



Universidad
Francisco de Vitoria
UFV Madrid

Introduction

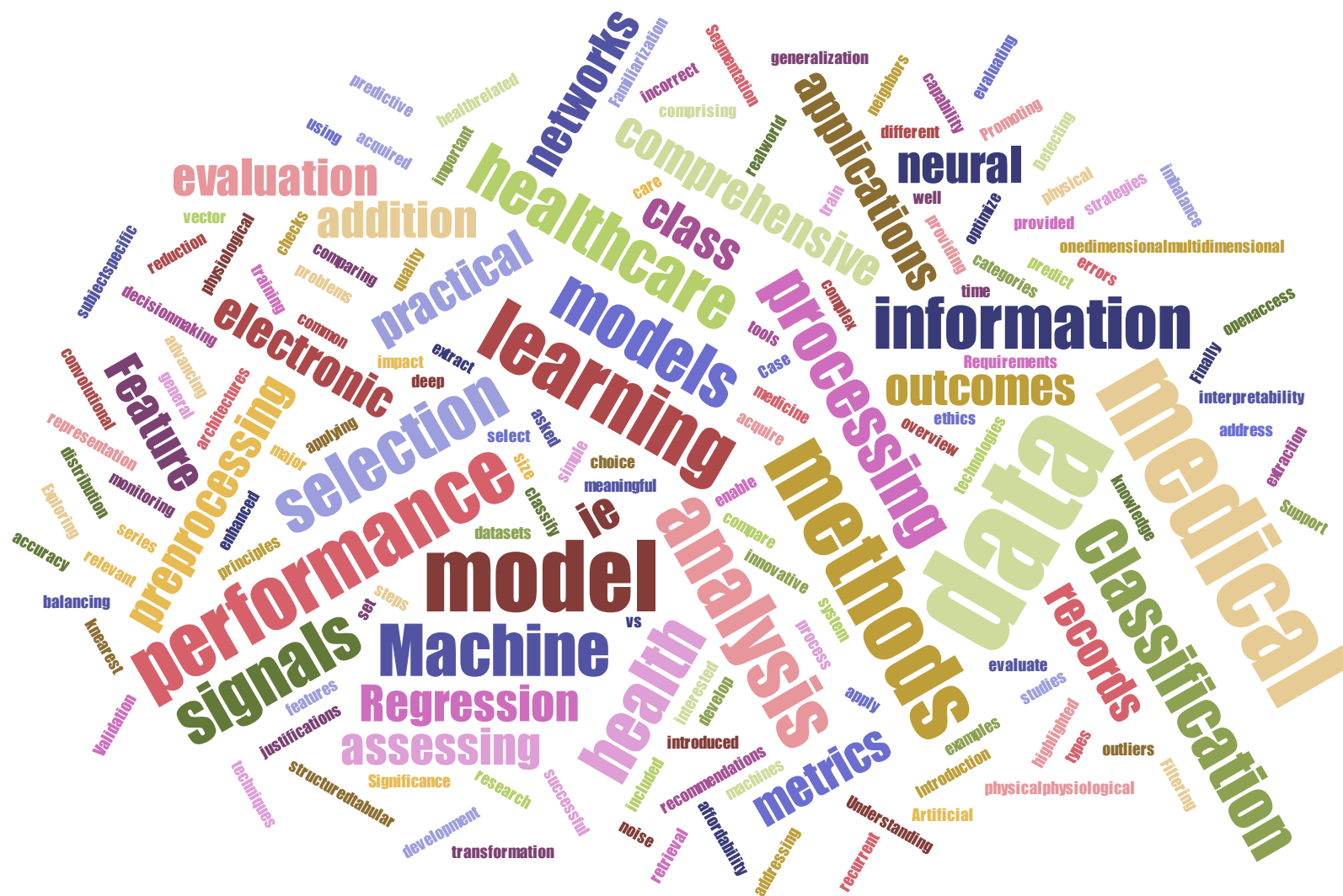


**Politecnico
di Torino**

Luigi Borzì



Overview

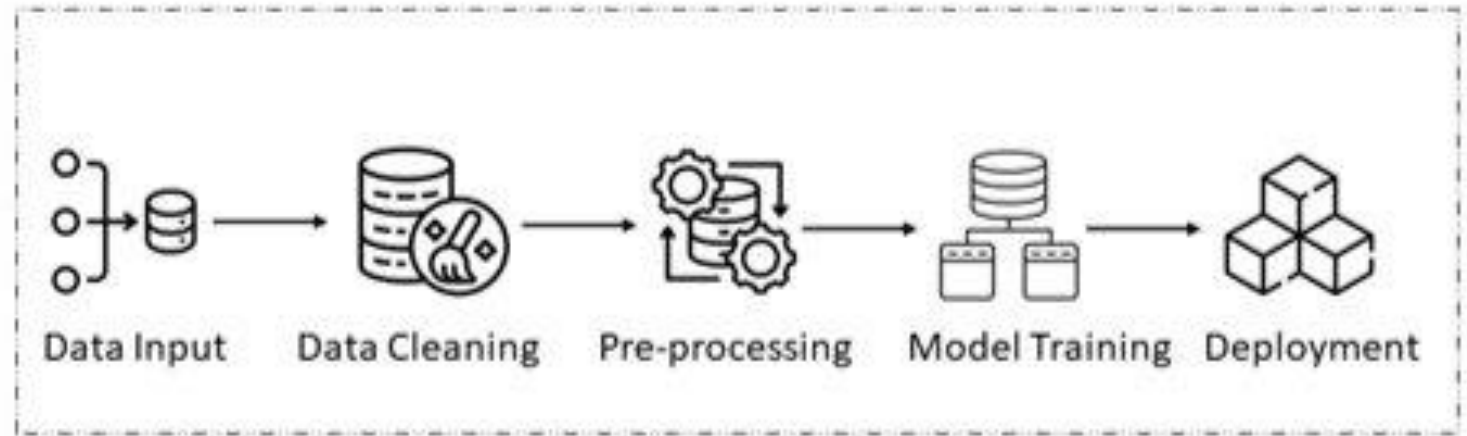


Overview

Data

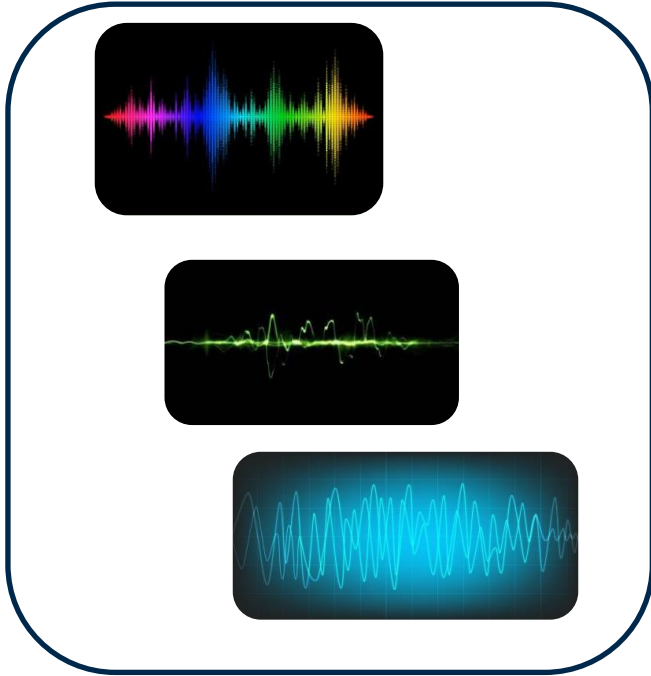


Data processing

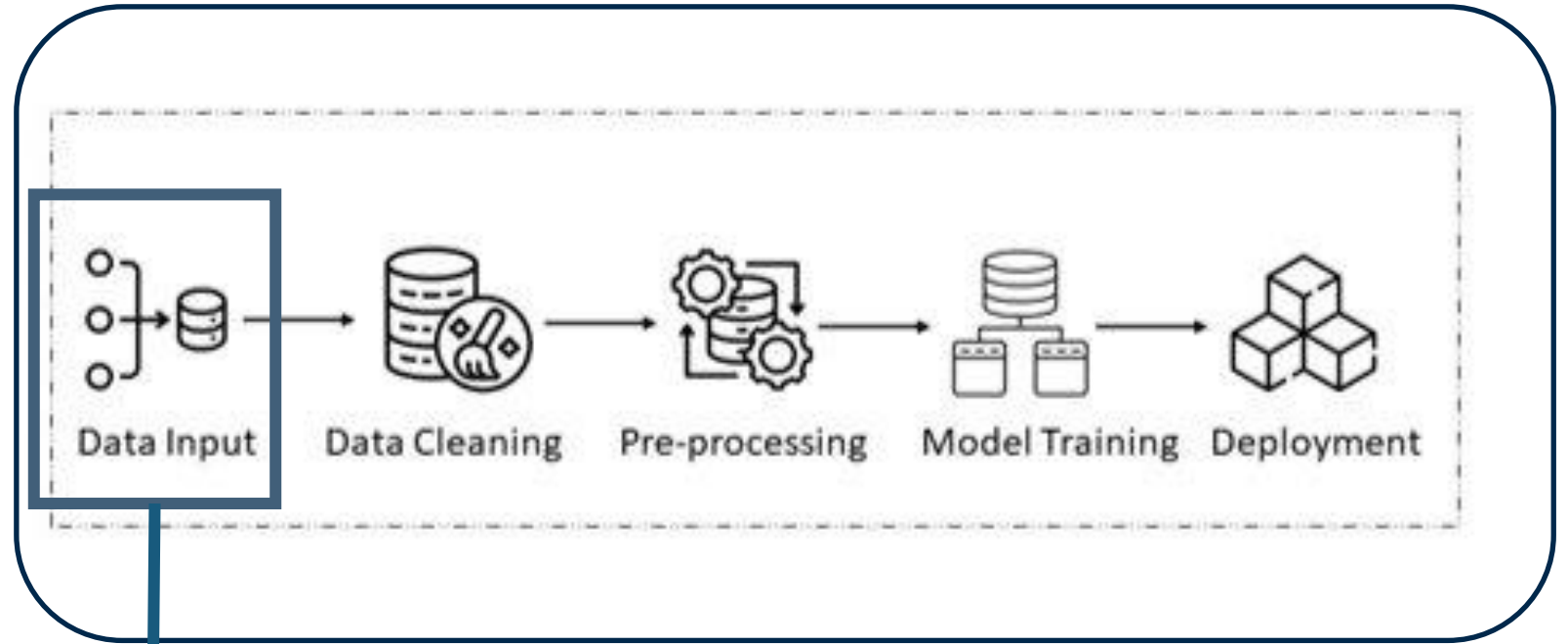


Overview

Data



Data processing



Data visualization and exploration

Data visualization and exploration

Data visualization
and exploration

The importance of data visualization

Line plot

