COURSE DATA

DATA SUBJECT

Code: 36416
Name: Optimisation
Cycle: Undergraduate Studies
ECTS Credits: 6
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
1406 - Degree in Data Science	Escola Tècnica Superior d'Enginyeria	1	Second quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1406 - Degree in Data Science	Optimisation	COMPULSORY

COORDINATION

CORRECHER VALLS JUAN FRANCISCO

SUMMARY

36416 Optimisation is a compulsory subject of the second term of the first year of the Degree in Data Science. From the mathematical foundations developed in the subjects 36408 Algebra and 36407 Mathematical Analysis, taught in the first term, the aim of the subject is to provide students with a practical knowledge of the basic methods of optimisation that appear in the advanced procedures of data analysis that will be developed throughout the Degree.

Theory lessons will be taught in Spanish and practical and laboratory lessons as according to the information sheet available on the web page of the degree.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

OTHER REQUIREMENTS

Basic knowledge of Linear Algebra and Differential Calculus is needed.

COMPETENCES / LEARNING OUTCOMES

1406 - Degree in Data Science

(CB5) Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.

(CE01) Ability to solve the mathematical problems that can be posed in data science and be able to apply knowledge on: linear algebra, differential and integral calculus and numerical methods and optimisation.

(CE13) To know how to design, apply and evaluate data science algorithms for the resolution of complex problems.

(CG01) Knowledge of basic subjects and technologies that enable students to learn new methods and technologies, and to provide them with versatility to adapt to new situations.

(CG03) Capability to elaborate models, calculations, reports, to plan tasks and other works analogous to the specific field of data science.

(CT01) To be able to access (bibliographical) information tools and appropriately use them in the development of their daily tasks.

(CT03) Ability to defend your own work with rigor and arguments and to expose it in an adequate and accurate way with the use of the necessary means.

Students must be able to apply their knowledge to their work or vocation in a professional manner and have acquired the competences required for the preparation and defence of arguments and for problem solving in their field of study.

DESCRIPTION OF CONTENTS

1. Introduction to Optimisation

1.1. Historical and epistemological context
1.2. Objective functions
1.3. Classification of optimisation problems

2. Unconstrained Optimisation

2.1. Optimality conditions
2.2. Search methods

2.3. Gradient method
2.4. Newton's and quasi-Newton's methods
2.5. Coordinate descent methods
2.6. Least squares methods

3. Constrained Optimisation

3.1. Method of penalties
3.2. Lagrange multipliers
3.3. Conditions of Karush-Kuhn-Tucker
3.4. Augmented lagrangian method

4. Linear and Integer Programming

4.1. Linear Programming models
4.2. Simplex Method
4.3. Integer Programming models
4.4. Exact algorithms

5. Heuristic and Metaheuristic Algorithms

5.1. Constructive and local search algorithms
5.2. Path-based algorithms
5.3. Population-based algorithms

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	32,00
Laboratory	20,00
Classroom practices	8,00
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	35,00
Independent study and work	20,00
Preparation of lessons	25,00
Preparation for assessment activities	10,00
Resolution of case studies	0,00
Total hours	**90,00**

TEACHING METHODOLOGY

MD1 - Theoretical activities. Expositive development of the subject (CG01) with the participation of students in the resolution of specific questions (CB02, CT03).

In those lessons, the topics of the course will be developed, encouraging the participation of students (CT03).

MD2 - Practical activities. Learning by solving problems, exercises and case studies through which competences are acquired on the different aspects of the course (CB02, CG03, CE01). Theoretical explanations are complemented by practical activities in order to apply the basic concepts and acquire an operational knowledge of the optimisation methods.

MD4 - Work in computer classroom. Learning by performing activities developed in small groups and carried out in computer classrooms (CB02, CB05, CG03, CT01, CT03, CE01, CE13).

In addition to classroom activities, students must perform work on their own, related to classroom practices, as well as preparing classes and exams (CG01). Some of these tasks will be carried out individually, in order to enhance autonomous work, but there will also be tasks that will require the participation of small groups of students (2-3) to promote the capacity for integration in work groups (CG03, CT03).

The Virtual Classroom of the Universitat de València will be used as a communication support with students. Through it they will have access to the didactic material used in class, as well as the problems and exercises to solve.

EVALUATION

The subject will be evaluated according to:

·SE-1: Objective test. There will be an exam at the end of the term that will consist of both theoretical and practical questions and problems (assessment of competencies CB02, CB05, CG01, CG05, CT03, CE01, CE13).

·SE-2: Objective test. There will be one or several exams on practical questions using the software studied in computer sessions (evaluation of competencies CB02, CB05,CG01, CG03, CT03, CE01, CE13).

·SE-3: Continuous evaluation of each student based on the resolution of questions and problems proposed in class (competences evaluation CB02, CG01, CT01).

The final grade of the course will be calculated as the weighted average of the three previous sections, according to the following criteria: SE-1 (50%), SE-2 (40%), SE-3 (10%)

Particular considerations on the evaluation:

-Recoverable sections: SE-1 i SE-2 are recoverable, independently, in the 2nd call. The exams will include all the contents of the course.

-Non-recoverable sections: The SE-3 criterion, which evaluates the follow-up of the course during the school term, is not recoverable later. The SE-2 criterion will be recoverable, only in the 2nd call, through an individual practical examination carried out in conditions equivalent to those of a practice, but with a time limitation and access to support materials.

-Sections that require a minimum grade: It is required to obtain a minimum grade of 5 (out of 10) in each of the following evaluation sections in order to pass the subject: SE-1 and SE-2.

In any case, the evaluation system will be governed by what is established in the Evaluation and Qualification Regulations of the University of Valencia for Degrees and Masters.

Copying or plagiarism of any activity that is part of the evaluation will result in the impossibility of passing the course, and the student will then be subject to the appropriate disciplinary procedures indicated in the ACTION PROTOCOL FOR FRAUDULENT PRACTICES AT THE UNIVERSITY OF VALENCIA (ACGUV 123/2020)

REFERENCES

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- Boyd, S. y Vandenberghe, L. Convex Optimization. Cambridge University Press, 2009.
- Bernhard Korte & Jens Vygen. Combinatorial Optimization. Theory and Algorithms. Springer, 2013.
- Wolsey L.A. Integer Programming. Wiley, 2021.
- Kochenderfer y A.J., Wheeler, T.A. Algorithms for Optimization. MIT Press, 2019.
- Martí, R.; Pardalos, P.M. y Resende, M.G.C. (Editors). Handbook of Heuristics. Springer, 2018.
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