Introduction to Machine learning

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About me

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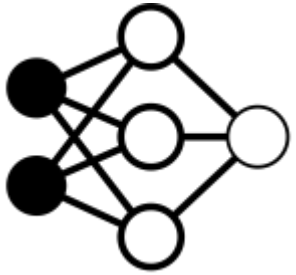
Machine learning

“Learning is any process by which a system improves performance from experience.”

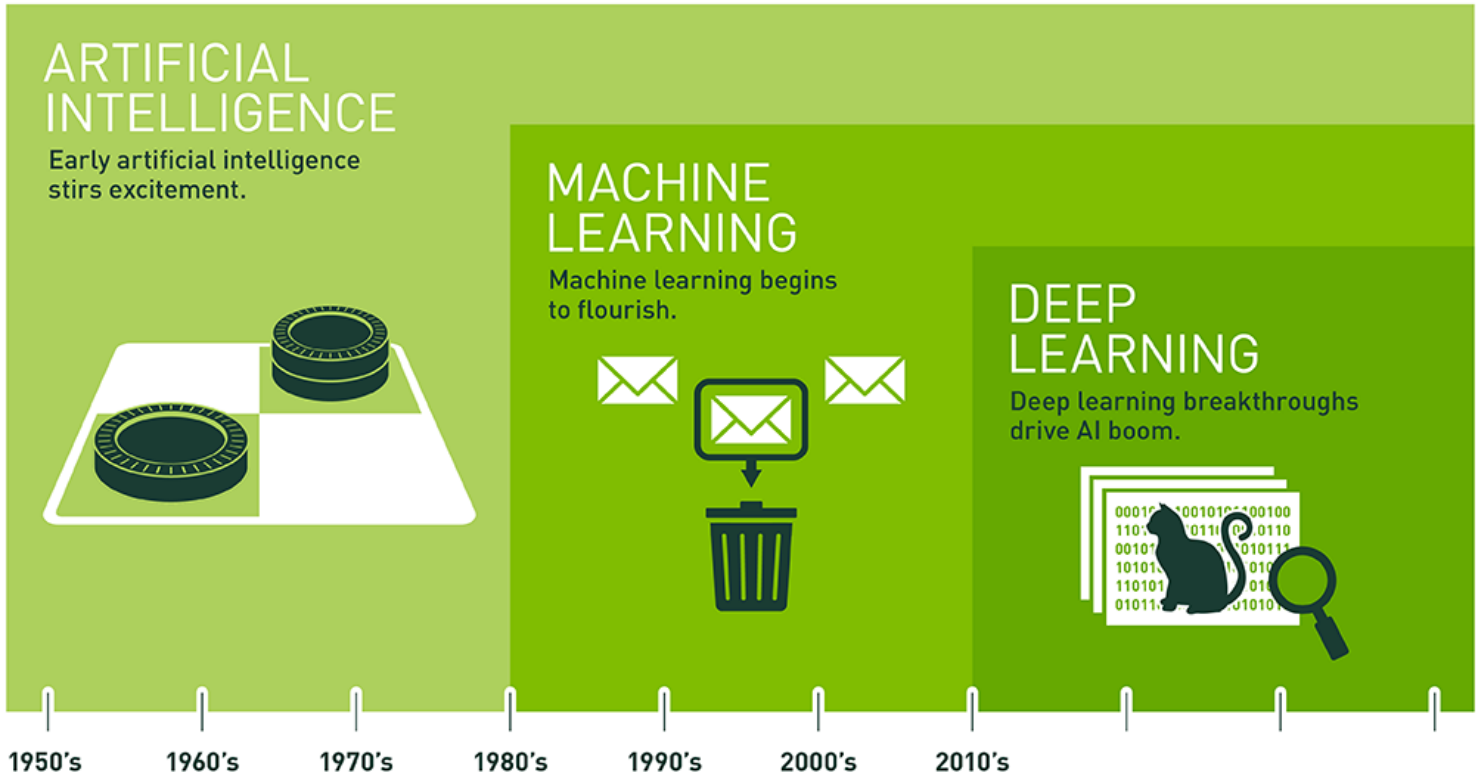
“Machine learning is concerned with computer programs that automatically improve their performance through experience.”

- Herbert Alexander Simon

From educational perspective

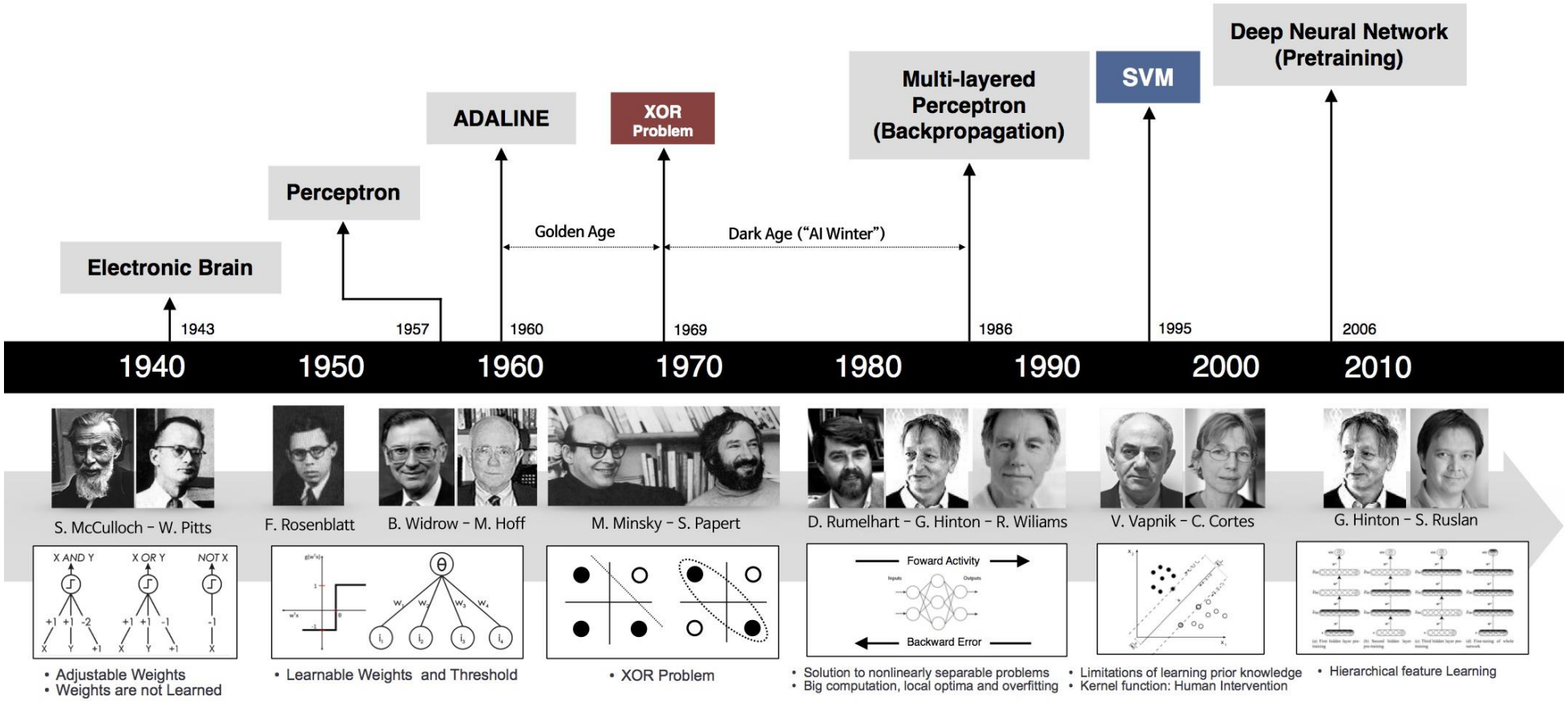
		
Energy	Food	Computation power
Data	Book	Dataset
Training	…	…
Testing	…	…

History



Since an early flush of optimism in the 1950s, smaller subsets of artificial intelligence – first machine learning, then deep learning, a subset of machine learning – have created ever larger disruptions.

