UAB
Universitat Autònoma de Barcelona

Fundamentals of Mathematics I

Code: 106550
ECTS Credits: 6

2024/2025

Degree	Type	Year
2504392 Artificial Intelligence	FB	1

Contact

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Teachers

Sundus Zafar

Teaching groups languages

You can view this information at the end of this document.

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.

Objectives and Contextualisation

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. All this will be reinforced with the use of powerful free software (sage).

Competences

- Develop critical thinking to analyse alternatives and proposals, both one's own and those of others, in a well-founded and argued manner.
- Introduce changes to methods and processes in the field of knowledge in order to provide innovative responses to society's needs and demands.
- Know, understand, use and apply appropriately the mathematical foundations necessary to develop systems for reasoning, learning and data manipulation.
- Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.

Learning Outcomes

1. Analyse a situation and identify areas for improvement.
2. Demonstrate your ability to manipulate matrices.
3. Develop critical thinking to analyse alternatives and proposals, both one's own and those of others, in a well-founded and argued manner.
4. Know and understand the application of vectors and eigenvectors.
5. Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
6. Understand and apply the concept of scalar product.
7. Understand projections onto a vector subspace.
8. Understand the concept of vector space, basis and linear representation.

Content

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 priorized. 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:

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

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Exercises	12	0.48	1, 2, 3, 4, 6, 7, 8
Practices	12	0.48	1, 2, 3, 4, 6, 7, 8
Theory	26	1.04	1, 2, 3, 4, 6, 7, 8

Type: Autonomous			
Practices	20	0.8	1, 2, 3, 4, 6, 7, 8
Project preparation	15	0.6	1, 2, 3, 4, 6, 7, 8
Solving exercices	20	0.8	1, 2, 3, 4, 6, 7, 8
Study of Theory	35	1.4	1, 2, 3, 4, 6, 7, 8

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 and the use of computer software.

At the beginning of the course, we will introduce the computer software used during the course. We will spend some time in the explanation of the system.

We will use the UAB Moodle classroom 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

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Delivery and exposition of Project	15%	1.5	0.06	1, 2, 3, 4, 5, 6, 7, 8
First partial exam	40%	4	0.16	1, 2, 3, 7, 8
Second Partial Exam	45%	4.5	0.18	1, 3, 4, 6, 7, 8

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

Mathsage (free software)

Language list

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	711	English	first semester	afternoon
(TE) Theory	71	English	first semester	afternoon