Bar chart

Pie chart

Histogram

Scatter plot

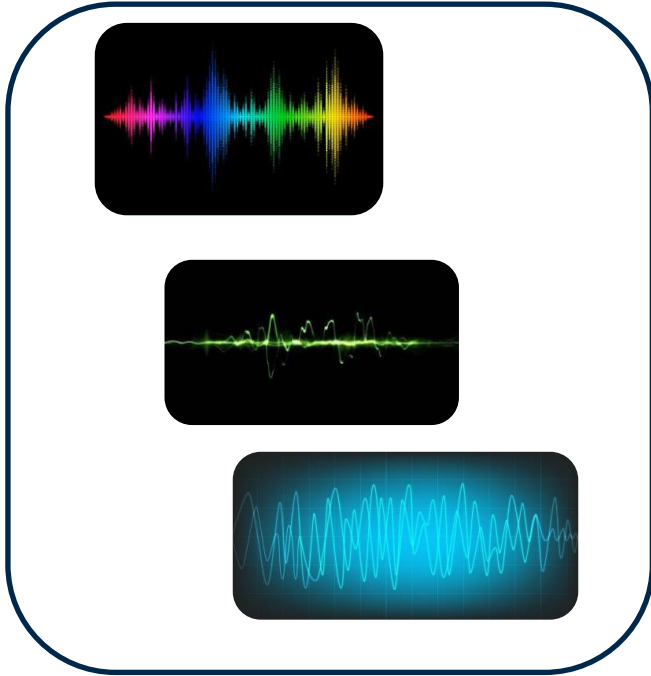
Heat map

Spider plot

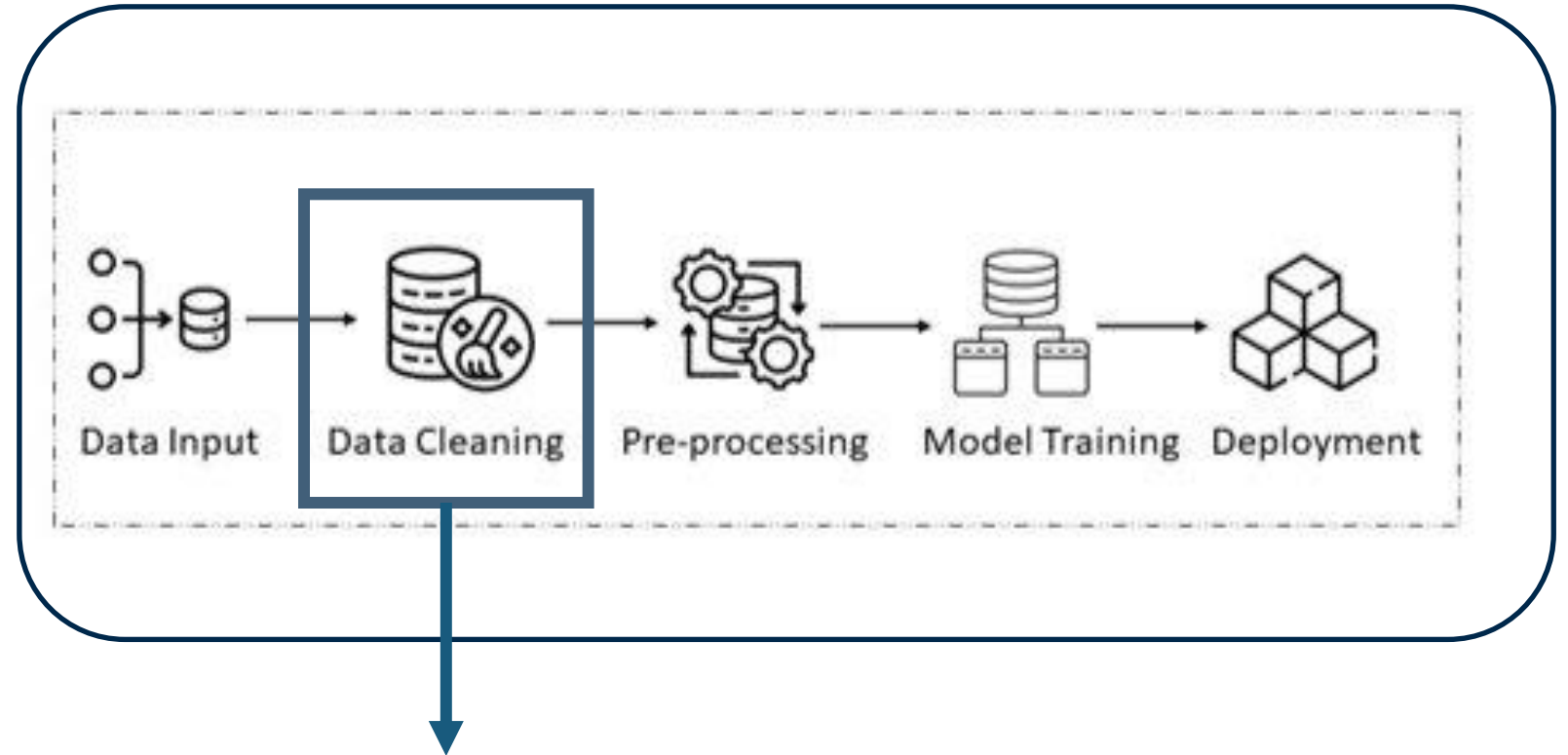
Correlation plot

Overview

Data



Data processing



Missing values and Outliers

Missing values and outliers

Missing values and Outliers

What are missing values and outliers?

Why it is important to manage them?

Detect missing values

Imputation strategies

Recognize outliers

Handle outliers

Verify data consistency

Practical examples

Who is me?