History


Deep Neural Network (Pretraining)
SVM
Multi-layered Perceptron (Backpropagation)
XOR Problem
ADALINE
Perceptron
Electronic Brain
Golden Age
Dark Age ("AI Winter")
1943
1957
1960
1969
1986
1995
2006
1940
1950
1960
1970
1980
1990
2000
2010
S. McCulloch - W. Pitts
F. Rosenblatt
B. Widrow - M. Hoff
M. Minsky - S. Papert
D. Rumelhart - G. Hinton - R. Wiliams
V. Vapnik - C. Cortes
G. Hinton - S. Ruslan
X AND Y
X OR Y
NOT X
Foward Activity
Backward Error
• Adjustable Weights
• Weights are not Learned
• Learnable Weights and Threshold
• XOR Problem
• Solution to nonlinearly separable problems
• Big computation, local optima and overfitting
• Limitations of learning prior knowledge
• Kernel function: Human Intervention
• Hierarchical feature Learning

Why machine learning?

Data mining: get new knowledge from big data

Ex: Predict stock prices

A software that can automatically upgrade and adapt to individual users.

Ex: Facebook newfeed

Mimic human which require some intelligence

Ex: Recognize, classification, …

Why’s it hot now?

Computational power: NVIDIA, AMD, Intel, …

The increasing of big data: from huge of the internet user.

New algorithms and techniques

Support from governments and industries

Its applications

- Computer vision: recognition, human - machine interaction, …
- Natural language processing (NLP): text mining, recommend system, artificial voice, …
- Other: fin-tech, bioinformation, physis, chemistry, …

The concept of learning in Machine learning

Learning = Improving the performance P with experience E at task T

Task T: recognize, classify, predict, …

Experience E: images, texts, time-series, …

Performance P: accuracy, F1-score, IoU, MAPE, …

Example: Filter spam email

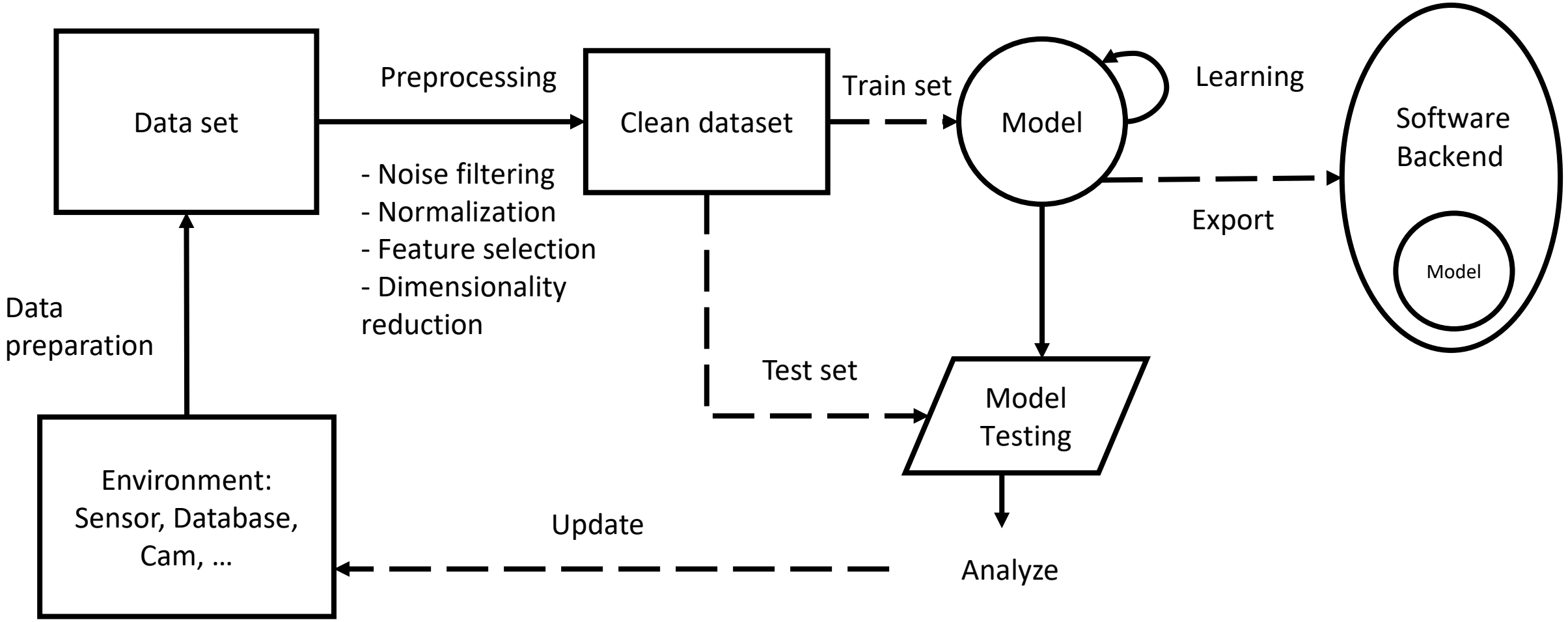
An email will be classified as a normal email or spam email.

T: classify (or identify)

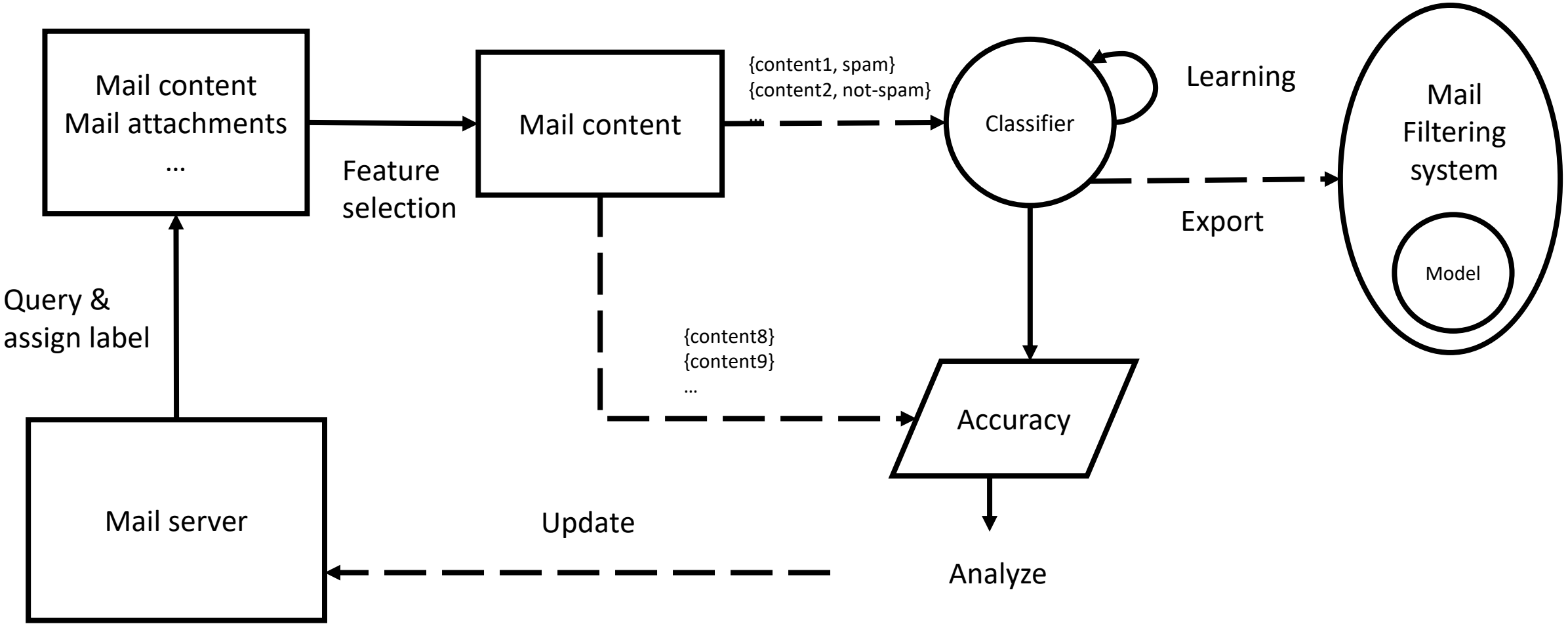
E: database of email (text) that were labeled by user.

