

Data Analysis, Optimization and Decision Making

Code: 44733
ECTS Credits: 6

Degree	Type	Year	Semester
4318303 Research and Innovation in Computer Based Science and Engineering	OT	0	1

Contact

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Teaching groups languages

You can check it through this [link](#). To consult the language you will need to enter the CODE of the subject. Please note that this information is provisional until 30 November 2023.

Teachers

Antoni Morell Perez

Jose Lopez Vicario

Carles Pedret Ferré

Carlos Sanchez Ramos

Prerequisites

N/A

Objectives and Contextualisation

The main objective of this subject is for the student to be able to understand what is the best possible strategy to optimize the treatment of the data to be analyzed. To do this, different techniques will be presented to process the input data (Time Series Analysis, coding in SVM or Random Forest or, in terms of text processing, techniques such as the Bag of Words or LDA). In a more advanced way, the use of techniques such as genetic algorithms or neural networks will be explored. In the optimization part, linear and non-linear methods will be studied, in addition to covering multi-objective optimization methodologies. Finally, advanced decision-making concepts will be introduced, touching on aspects such as the introduction of risk and uncertainty associated with the information to be analyzed.

Learning Outcomes

- CA10 (Competence) Design the correct data processing strategy to obtain the expected result.

- CA11 (Competence) Propose a robust decision-making system that considers the associated risk and uncertainty given the available information.
- KA14 (Knowledge) Describe the most appropriate data representation techniques for solving a specific problem.
- KA15 (Knowledge) Identify appropriate optimisation and decision-making strategies in order to comply with the restrictions of the problem at hand, and obtain optimum algorithm performance.
- SA18 (Skill) Apply the most appropriate data manipulation and representation techniques to the problem at hand.
- SA19 (Skill) Critically apply optimisation methods to decision-making processes for scientific and engineering problems.
- SA20 (Skill) Formulate decision-making problems so that they can be tackled using numerical methods and offer solutions that incorporate considerations related to risk and uncertainty.

Content

Exploratory data analysis

- Introduction to Data Processing. Main application areas and problems
- Data representation, feature extraction.
- Data structure exploration, visualization and clustering
- Dimensionality reduction and feature selection.
- Supervised Methods for Data Analysis: SVM, regression.
- Validation. Metrics, analysis of bias in models, statistical tools, trustworthiness

Optimization

- linear programming
- Non-linear optimisation
- Duality, multipliers, dynamic programming
- modelling and optimisation software

multi-objective optimisation

- Multicriteria decision making
- Methods
- Multicriteria, preferences
- Uncertainty and risk

Advanced topics and applications

Methodology

This subject has a marked engineer character. Theory: it is rather a methodology, therefore trying to promote methodological application instead of theoretical developments. At the end of the subject, assignments/projects will be presented for evaluation.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities



Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Face-to-face classroom	30	1.2	CA10, CA11, KA14, KA15, SA18, SA19, SA20, CA10
Type: Supervised			
Supervised Activity	15	0.6	CA10, CA11, KA14, KA15, SA18, SA19, SA20, CA10
Type: Autonomous			
Autonomous activity	90	3.6	CA10, CA11, KA14, KA15, SA18, SA19, SA20, CA10

Assessment

This subject is assessed on the basis of a work/project: in which you will have to deal with a problem based on the elements seen during the subject. A report must be presented and a presentation made.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Project and exercises	100	15	0.6	CA10, CA11, KA14, KA15, SA18, SA19, SA20

Bibliography

Reference material and sources will be provided in each section

Software

MATLAB