Luigi Borzì, PhD
Assistant professor

Department of Control and Computer engineering



Topics

Signal processing

Artificial intelligence

Wearable technology

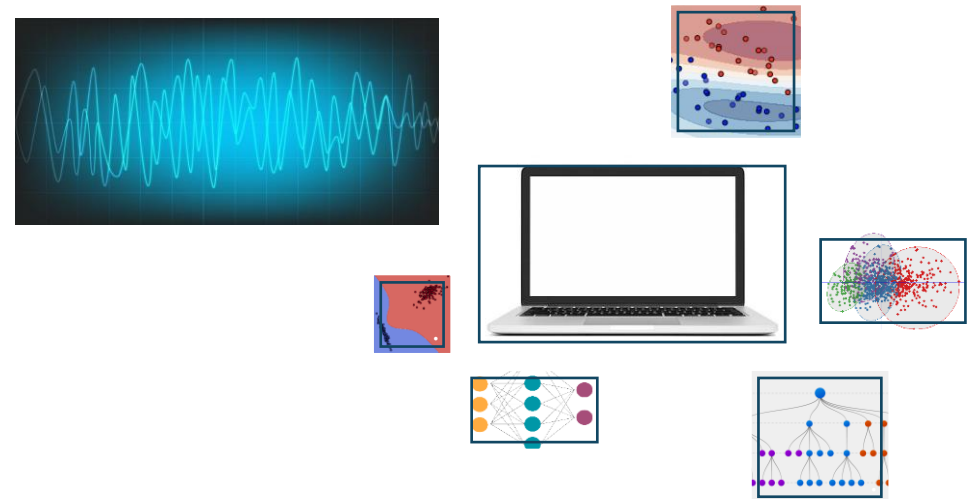
What I do?

Technologies for health monitoring

Wearable sensors and cameras



Signal processing / Artificial intelligence



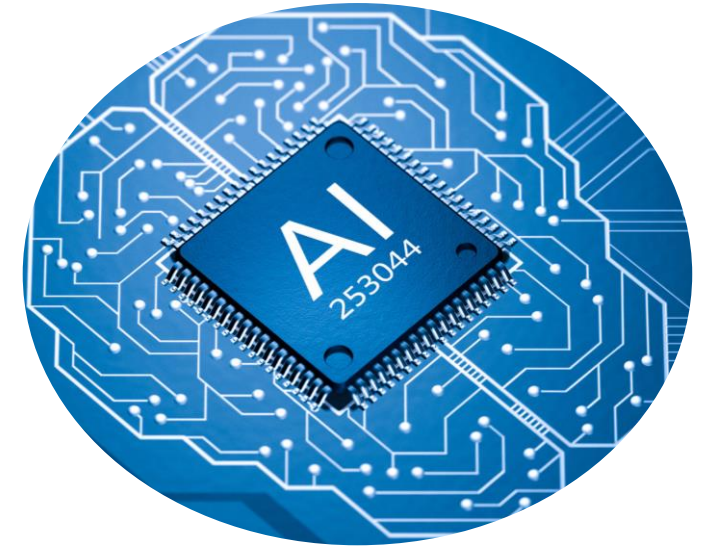
Artificial intelligence

Big amount of high-dimensional multi-modal data



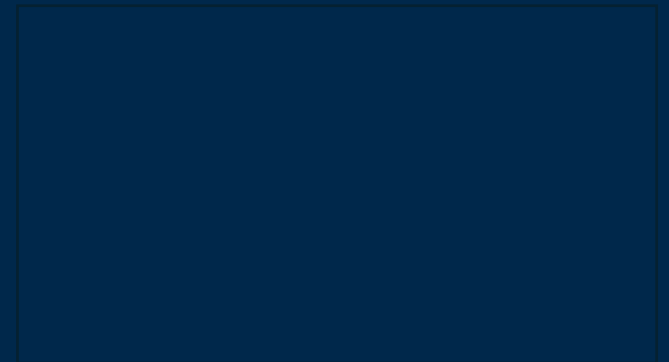
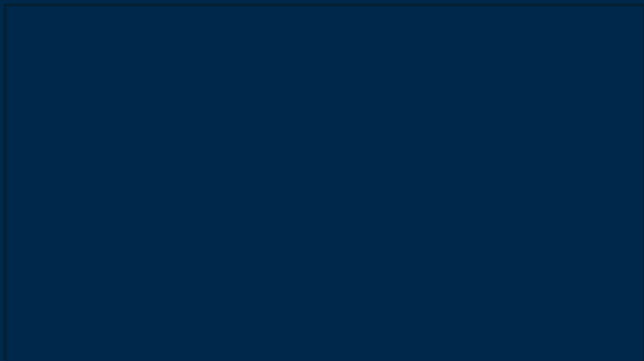
Artificial intelligence

- Speed up data analysis
- Extract meaningful info
- Anomaly detection
- Find hidden patterns
- Monitor changes
- Predict changes



A decorative laurel wreath, composed of stylized leaves, curves vertically along the left side of the slide.

1. Research activities



Collaborations



Main activities

Data collection, signal processing and artificial intelligence

Applications:

- Sleep monitoring
- Speech analysis
- Movement analysis
- Rehabilitation
- Stress and emotion recognition

Sleep monitoring

EEG



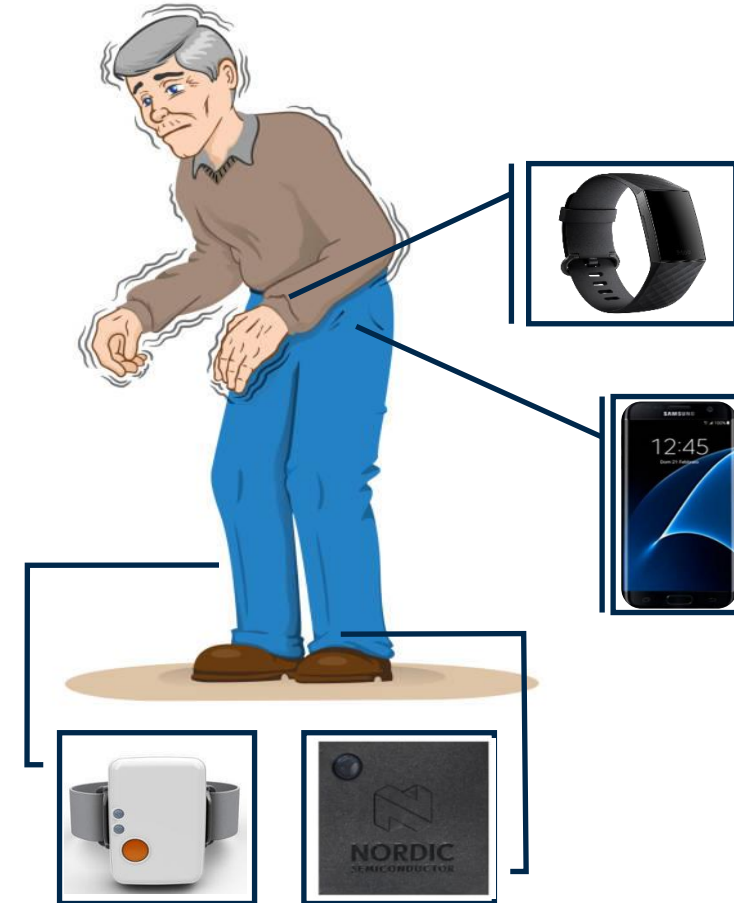
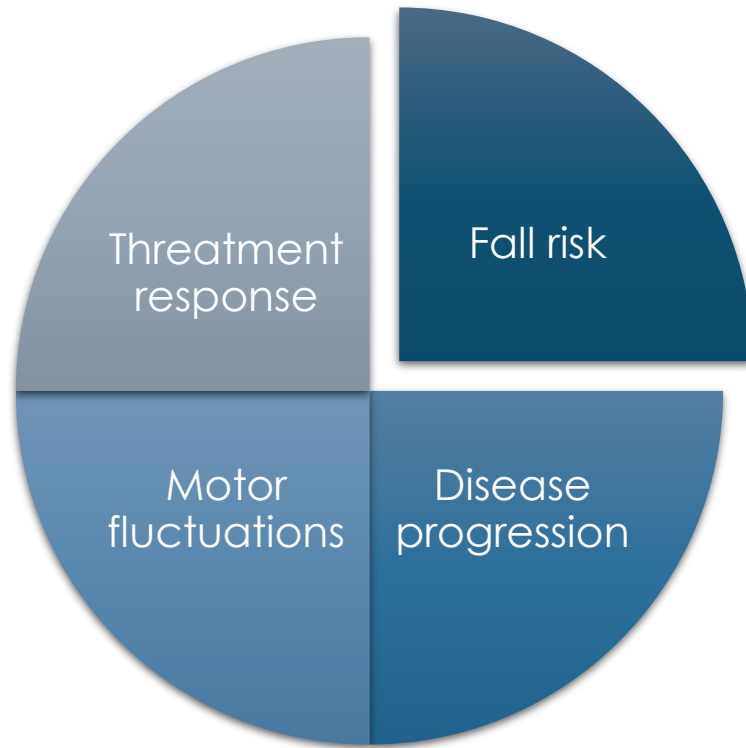
ECG