P: accuracy (%) = |correct label| / |total email|

Learning process



In our example



Dataset

The dataset is splitted into train set and test set (or train – val – test)

{content1, spam}

{content2, not-spam}

…

{content8, spam}

{content9, spam}

{content10, spam}

Train set:

{content1, spam}

{content2, not-spam}

…

Test set:

{content9}

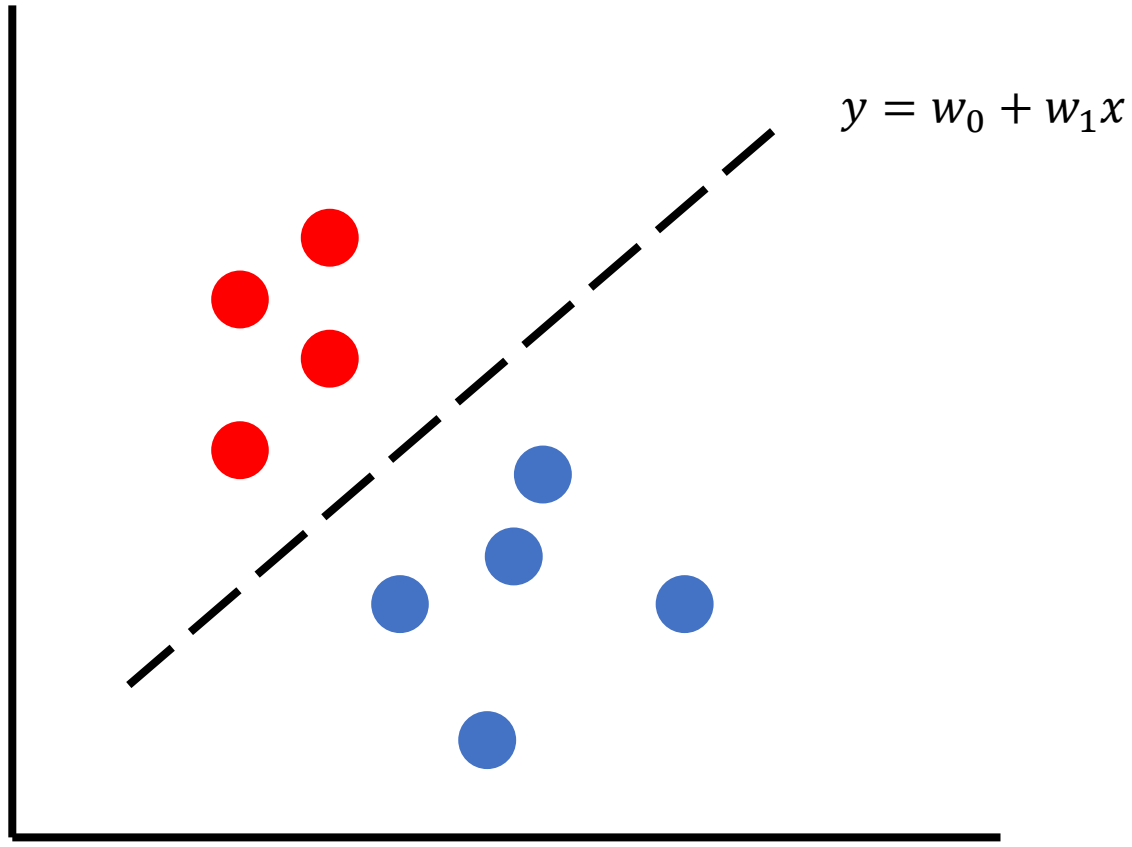
{content10}

Test label:

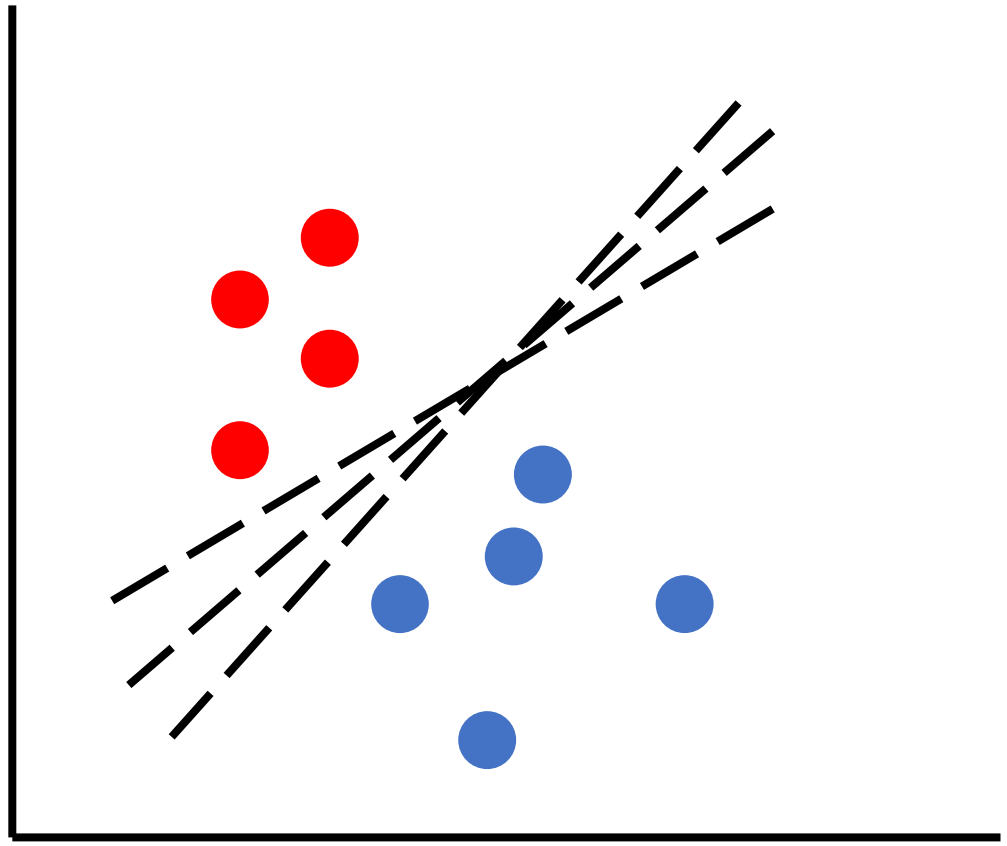
{spam}

{spam}

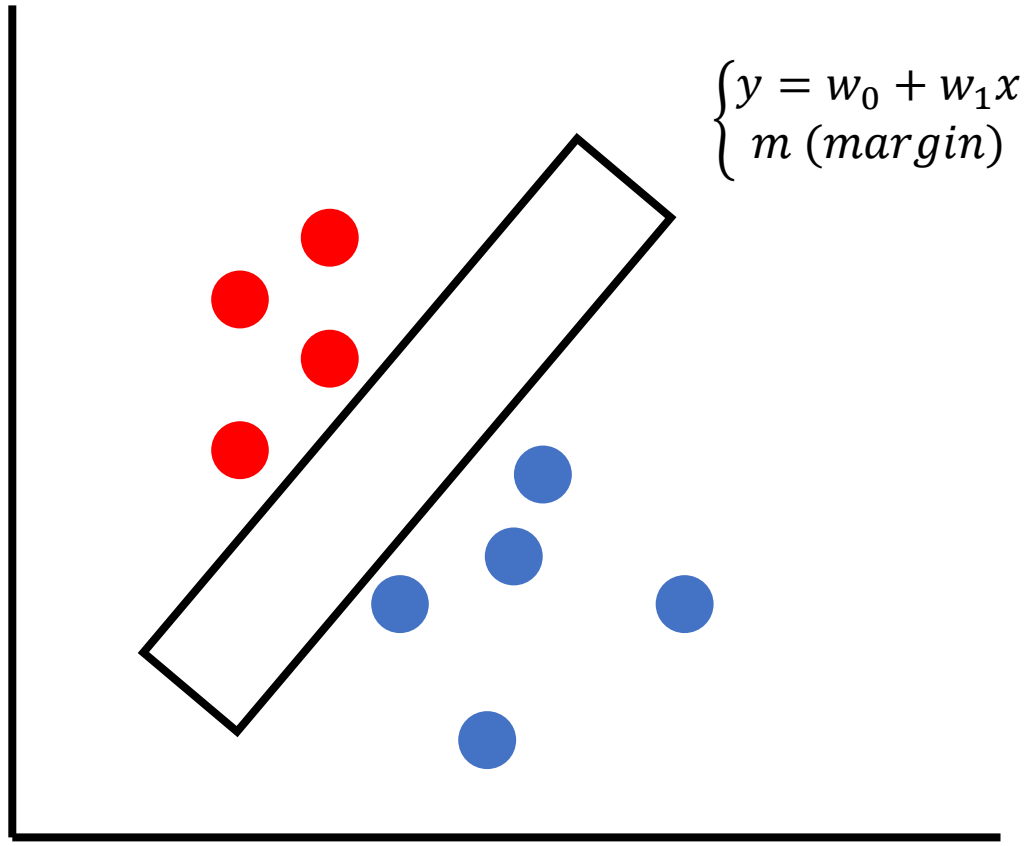
Linear classifier



Linear classifier

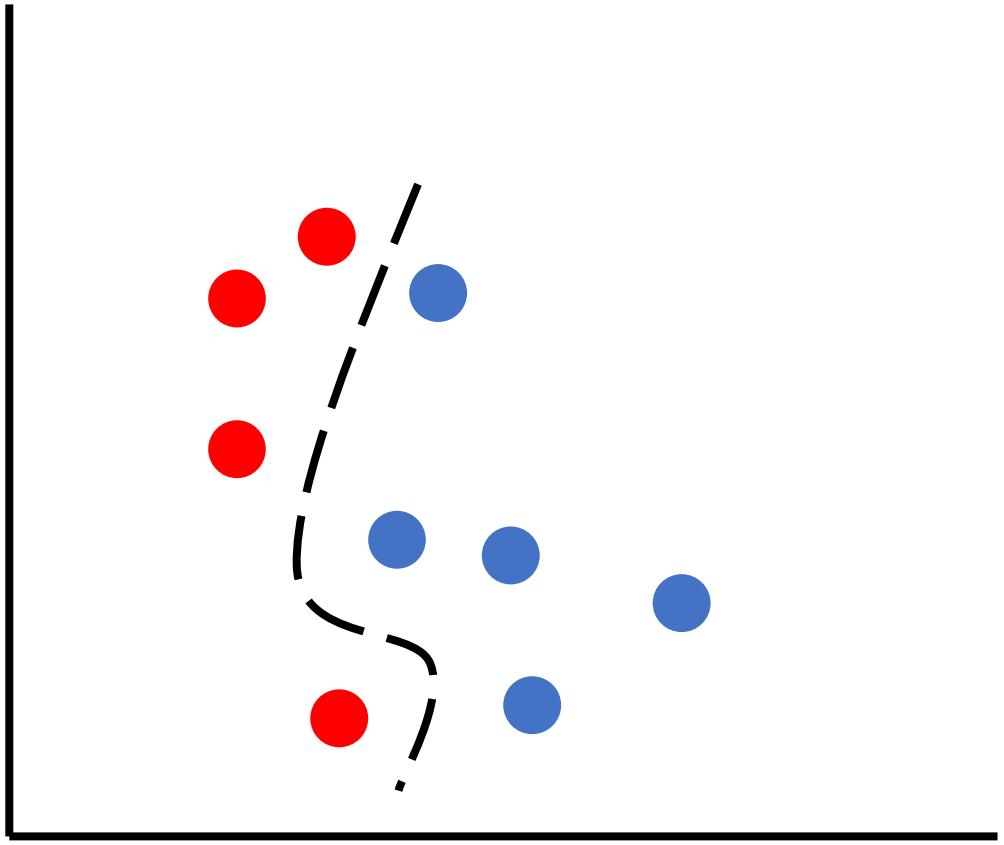


Linear classifier – add more parameters



