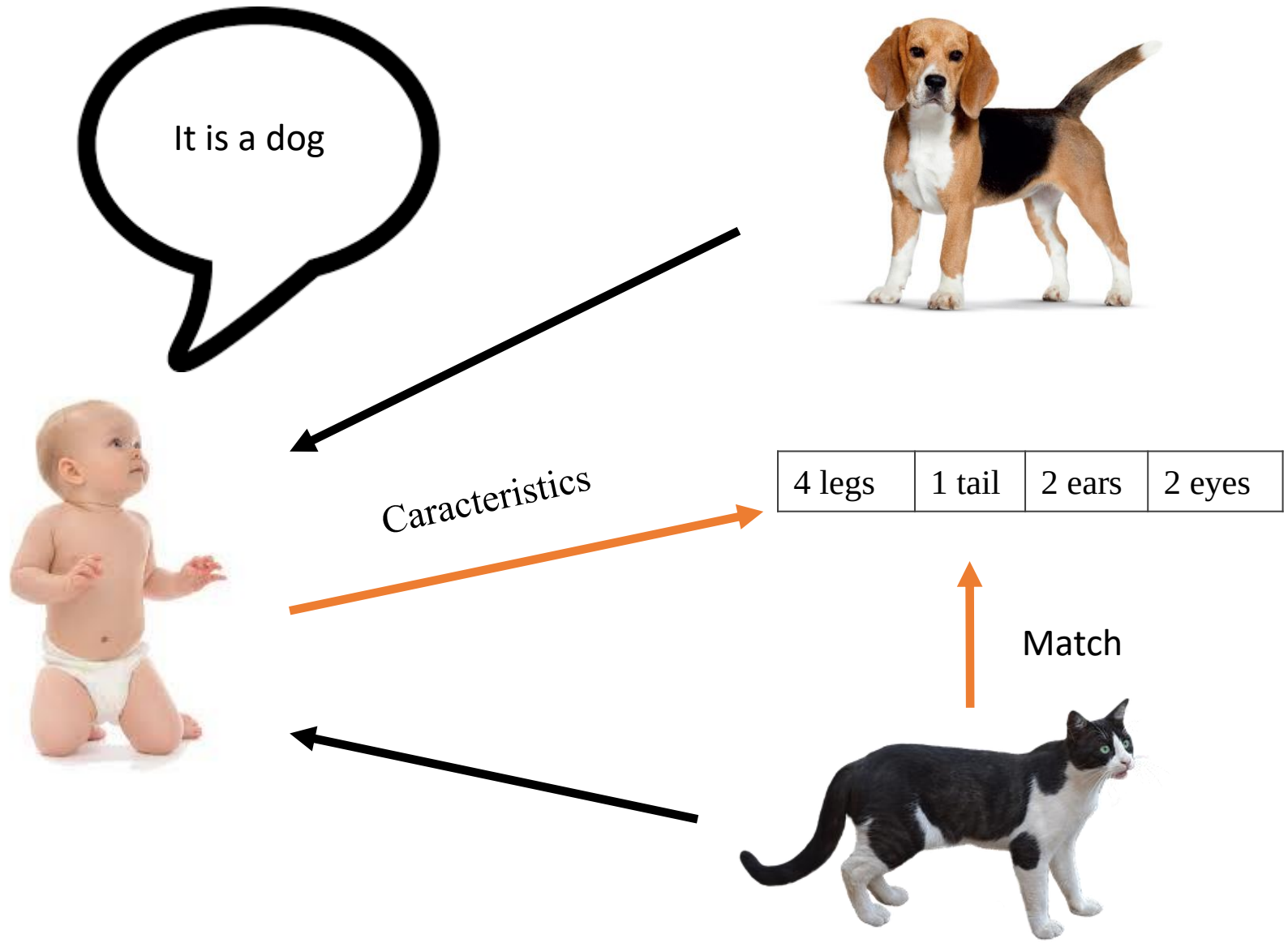


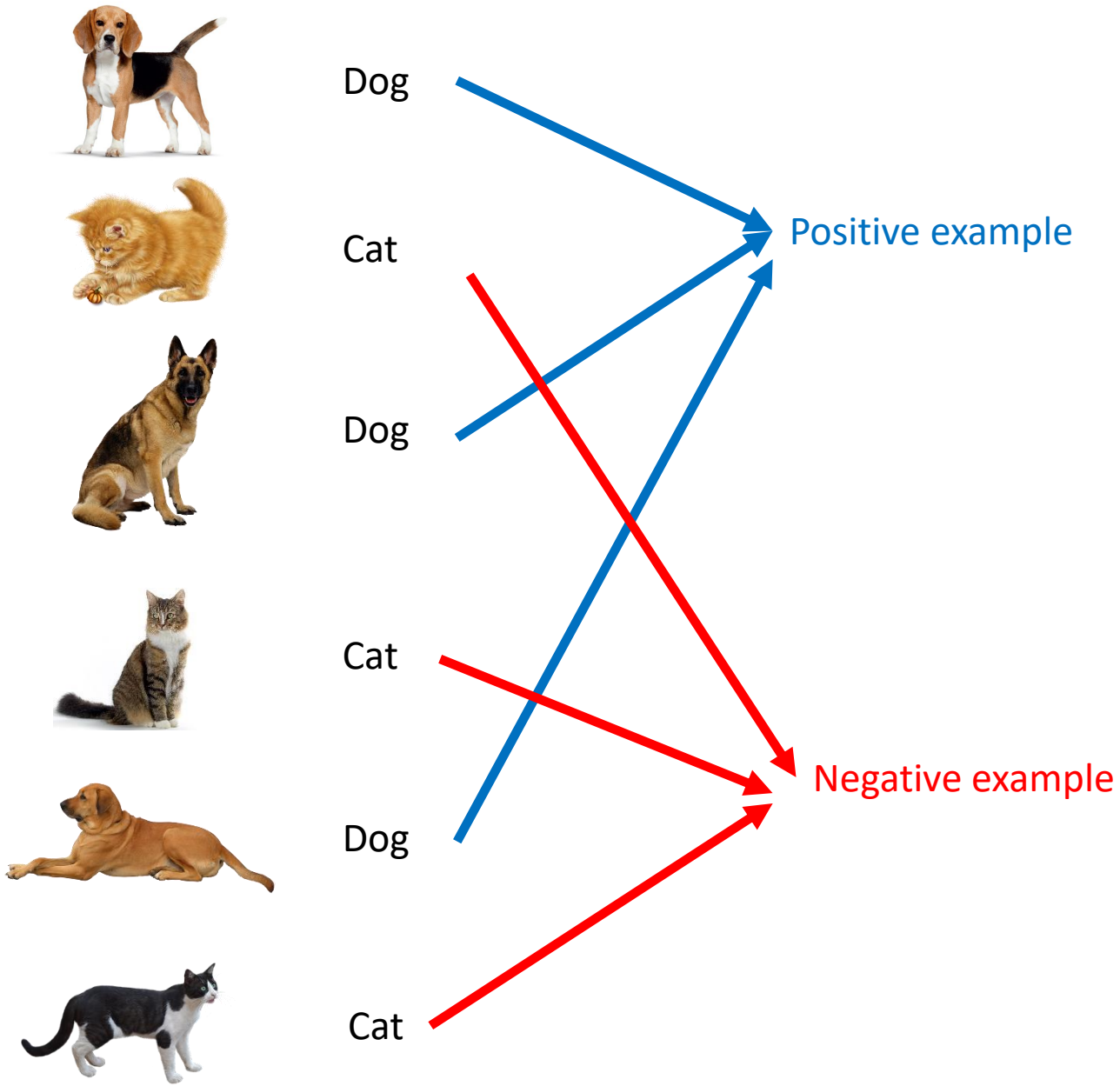


Clusters

Unsupervised Learning

- In a learning problem is necessary that the system has both ***positive*** and ***negative*** examples.
  - Positive examples are examples that show the characteristic that we want the system to learn
  - Negative examples are examples that show the characteristics contrary to what we want the system to learn