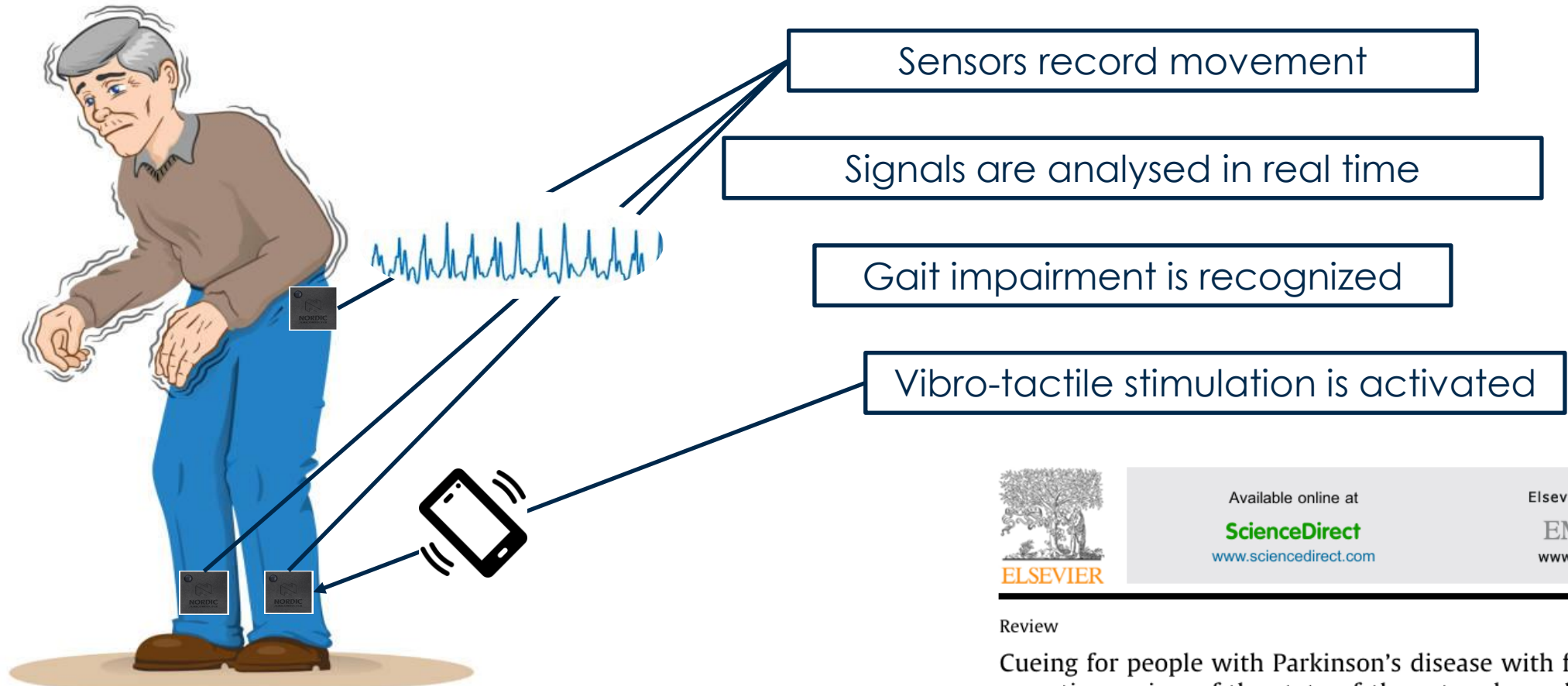
Movimento



Movement analysis in Parkinson's disease



Movement analysis in Parkinson's disease



Available online at
ScienceDirect
www.sciencedirect.com

Elsevier Masson France
EM|consulte
www.em-consulte.com

Review

Cueing for people with Parkinson's disease with freezing of gait: A narrative review of the state-of-the-art and novel perspectives

Pieter Ginis*, Evelien Nackaerts, Alice Nieuwboer, Elke Heremans

KU Leuven, Department of Rehabilitation Sciences, Neuromotor Rehabilitation Research Group, Tervuursevest 101 box 1501, 3000 Leuven, Belgium

