VNIVERSITAT ĬĎ VALÈNCIA

COURSE DATA

Data Subject	
Code	36408
Name	Algebra
Cycle	Grade
ECTS Credits	6.0
Academic year	2022 - 2023

Study (s)			
Degree	**Center**	**Acad. year**	**Period**
1406 - Degree in Data Science	School of Engineering	1	First term

Subject-matter		
Degree	**Subject-matter**	**Character**
1406 - Degree in Data Science	1 - Mathematics	Basic Training

Coordination	
Name	**Department**
LEBTAHI CHEROUATI, LEILA	363 - Mathematics

SUMMARY

Linear Algebra is a basic tool for almost every field of Mathematics as well as for related subjects such as Engineering, Physics and Computing among others. This subject aims to develop, in the future Data Science degrees, the abstraction ability based on the learning of concepts and suitable skills of Linear Algebra, allowing theoretical and applied problems solving in the scope of data analysis.

We will introduce linear Algebra concepts needed for the development of data analysis as well as their display along the degree course. We will study algebraic concepts not only from the matrix Algebra point of view but also from the geometrical and numerical perspective.

The theoretical classes will be taught in Spanish and the practical and laboratory sessions according to what appears in the subject file available in the degree description website.

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PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

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

Other requirements

Due to the basic education characteristic of this subject, students will not need to have passed other subjects as a necessary requisite in order to take this subject except for those that are typical to access the degree.

OUTCOMES

1406 - Degree in Data Science

- (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.

- (CG05) Analysis and synthesis capability in the preparation of reports and in the defence of ideas.

- (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.

- (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.

- (CB1) Students must have acquired knowledge and understanding in a specific field of study, on the basis of general secondary education and at a level that includes mainly knowledge drawn from advanced textbooks, but also some cutting-edge knowledge in their field of study.

- (CB2) 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.

LEARNING OUTCOMES

To get to learn basic matrix algebra. (CG01, CB1)
To get to learn how to efficiently solve massive linear systems. (CB2)
To get to learn the most widespread decompositions of matrices and their applications. (CE01)

DESCRIPTION OF CONTENTS

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1. Matrices

Definition and operation with matrices.
Determinant of a matrix.
Rank of a matrix.
Elemental transformations.

2. Linear systems

Gaussian elimination. Discussion on solving linear systems.
Numerical methods of systems resolution (Jacobi, Gauss-Seidel methods).
Linear systems in data modeling.

3. Vector spaces

Definition of vector space.
Vectors, linear combinations, dependency, generators, bases, coordinates.
Vector subspaces, operations with subspaces, generator system.
Dimension of a vector space. Coordinates of a vector in a base. Base change equations.

4. Euclidean vector spaces. Orthogonality

Scalar product, norm, distance, angle.
Orthogonal complement and orthogonal projection.
Orthonormal bases and orthogonalisation methods. Gramm-Schmidt procedure.
Least squares method. Data adjustment

5. Linear applications

Linear applications.
Kernel and image. Rank.
Matrix of an application in a base; base change.

6. Diagonalization

Similar matrices. Properties of similar matrices.
Eigenvalues and eigenvectors; characteristic polynomial and spectrum of a matrix; geometric and algebraic multiplicity.
Diagonalization; application to the calculus of matrix powers.

7. Matrix factorization

Decomposition LU.
Decomposition QR.
Singular value decomposition of matrices.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	28,00	100
Laboratory practices	20,00	100
Classroom practices	12,00	100
Attendance at events and external activities	2,00	0
Development of group work	10,00	0
Development of individual work	5,00	0
Study and independent work	18,00	0
Readings supplementary material	5,00	0
Preparation of evaluation activities	25,00	0
Preparing lectures	5,00	0
Preparation of practical classes and problem	10,00	0
Resolution of case studies	5,00	0
Resolution of online questionnaires	5,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

Theory lessons: In theory lessons all the concepts will be explained and illustrated with examples, by using computer tools of calculation or graphic representation. Likewise, the standard procedures for problem solving related to the subject will be explained. (CG01, CB1)

Practical lessons: Most of the exercises will be solved during practical lessons, by the professor or by the students themselves. This work may be recognised in the final qualification. (CB2, CG05)

Laboratories: The objective is to train students in the use of the R software. The R program is a very powerful tool for performing all types of mathematical calculus: arithmetic operations, symbolic calculus, graphics... (CE01, CT03)

EVALUATION

The assessment of the learning of the knowledge and competences achieved by the students will be done continuously throughout the course, and will consist of the following assessment blocks:

SE1 - Objective test, consisting of one or several exams that consist of both theoretical-practical questions and problems (assessment of competencies CG01, CB1, CB2, CG05) (50%)

SE2 - Assessment of laboratory activities based on the preparation of homeworks / reports and / or oral presentations as well as an active participation in class (assessment of competencies CB1, CB2, CG01, CG05, CT03, CE01) (30%)

SE3 - Continuous assessment of each student, based on the participation and the degree of involvement of the student in the teaching-learning process, taking into account the regular attendance at the presential activities and the results obtained in the evaluation questionnaires periodically posted in the Aula Virtual (assessment of competences CE01, CT03). (NON-RECOVERABLE Activity) (20%)

The final grade of the subject will be calculated as the weighted average of each of the previous sections, according to the following criteria: SE1 (50%), SE2 (30%), SE3 (20%).

Considerations:
 It is necessary to obtain a minimum grade of 4 in SE1 for averaging.

· If the subject is not exceeded in the first call, the grade obtained in SE2 will be maintained for the second call, only if it is greater than or equal to 5.

· The SE3 activity is not recoverable, using in the second call the qualification obtained in the first one.

· In the second call, SE1 will be evaluated with a final exam under the same conditions as in the first one.

· In the second call, SE2 will be evaluated with a final test of recovery in computer laboratory in similar conditions to those of computer laboratory classes the same day of the second call.

In any case, the assessment of the subject will be done in accordance with the assessment and qualification Regulation of the University of Valencia for degrees and masters

https://webges.uv.es/uvTaeWeb/MuestraInformacionEdictoPublicoFrontAction.do?accion=inicio&idEdictoSeleccionado=5639

REFERENCES

Basic

-   Grossman, Stanley I.: Álgebra lineal, 5ª ed. McGraw Hill, 1996.
-   Lay, David C.: Álgebra lineal y sus aplicaciones, 3ª ed. Prentice Hall, 2007.

- Strang, G: Álgebra lineal y sus aplicacions, versión espanyola de M. Lopez.

- https://editorialpatria.com.mx/pdffiles/9786074387704.pdf

- http://fcaglp.fcaglp.unlp.edu.ar/~morellana/algebra/bibliografia/Algebra_lineal_y_sus_aplicaciones4taEd-David_Lay.pdf

Additional

- Ejercicios y Problemas de Algebra Lineal. Rojo, Martín. McGraw-Hill.

- https://upcommons.upc.edu/bitstream/handle/2117/90194/Libro-problemas-def.pdf

- https://civilgeeks.com/2014/06/22/libro-de-problemas-resueltos-de-algebra-lineal-aaron-aparicio/

- Problemas resueltos de Álgebra Lineal, Arvesú Carballo, Jorge, et al.