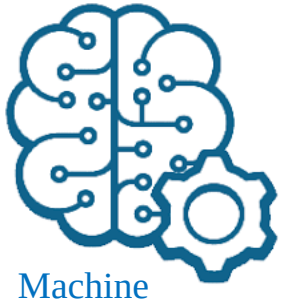

It is a dog
Caracteristics
4 legs
1 tail
2 ears
2 eyes
Match


Dog
Cat
Dog
Cat
Dog
Cat
Positive example
Negative example

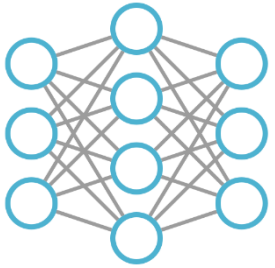
Training

Data

learning process



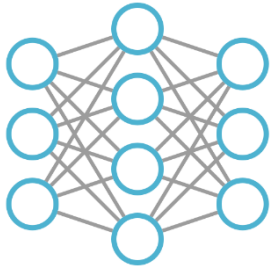
Machine Learning



Model

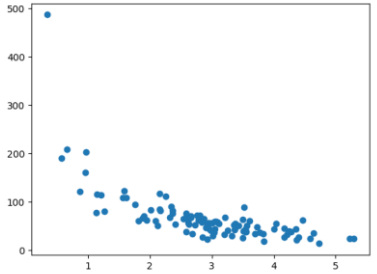
Test

New Data



Model

Test the model



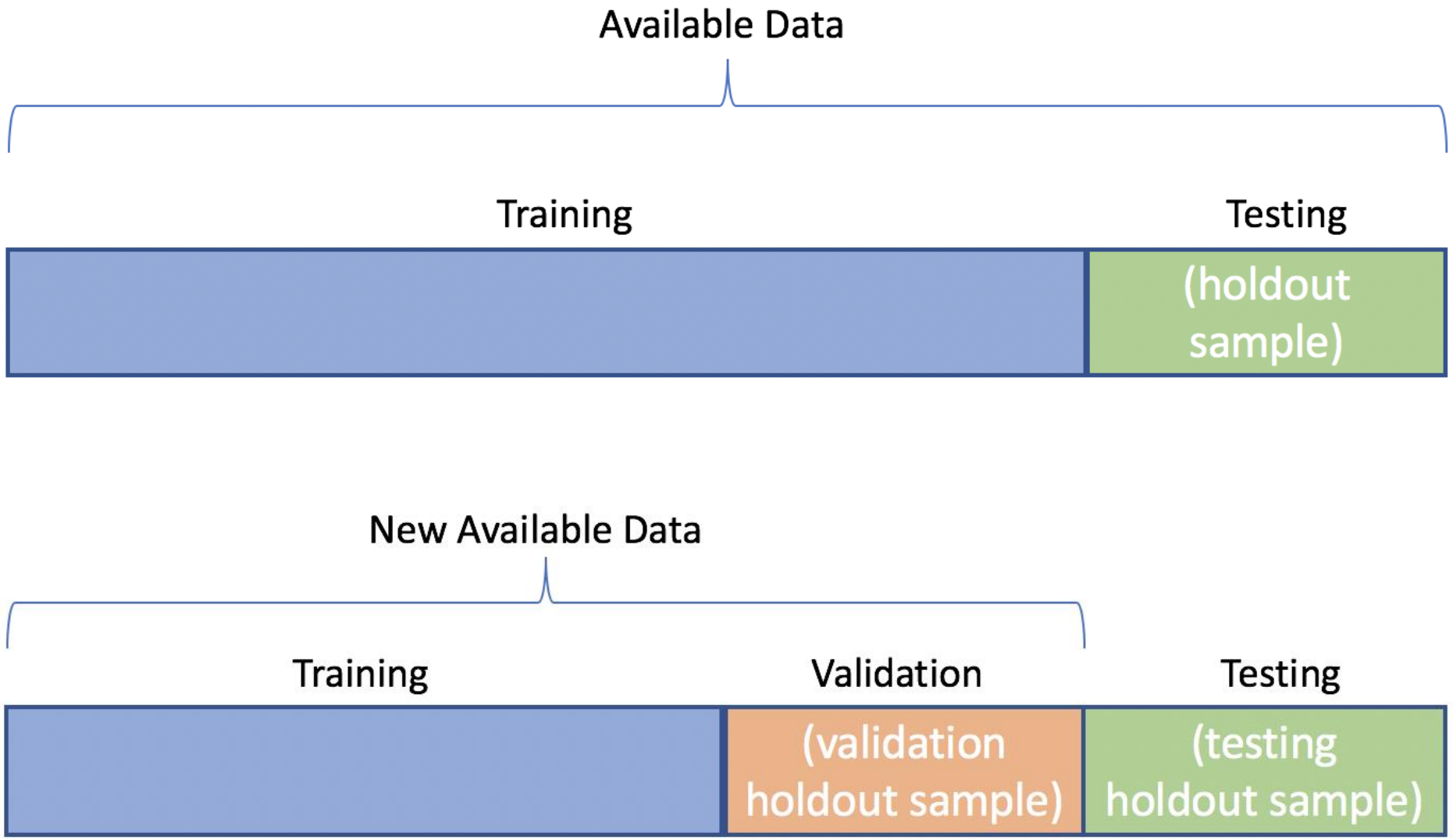
Predictions

Training dataset

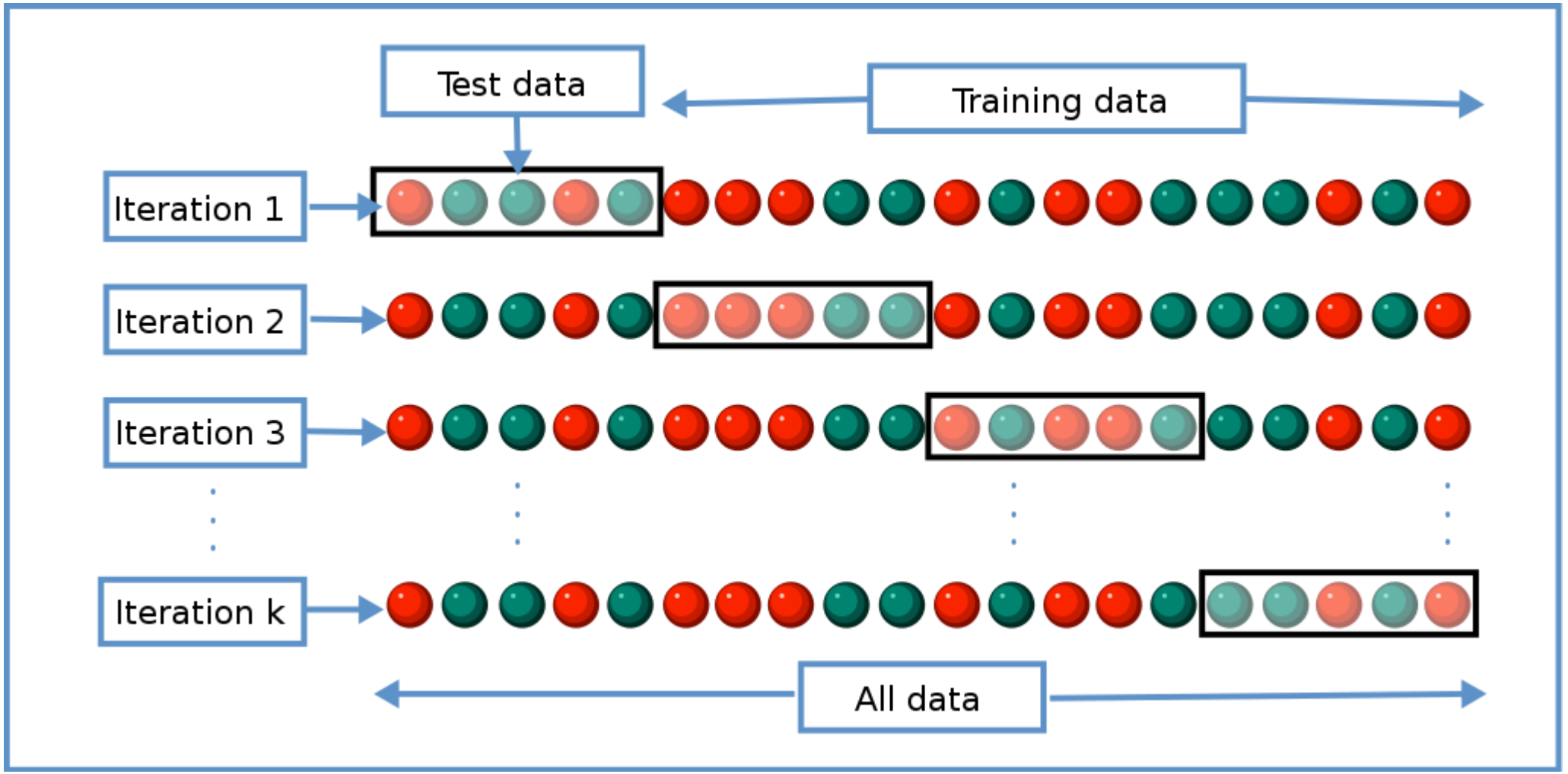
A training dataset is a dataset of examples used during the learning process and is used to fit the parameters