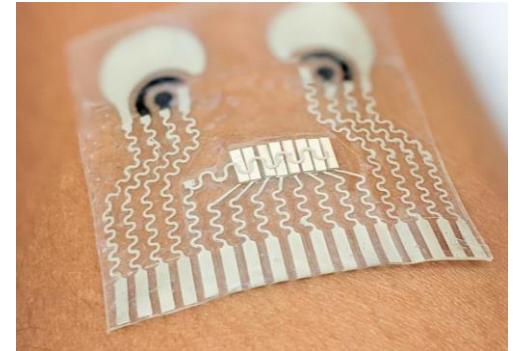
Swallowing



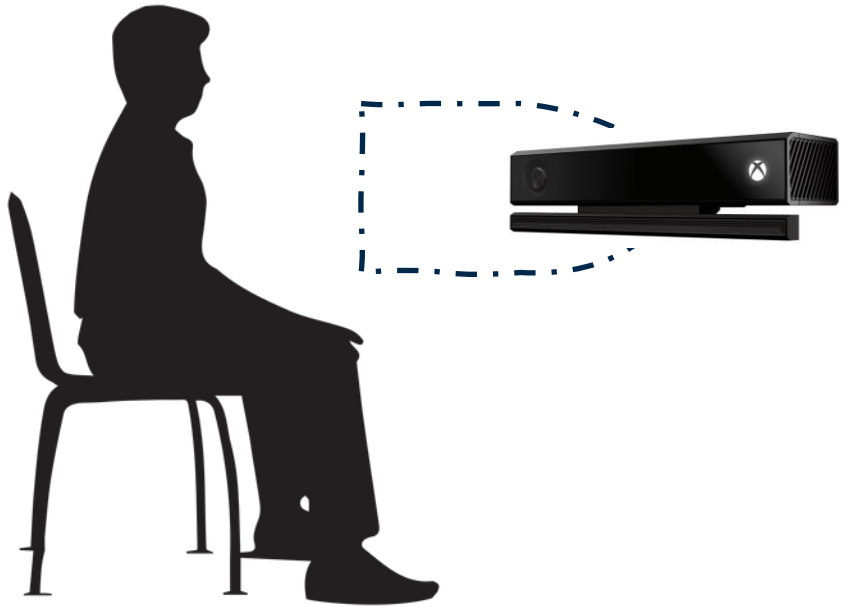
Movement



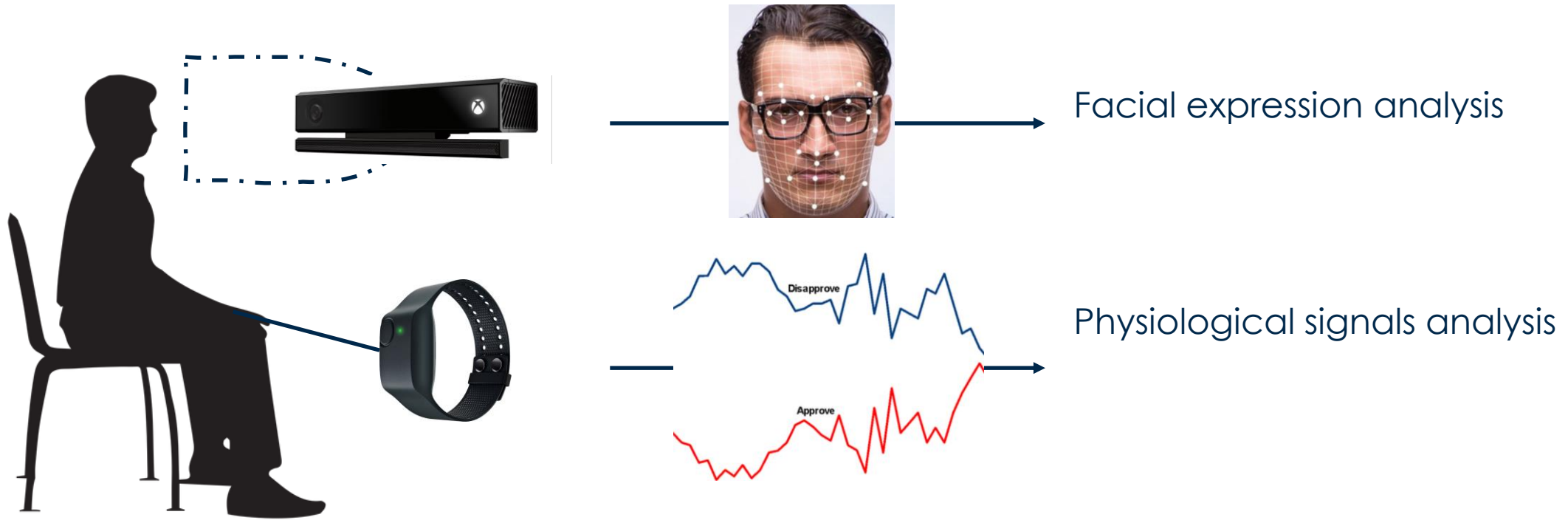
Muscle activity



Rehabilitation



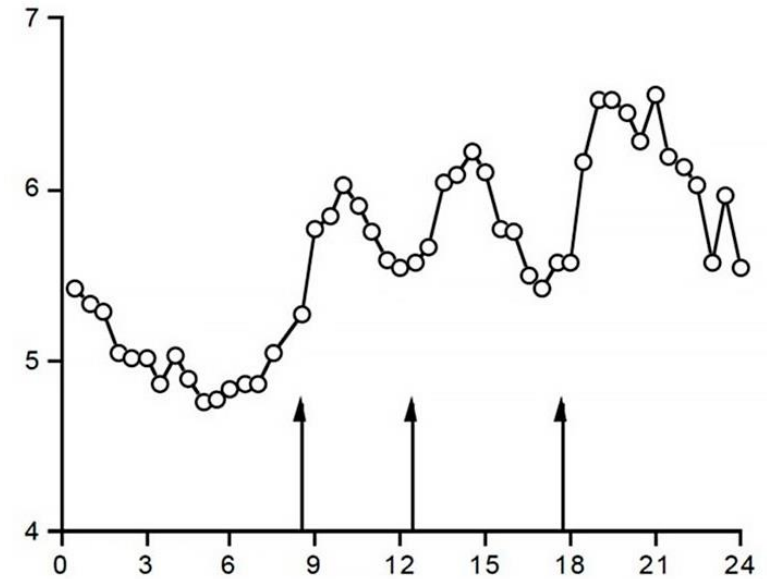
Stress and emotions



Home monitoring

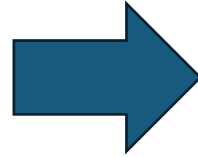
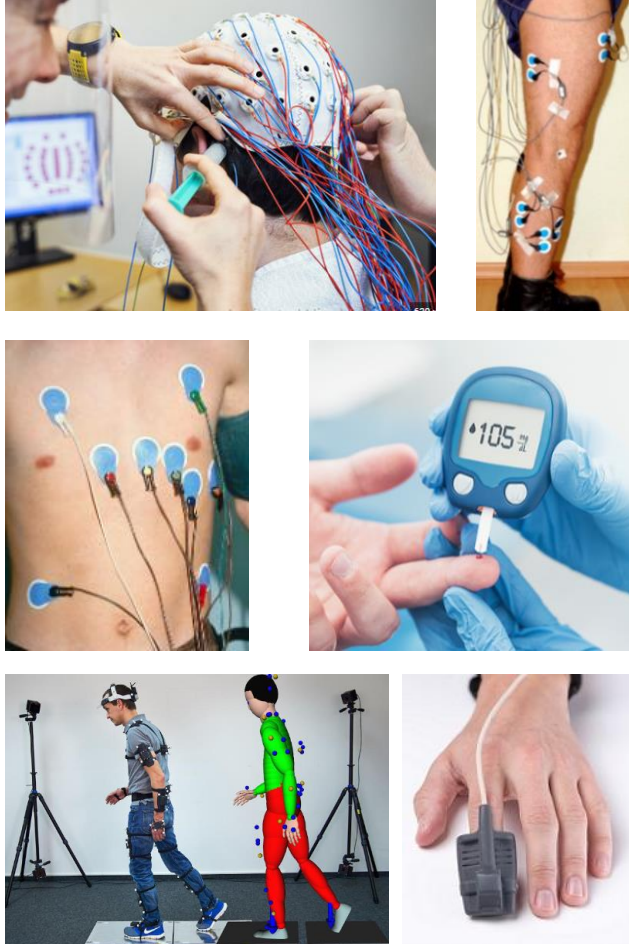


- Medical device(class IIa)
- Battery life: 7 days
- Recording : 8h/day



Data

Continuous, non-invasive data collection



- Heart rate
- Respiration
- Oxygen saturation
- Movement
- Pressure
- Voice
- Temperature
- Location
- Sweating

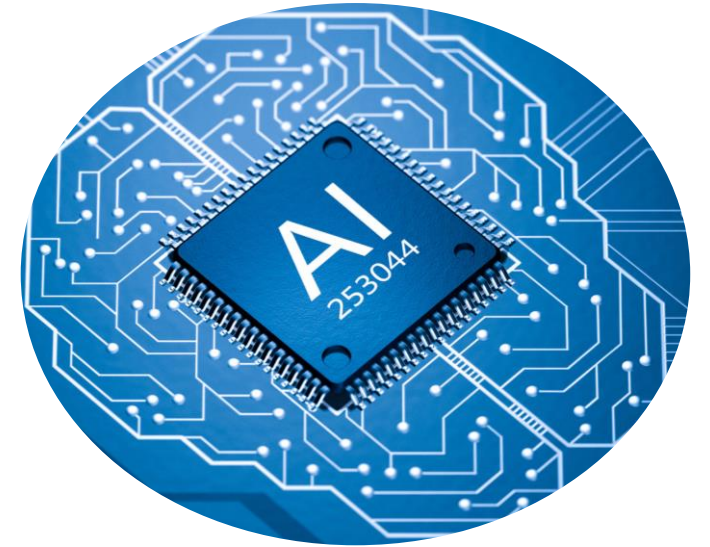
Artificial intelligence

A huge quantity of data is collected!

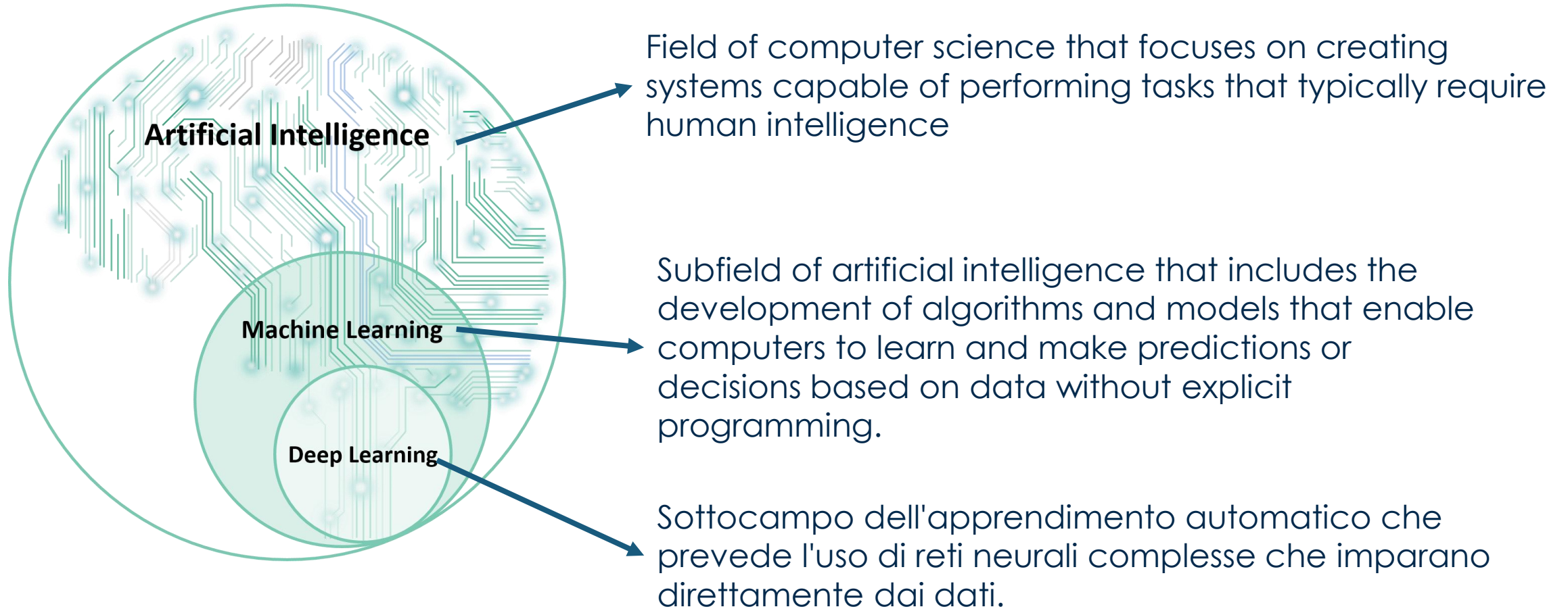


Artificial intelligence

- Speed up analysis
- Information extraction
- Anomaly detection
- Find hidden patterns
- Monitor changes over time
- Predict complications



