

Data Analysis and Pattern Recognition (E900540)

Course size *(nominal values; actual values may depend on programme)*

Credits 6.0

Study time 180 h

Course offerings in academic year 2023-2024

A (semester 1)

English

Gent

Lecturers in academic year 2023-2024

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BARCELO3 lecturer-in-charge

Offered in the following programmes in 2023-2024

[International Master of Science in Fire Safety Engineering](#)

crdts

6

offering

A

Teaching languages

English

Keywords

Machine learning, Neural networks, deep learning

Position of the course

During this course, the students learn how to apply techniques of pattern recognition, artificial intelligence and statistical data analysis that allow decisions to be made objectively, quantitatively and reproducibly in problems of a multidisciplinary nature.

Contents

- 1 Exploratory data analysis
 - Data visualization (histograms, box-plot, qq-plot, multi-dimensional scatter plots, etc)
 - Data clustering (k-means, agglomerative, Gaussian Mixture Models)
 - Dimensionality reduction and Principal Component Analysis
 - Data representation and feature extraction
 - Data metrics, distances, norms, etc.)
- 2 Supervised Machine learning
 - Introduction to Classification/Regression problems
 - Distance-based methods: kNN & Centroids algorithm
 - Probabilistic methods: Naïve Bayes & LDA
 - Rule-based methods: Decision Trees & AdaBoost
 - Hyperplane-based methods: kernels & SVM
- 3 Performance evaluation
 - Type I and type II errors
 - Univariate and multivariate hypothesis testing approaches
 - Statistical inference and parameter estimation (Maximum-likelihood, Bayesian, bootstrapping)
 - Validation procedures: cross-validation; leave-one-out, etc.)
- 4 Neural networks and deep learning
 - Introduction to artificial neural networks (ANNs) and deep learning
 - Feed-forward ANNs for classification and regression
 - Training ANNs: backpropagation algorithm, optimization stages, advanced strategies (network complexity, early stopping, dropout, weight regularization)
 - Specialized architectures: recurrent neural networks, autoencoders, generative adversarial networks, convolutional neural networks
- 5 Advanced topics and Applications
 - Seminars by experts, application projects, analysis of publications, news and

trending topics.

Initial competences

Programming, basic statistics

Final competences

- 1 Appreciate the role and importance of fire safety engineering in the design of modern infrastructures
- 2 Describe the range of approaches adopted, with an awareness of distinctions and limitations
- 3 Justify fire design specifications with reference to appropriate codes and standards, with appropriate consideration of information that may be incomplete or uncertain
- 4 Undertake design calculations of fundamental aspects of fire systems and infrastructures

Conditions for credit contract

This course unit cannot be taken via a credit contract

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Group work, Seminar, Lecture, Practical, Independent work

Extra information on the teaching methods

The methodology of the course combines theory lessons, laboratory sessions and autonomous learning through the development of projects and the analysis of real applications.

Learning materials and price

All material needed can be found digitally on the course web (for free)

References

- Bishop, Christopher M. Pattern recognition and machine learning. New York: Springer, cop. 2006. ISBN 9780387310732.
- Duda, Richard O; Hart, Peter E; Stork, David G. Pattern classification. 2nd ed. New York [etc.]: John Wiley & Sons, cop. 2001. ISBN 0471056693.

Course content-related study coaching

Assessment moments

end-of-term and continuous assessment

Examination methods in case of periodic assessment during the first examination period

Written assessment with multiple-choice questions, Written assessment with open-ended questions, Written assessment

Examination methods in case of periodic assessment during the second examination period

Written assessment with multiple-choice questions, Written assessment with open-ended questions, Written assessment

Examination methods in case of permanent assessment

Assignment

Possibilities of retake in case of permanent assessment

examination during the second examination period is not possible

Extra information on the examination methods

The examination of the course consists of three parts: A written mid-term exam, a written final exam and the continuous assessment.

Calculation of the examination mark

30% mid-term exam, 30% final exam, 40% continuous assessment

Facilities for Working Students

There are no special facilities for working students