

Degree programme	Type	Course
Bachelor in Artificial Intelligence	FB	1

Contact lecturer

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Prerequisites

Although this course is self-contained, it is required that the student knows how to solve systems of linear equations, basic arithmetics of numbers and polynomials, and that he/she is fluent with the calculus of symbolic expressions.

Group languages

You can consult this information at the [end](#) of the document.

Objectives

To get a good mathematical formation, and to understand and solve many problems in science and technology, it is essential to deeply understand the theory of Linear Algebra. It is needed to learn to manipulate the objects of study and to interpret their meaning. Among the objectives which are important for the formation of the students we highlight the following: to understand and to use correctly the mathematical language, to develop a good feeling on the need for having correct and rigorous proofs of the results, and to develop a critical attitude towards the validity of mathematical statements.

More specific objectives include the following: the student will learn to handle matrices as a basic tool to analyse systems of linear equations, to formalize the necessary language to understand the concepts of vector space and linear map, and also to handle bilinear forms. It is true that matrices play a vital role in all these developments, and it is a main objective of the course that the students can discern what is the meaning and the role of the involved matrices in each of the considered problems and settings.

Learning outcomes

- KM01 (Explain the linear algebra concepts that form the basis of machine learning and data analysis algorithms.) Explain the linear algebra concepts that form the basis of machine learning and data analysis algorithms.
- SM01 (Apply concepts of linear algebra, calculus, probability, and statistics to problem solving in the context of artificial intelligence applications.) Apply concepts of linear algebra, calculus, probability, and statistics to problem solving in the context of artificial intelligence applications.
- SM02 (Interpret the mathematical formulation associated with algorithms and procedures in the field of artificial intelligence.) Interpret the mathematical formulation associated with algorithms and procedures in the field of artificial intelligence.
- SM03 (Appropriately use mathematical language to formulate solutions to problems that require the use of mathematical concepts in the context of artificial intelligence.) Appropriately use mathematical language to formulate solutions to problems that require the use of mathematical concepts in the context of artificial intelligence.
- SM04 (Use computer tools and programming languages for problem solving and manipulation of

mathematical objects.) Use computer tools and programming languages for problem solving and manipulation of mathematical objects.

Contents

This course is structured in four blocks: a first block which is more computational and where the manipulation of matrices and basic operations with them is prioritized. In the second block, we formalize the key concepts of abstract vector space and linear map, relating them with the concepts from the first block. The third and fourth blocks are devoted to more advanced concepts, based on the notions of vector space and linear map.

Blocks:

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- Matrices and linear equations
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- Vector spaces and linear maps
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- Diagonalization
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- Orthogonality and quadratic forms
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Learning activities and methodology

Title	Hours	ECTS	Learning outcomes
Exercises	12	0.48	KM01, SM01, SM02, SM03, SM04
Theory	26	1.04	KM01, SM01, SM02, SM03, SM04
Solving exercises	20	0.8	KM01, SM01, SM02, SM03, SM04
Study of Theory	35	1.4	KM01, SM01, SM02, SM03, SM04
Practices	20	0.8	KM01, SM01, SM02, SM03, SM04
Practices	12	0.48	KM01, SM01, SM02, SM03, SM04
Project preparation	15	0.6	KM01, SM01, SM02, SM03, SM04

This course has 4 hours of teaching each week, which consists of blocks of 2 hours each. Each of these blocks will combine theoretical and practical contents, including problem solving.

We will use the UAB campus virtual in order to store and keep all the necessary information on the course.

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.

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Assessment

Continuous assessment activities

Title	Weight	Hours	ECTS	Learning outcomes
Delivery and exposition of Project	15%	1.5	0.06	KM01, SM01, SM02, SM03, SM04
First partial exam	40%	4	0.16	KM01, SM01, SM02, SM03, SM04
Second Partial Exam	45%	4.5	0.18	KM01, SM01, SM02, SM03, SM04

The subject will be evaluated by means of two partial exams and project deliveries and exposition. The grade of each will lead to a final grade that will be obtained by adding:

40% P1 (first partial)

45% P2 (second partial)

15% E (project deliveries and expositions)

In order to pass the subject, the student must obtain a final grade of 5 or more and also must have a mark in each of the partial exams greater or equal to 3 (out of 10). There will be a second chance exam to recover the part of the subject corresponding to exams, in case the student has failed to pass the subject in first instance. In order to be admitted to this recovering exam, the student must participate in at least 2/3 of the evaluation (in terms of grade). Therefore, the student must attend the two partial exams in order to be admitted in the recovery exam.

Bibliography

Basic:

- Otto Bretscher, . Pearson, 2013. Linear Algebra with Applications
- Marc Masdeu, Albert Ruiz, Apunts d'Àlgebra Lineal, UAB 2020
- Enric Nart, Xavier Xarles, . Materials UAB, 2016. Apunts d'àlgebra lineal
- M. P. Deisenroth, A. A. Faisal, C.S. Ong, Mathematics for Machine Learning, Cambridge University Press, 2020.

Complementary:

- Sheldon Axler, Springer UTM, 2015. Linear algebra done right
- Manuel Castellet i Irene Llerena, . Manuals UAB, 1991.
- Ferran Cedó and Agustí Reventós, Àlgebra lineal i geometria, Manuals UAB, 2004.

Software

Course groups and languages

The information provided is provisional until November 30. After this date, you will be able to consult the language of each group through this [link](#). To access the information, you will need to enter the course CODE

Type of teaching	Group	Language	Semester	Shift
(TE) Theory	71	English	first semester	afternoon
(PAUL) Classroom practices	711	English	first semester	afternoon