Artificial intelligence



Artificial intelligence

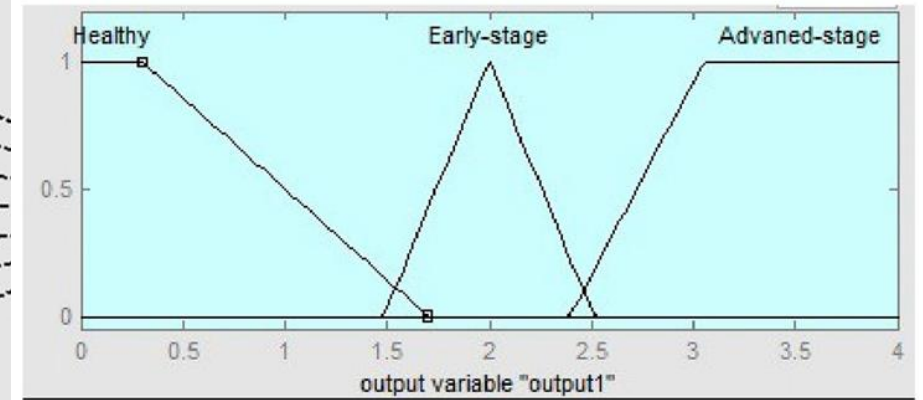
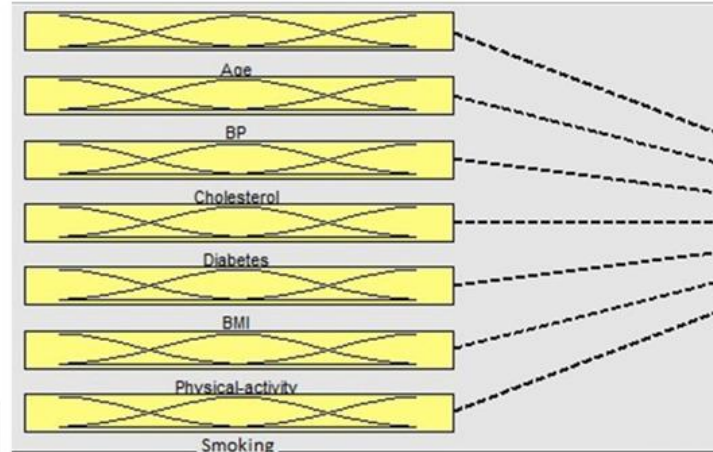
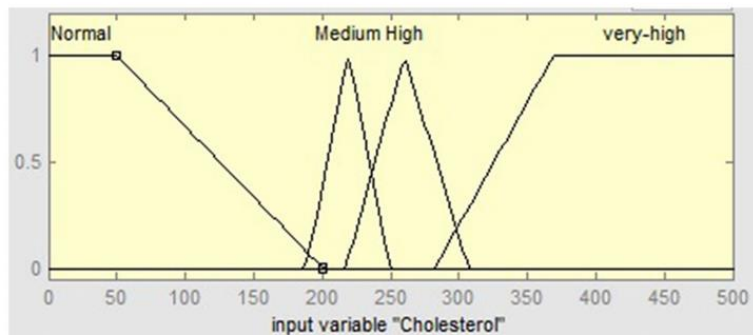
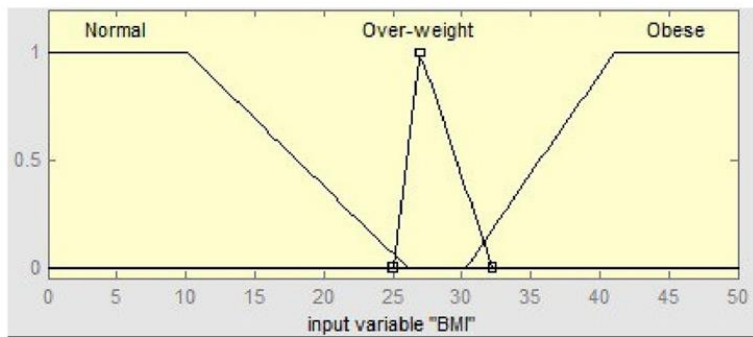
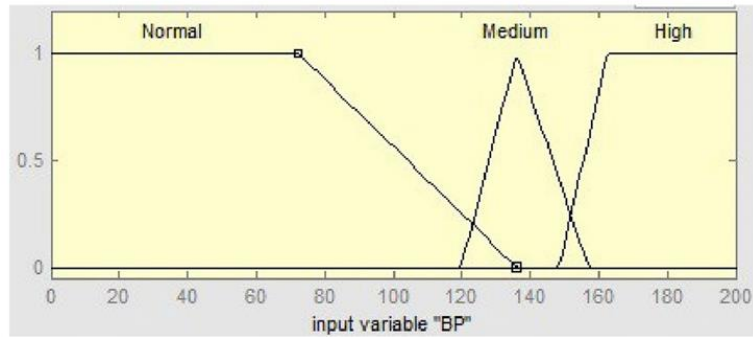
Subject	Age (years)	Gender	Blood pressure (mmHg)	Heart rate(bpm)	Glucose level(mg/dL)
1	45	Male	120	72	90
2	35	Female	110	65	95
3	50	Male	130	80	105
4	28	Female	115	68	88
5	50	Male	130	85	120
6	32	Female	118	70	98
7	55	Male	135	85	95
8	40	Female	112	60	92
9	48	Male	125	75	102
10	38	Female	120	70	100
...					
...					
N	40	Female	112	60	95

IF $60 < \text{heart rate} < 90$ AND $\text{blood pressure} < 120$ AND $\text{glucose level} < 100 \rightarrow$ THEN condition: normal

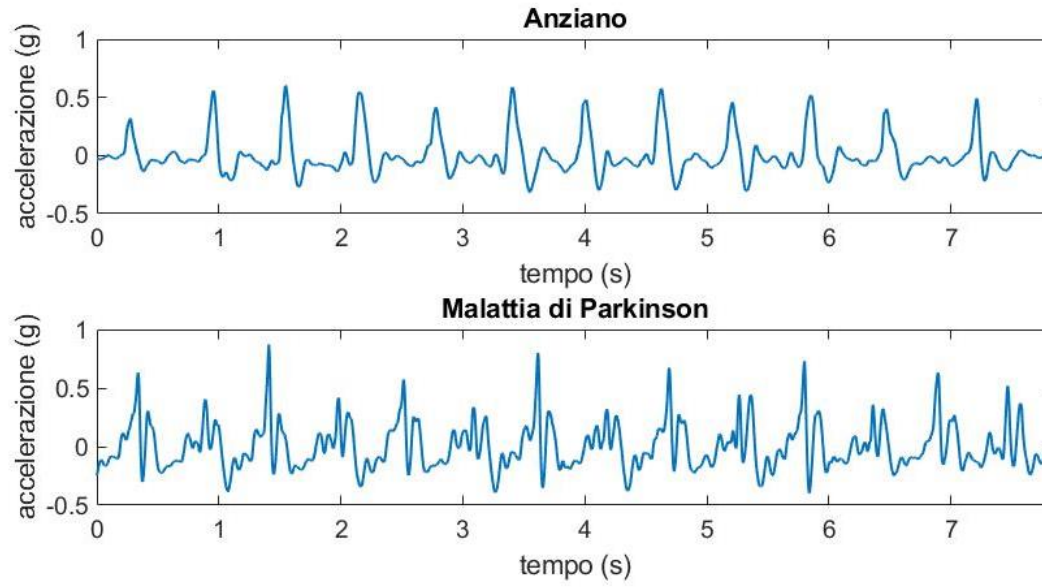
IF $90 < \text{heart rate} < 120$ AND $120 < \text{blood pressure} < 140$ AND $100 < \text{glucose level} < 125 \rightarrow$ THEN condition: at risk