Test dataset

The test dataset is a dataset used to provide an unbiased evaluation of a final model fit on the training dataset


Available Data
Training
Testing
(holdout sample)
New Available Data
Training
Validation
Testing
(validation holdout sample)
(testing holdout sample)

k-fold Cross-Validation

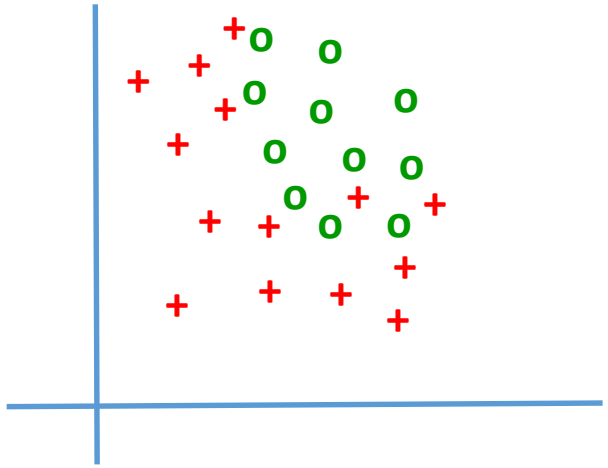


Overfitting and Underfitting

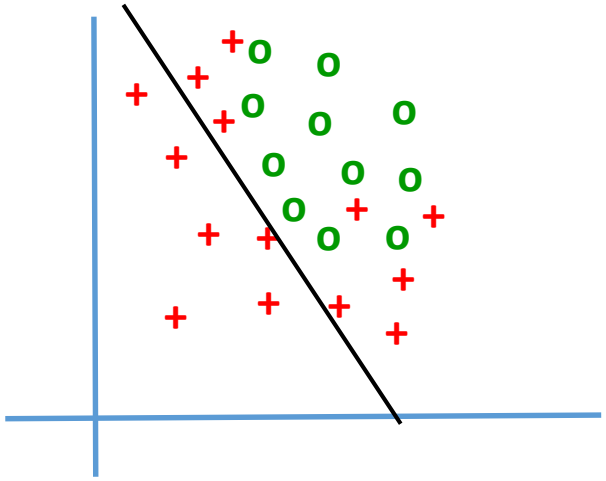
Overfitting and underfitting are two of the most common causes of poor model accuracy.

An underfit model results in high prediction errors for both training and test data

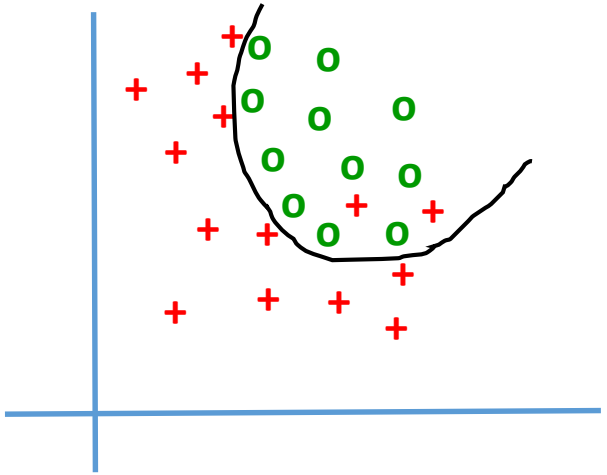
An overfit model gives a very low prediction error on training data, but a very high prediction error on test data