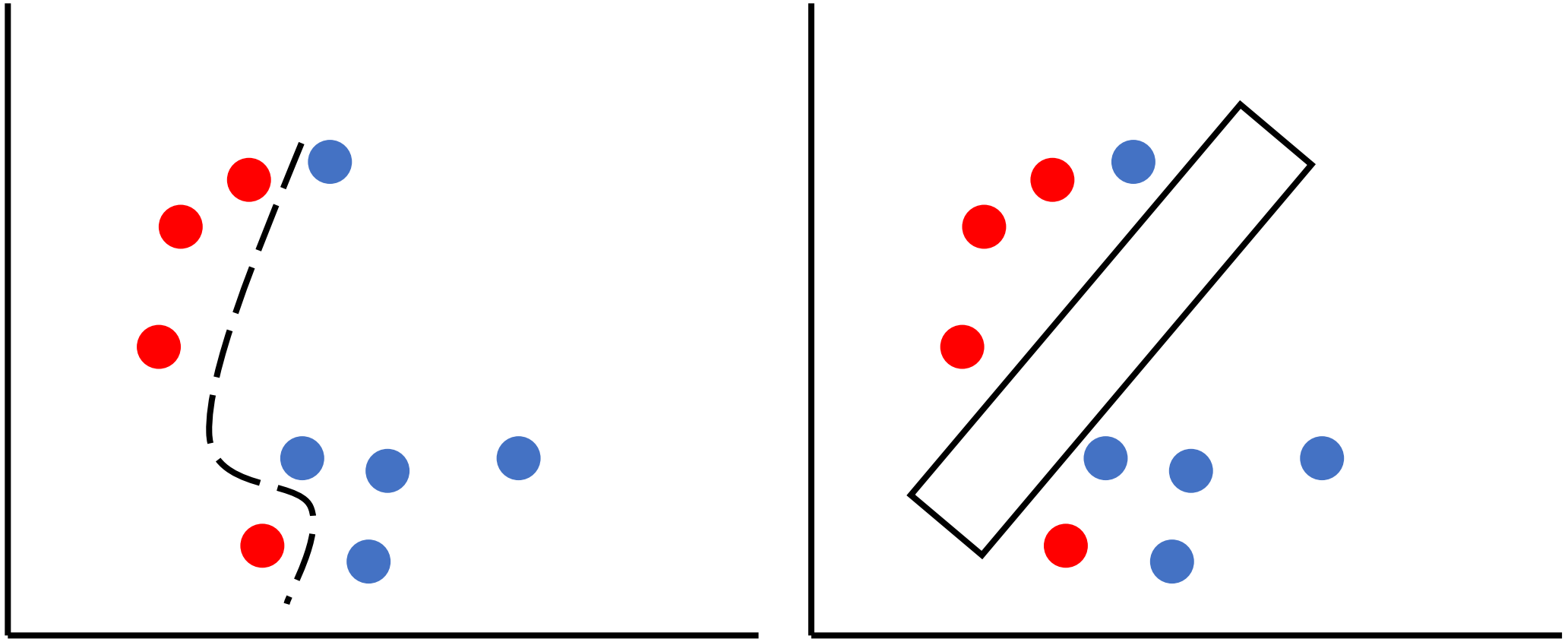
$$\begin{cases} y = w_0 + w_1 x \\ m\ (margin) \end{cases}$$

No linear classifier can cover all instances

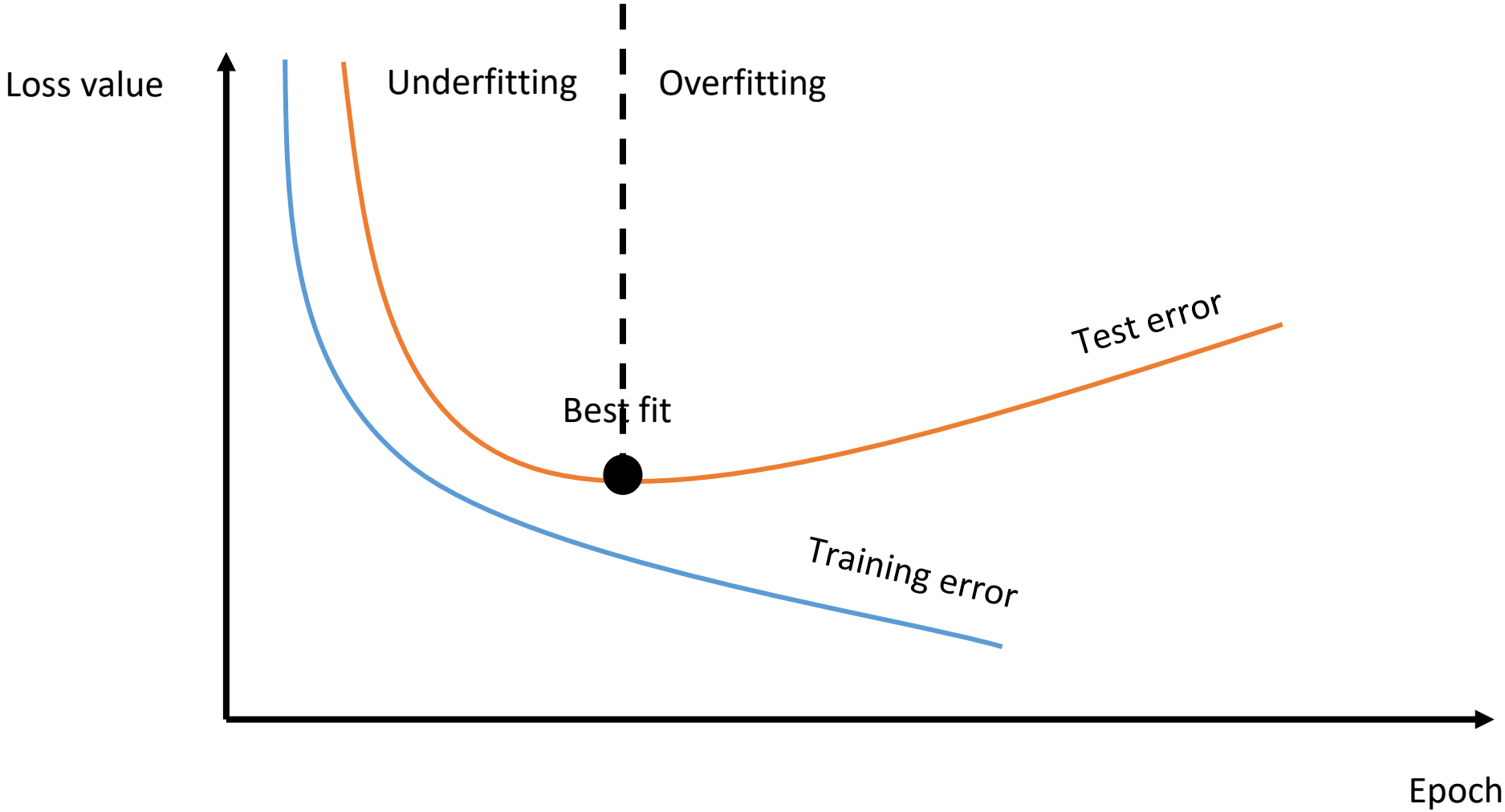


New model with higher degree
→ Issue of generalization

Which one?