If $\text{heart rate} = 0 \rightarrow$ THEN condition: dead

Artificial intelligence

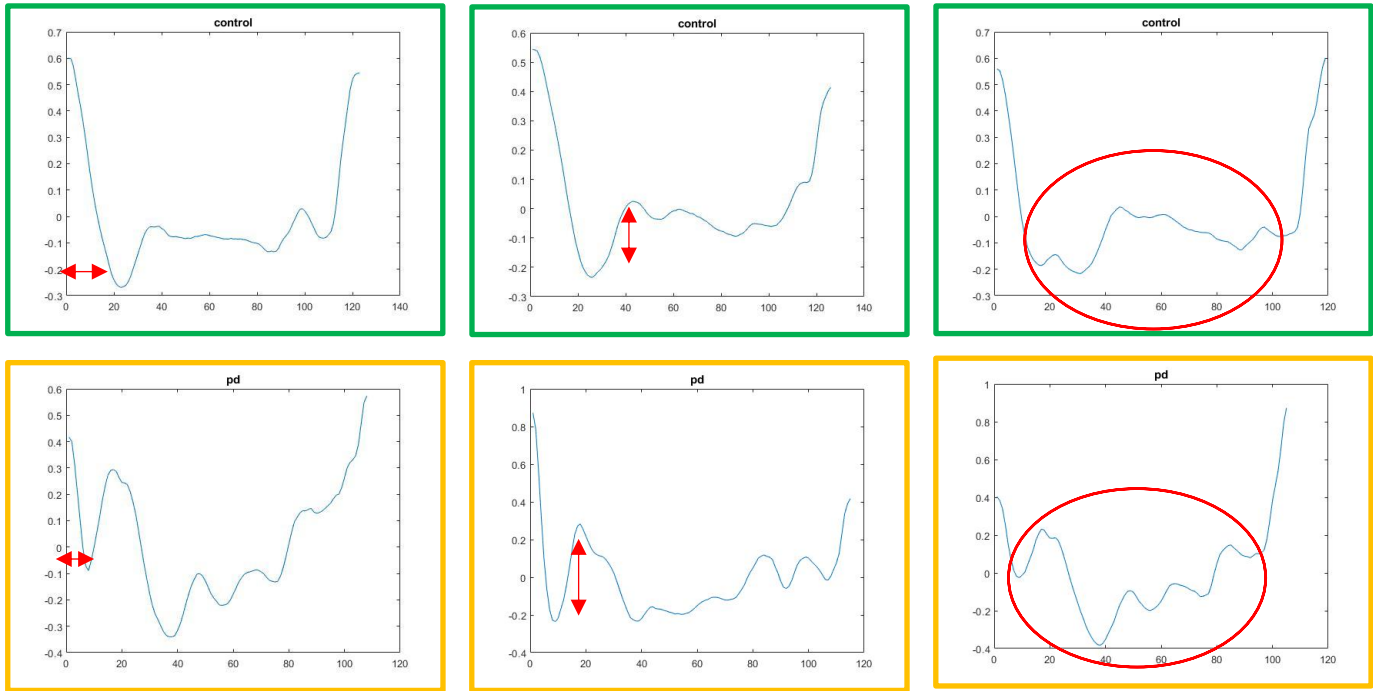


Machine learning



Machine learning

Control

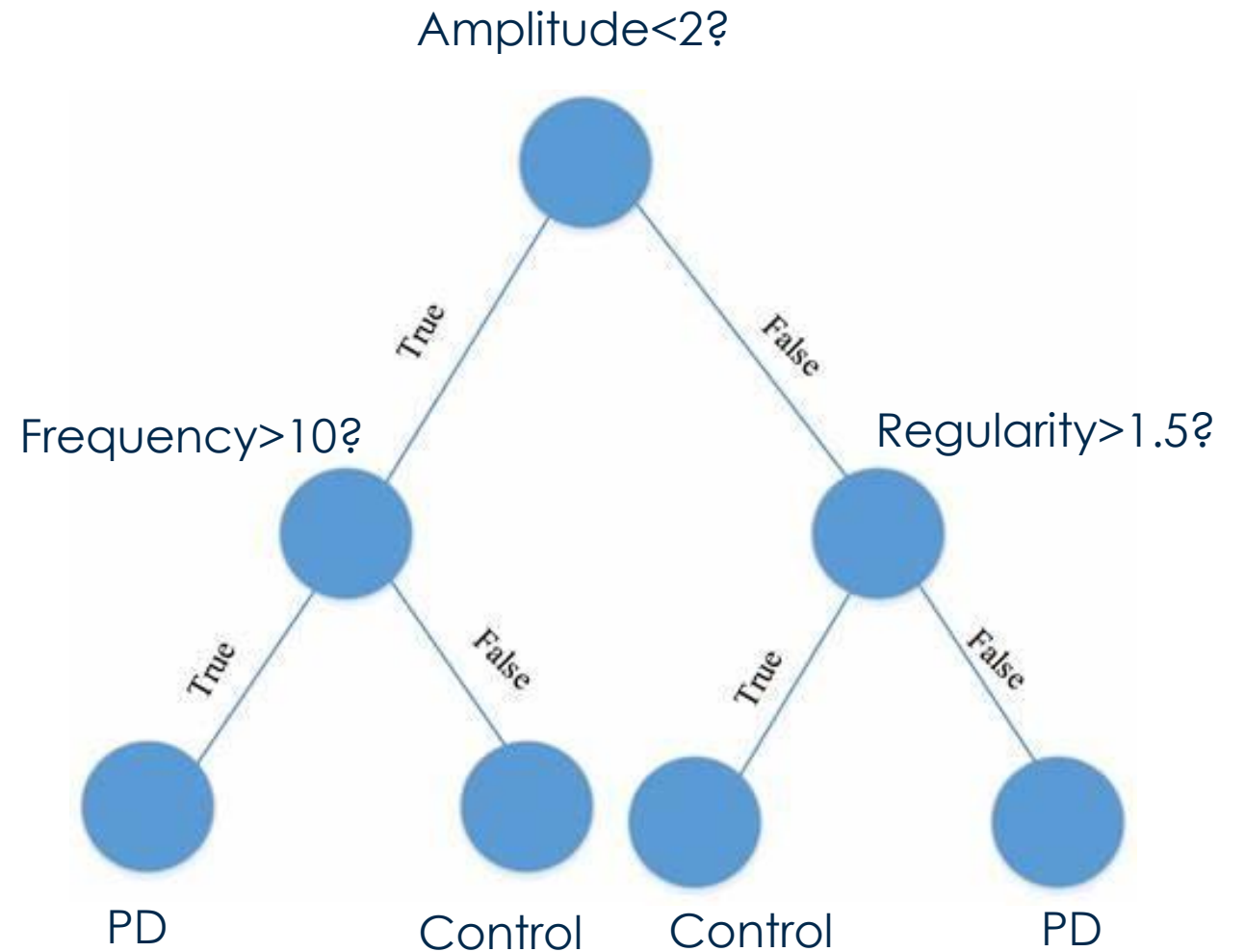
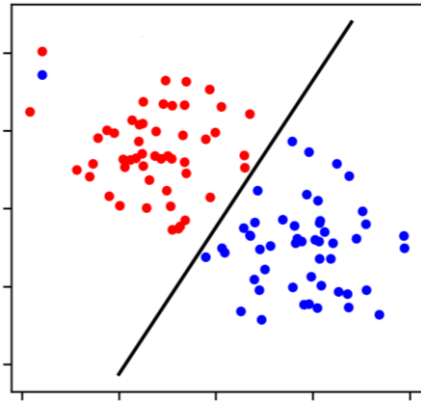


PD

Amplitude	Frequency	Regularity	Symmetry	Class
1.5	12	2.5	0.8	PD
1.8	8	2.1	0.9	Control
1.6	6	1.8	1.2	Control
1.2	15	1.5	1.1	PD
2.5	12	1.4	0.7	PD
3.2	11	1.6	1.35	Control
2.8	8	1.2	0.75	PD