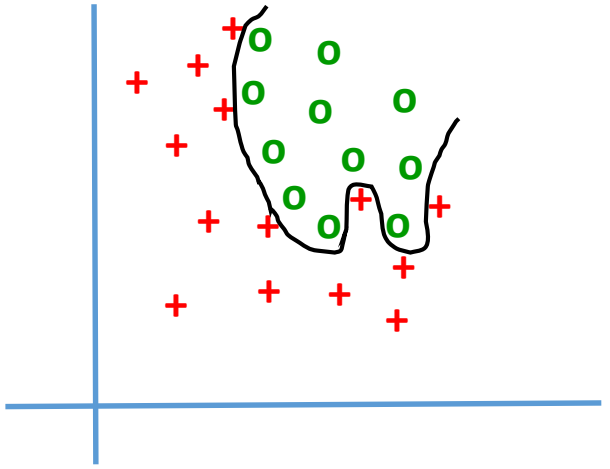
Underfitting

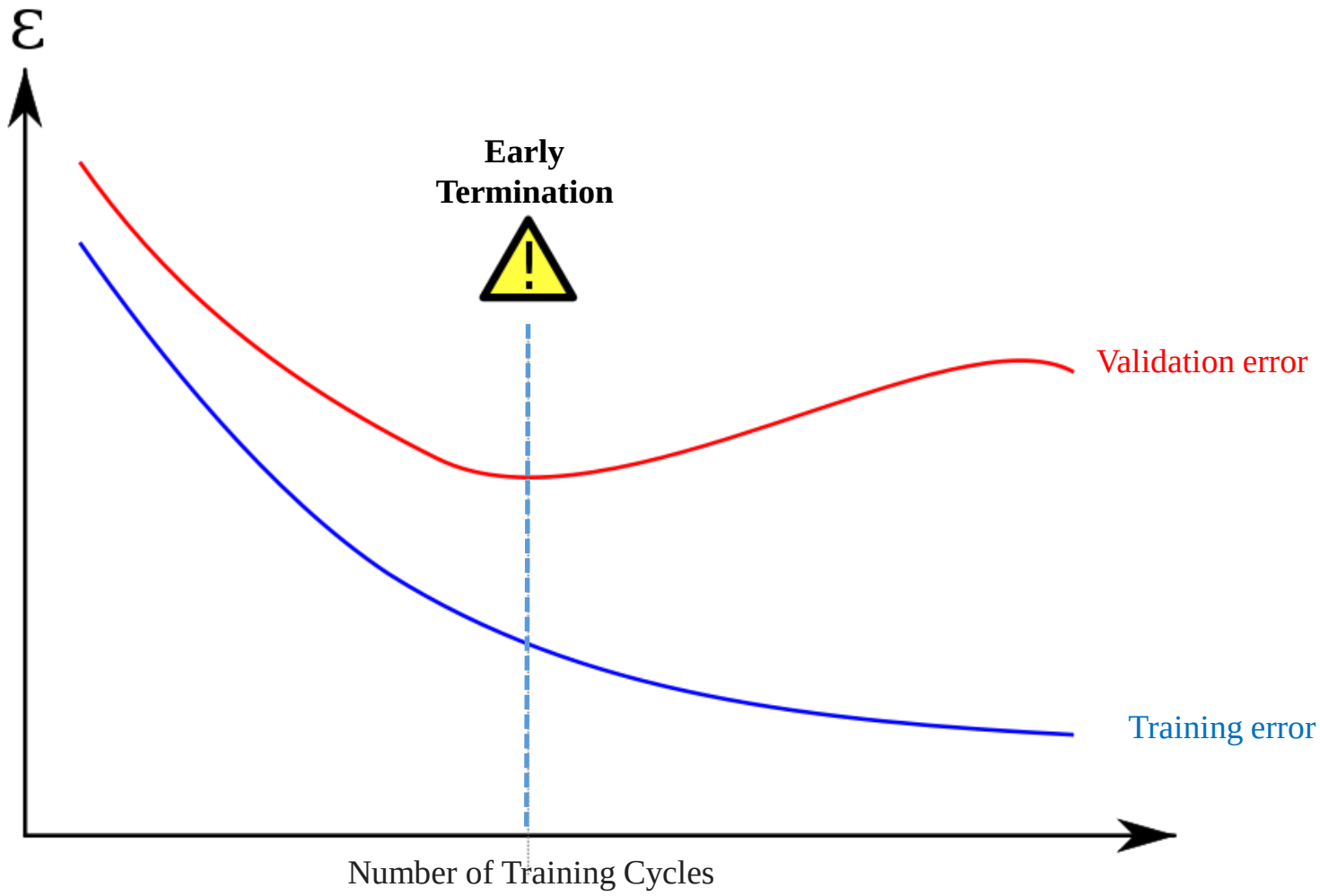


Optimal



Overfitting




ε
Early
Termination
Validation error
Training error
Number of Training Cycles