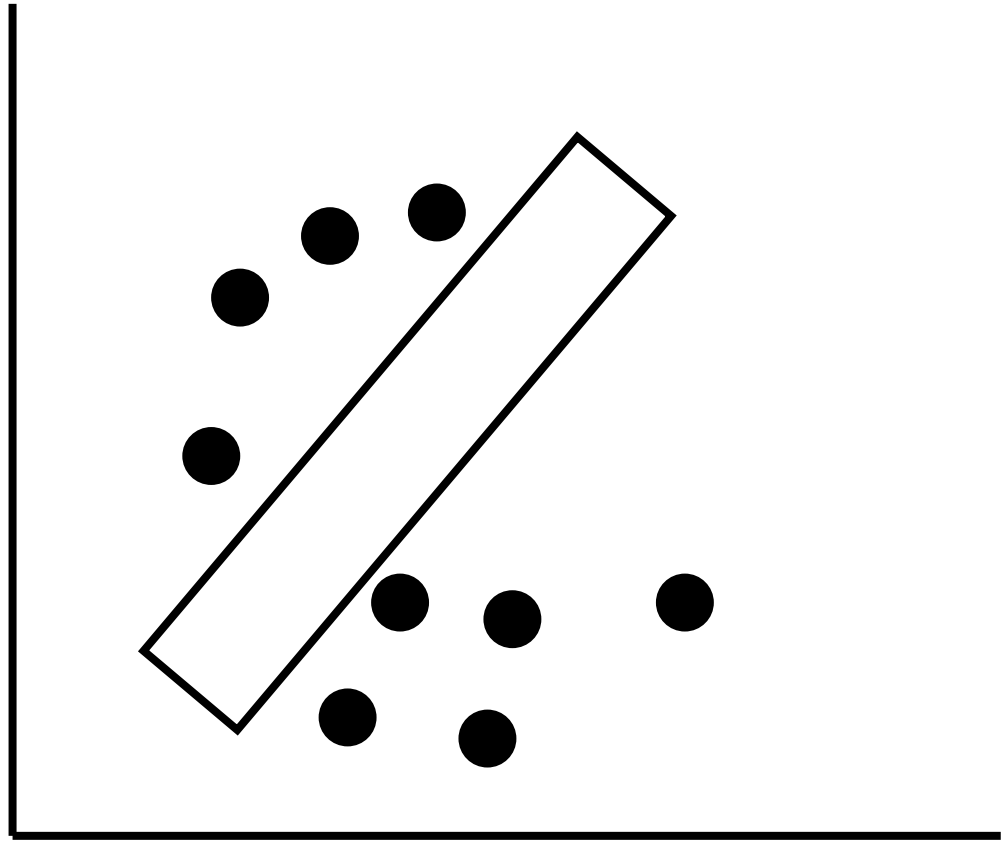
Overfitting and underfitting



Model testing

Confusion matrix

	Predict spam	Predict non-spam
Actual spam	True positive 3	False negative 1
Actual non-spam	False positive 1	True negative 4



Accuray = $\frac{TP+TN}{TP+TN+FP+FN}$, Recall = $\frac{TP}{TP+FP}$, Precision = $\frac{TP}{TP+FN}$

F1 score = $\frac{2*recall*precision}{recall+precision}$

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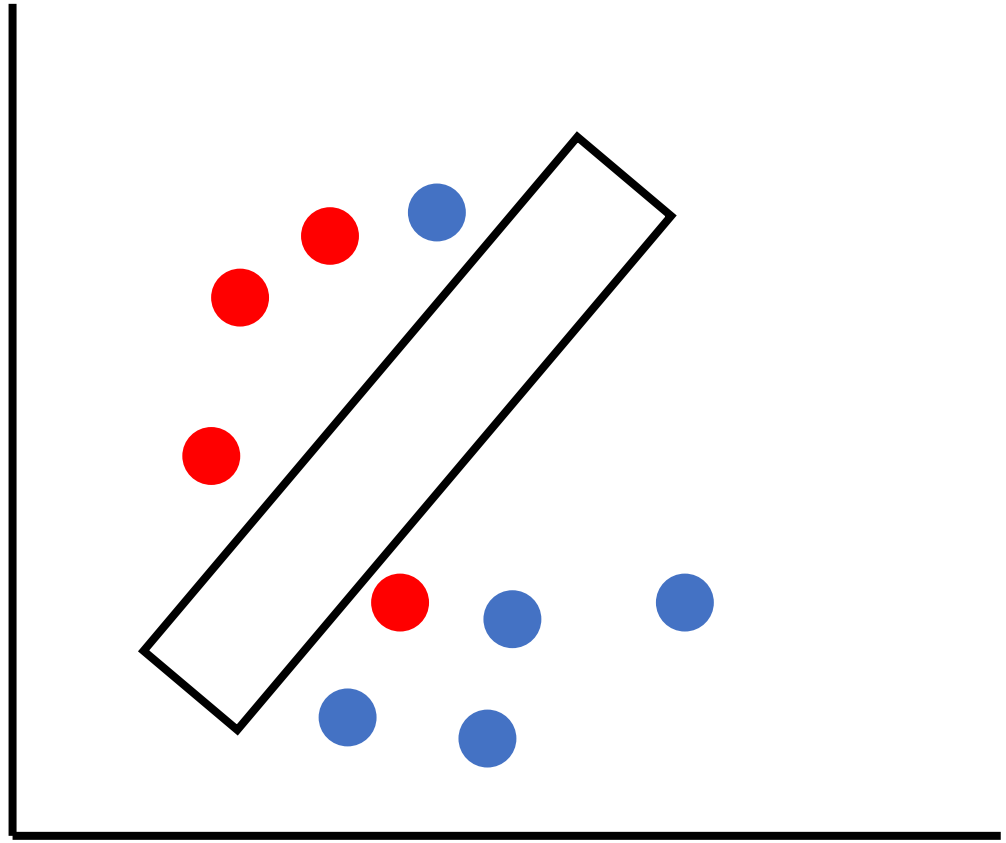