Machine learning

Amplitude	Frequency	Regularity	Symmetry	Class
1.5	12	2.5	0.8	PD
1.8	8	2.1	0.9	Control
1.6	6	1.8	1.2	Control
1.2	15	1.5	1.1	PD
2.5	12	1.4	0.7	PD
3.2	11	1.6	1.35	Control
2.8	8	1.2	0.75	PD



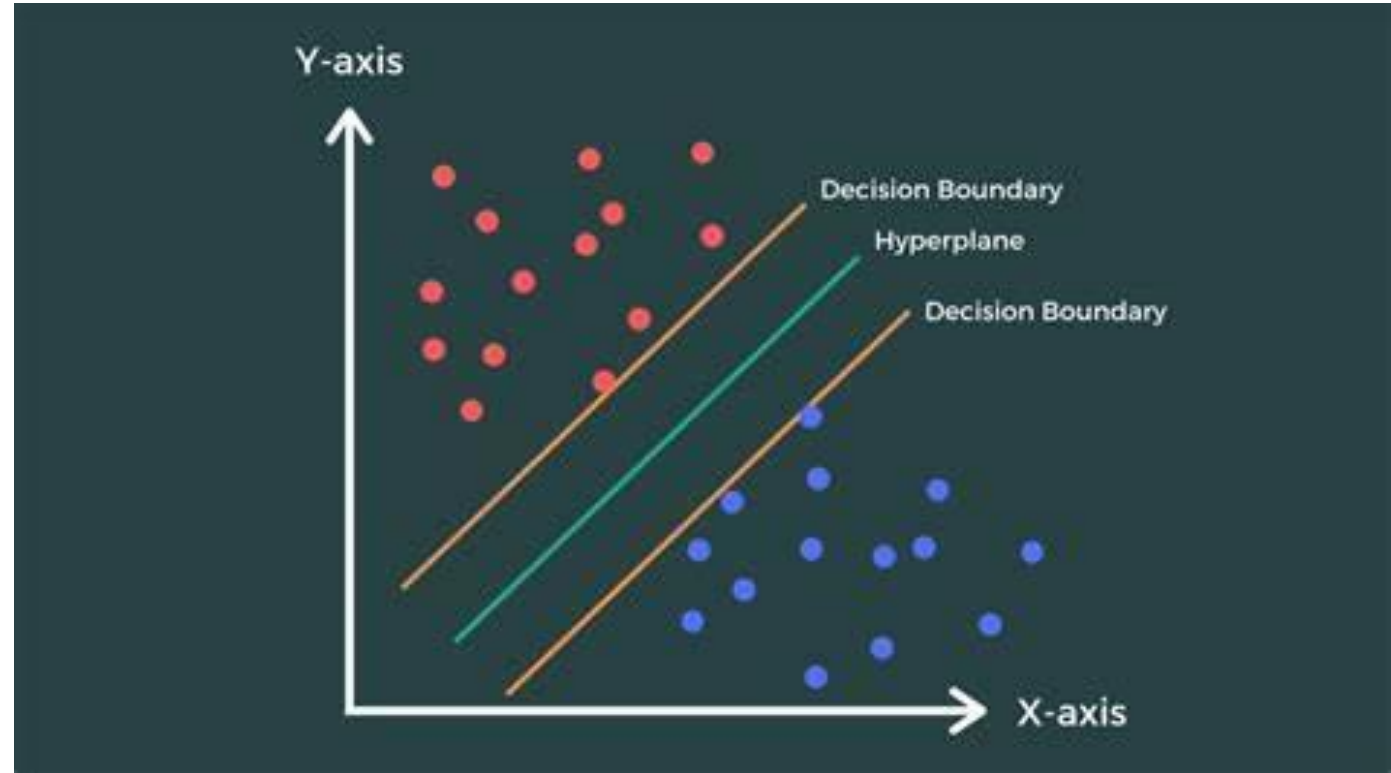
Machine learning

The decision tree is the simplest machine learning model.

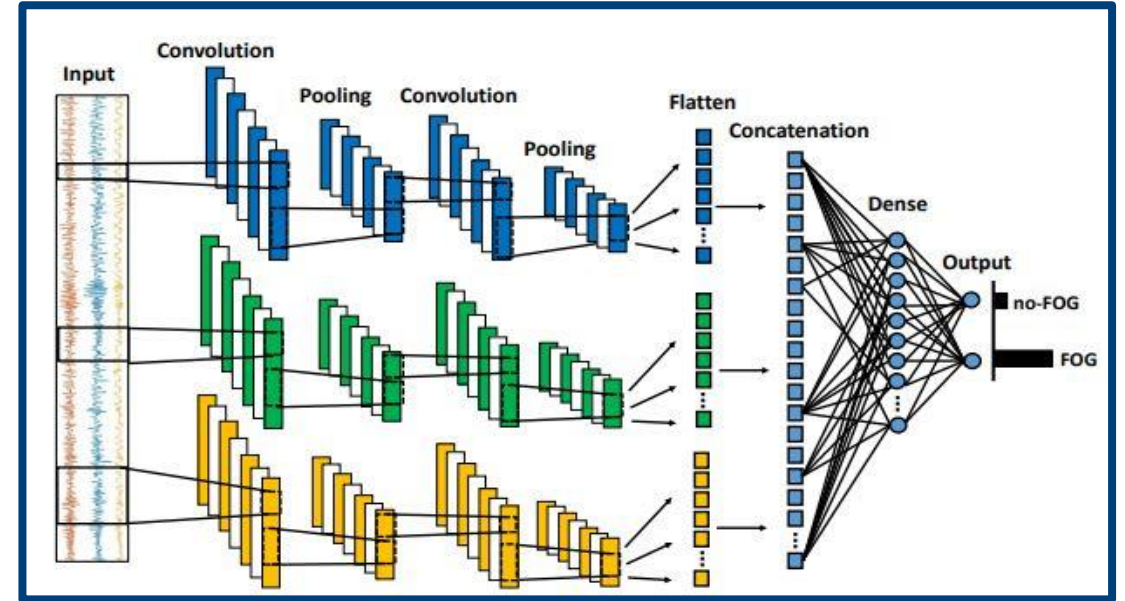
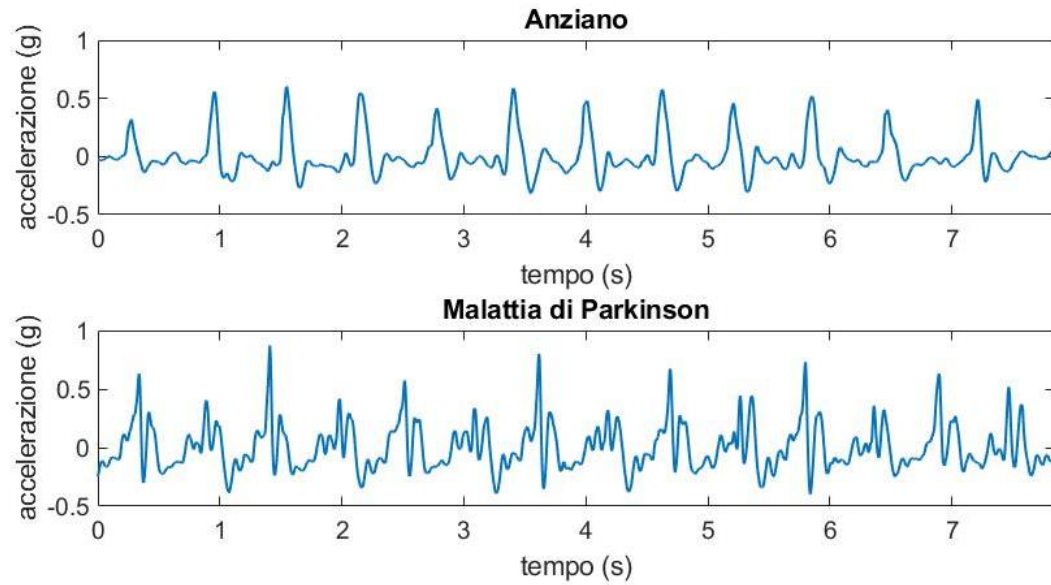
It is fast, easy to visualize and thus interpretable.

However, it is not the most convincing.

Usually, instead of choosing sharp thresholds, it is preferred to maximize the separation between classes.



Deep learning



A decorative laurel wreath, composed of several stylized leaves, curves vertically along the left side of the slide.

2. *Examples*