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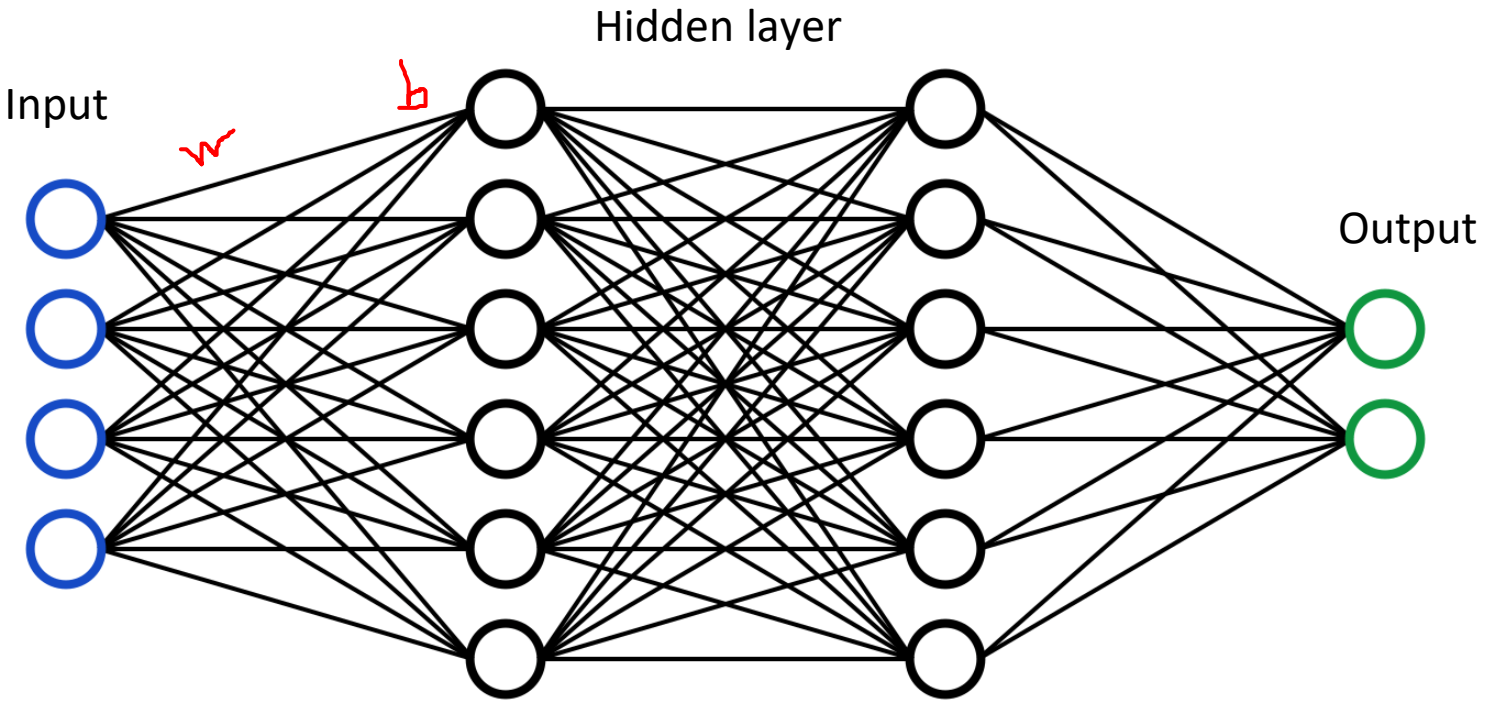
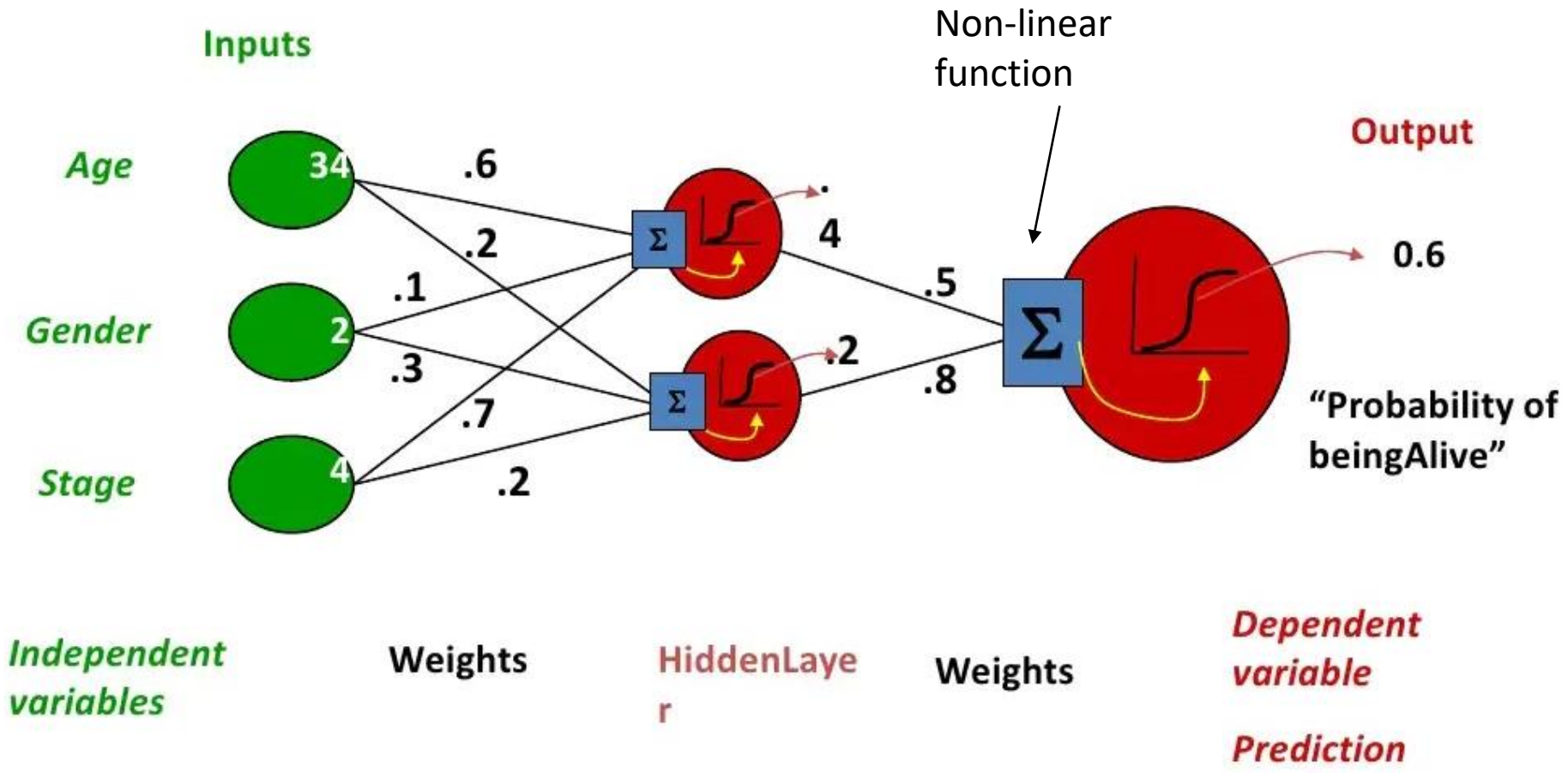
Deep learning – Neural network



Neural network



DNN

Some famous architechtures:

Computer vision:

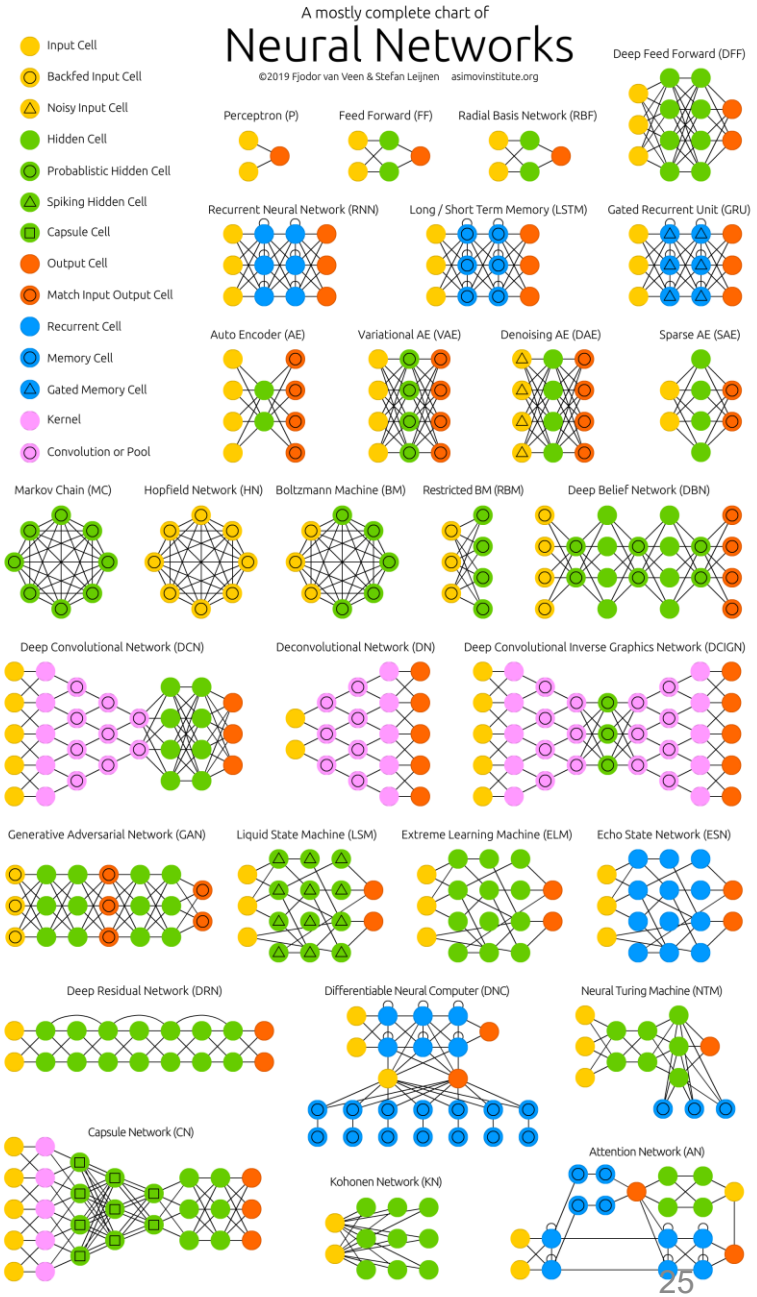
- Alexnet
- Resnet
- CNN

Natural language processing:

- GRU
- RNN
- LSTM

Generating task:

- Auto-encoder
- VAE
- GAN: WGAN, CycleGAN, Pix2Pix



Other learning task

Supervised learning

Unsupervised learning

Transfer learning

Online learning

Federated learning

…

Software

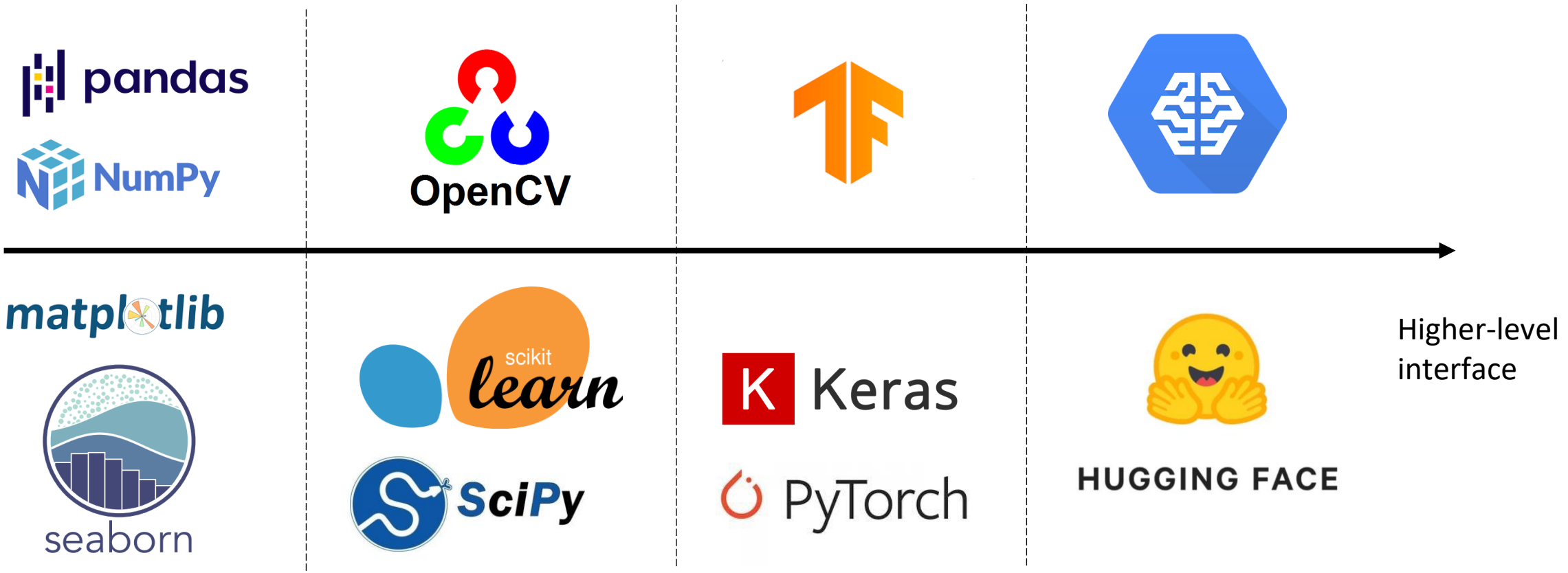
Framework (Python):

- Tensorflow, Keras
- Pytorch

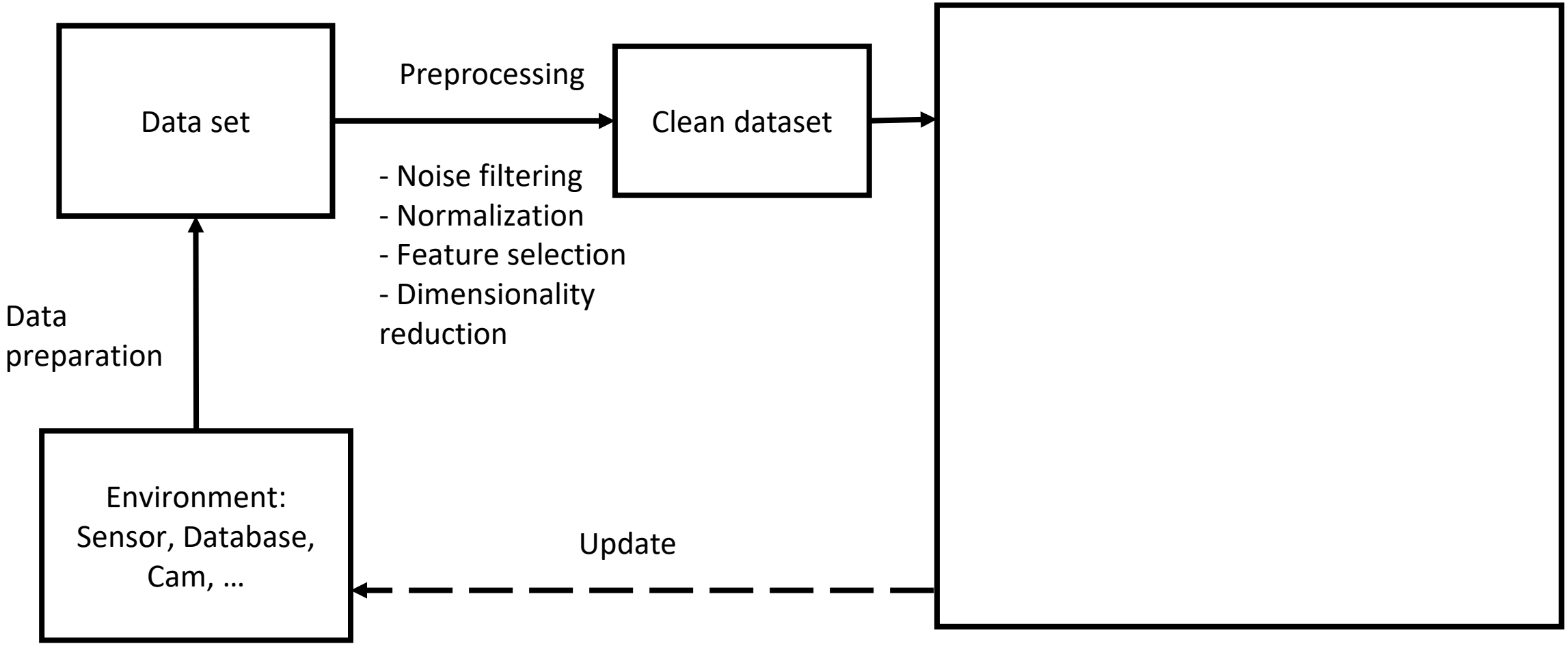
Computational services:

- Google Colab
- MS Azure
- AWS

Software


pandas
NumPy
OpenCV
matplotlib
seaborn
scikit learn
SciPy
Keras
PyTorch
HUGGING FACE
Higher-level interface
Python package
Python library
Python framework
ML API

What we need to do?



Thanks for listening

Q&A