Universitat Autònoma de Barcelona

Fundamentals of Mathematics I

2021/2022

Code: 106481
ECTS Credits: 6
Type: FB Year: 1 Semester: 1

Degree

1488 - Artificial Intelligence

The contents of this guide are provisional and may be subject to minor changes. The final version of the guide will be available at the beginning of the semester.

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities

Contact

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Use of languages

Principal working language: English

Some groups entirely in English: Yes

Some groups entirely in Catalan: No

Some groups entirely in Spanish: No

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

- To know, understand, use and apply in a proper way the mathematical foundations that are necessary to develop systems for reasoning, learning and manipulation of large volumes of data.
- T.01 To develop critical thinking to analyse in a grounded and reasoned way alternatives and proposals, both own and others.
- T.04 To analyse and solve problems effectively, generating innovative and creative proposals to achieve the objectives.
- T.05 To work autonomously, with responsibility and initiative, planning and managing the time and available resources, adapting to unforeseen situations

Learning outcomes

- To understand the concept of vector space, base and linear representation.
- To demonstrate ability to manipulate matrices.
- To understand and apply the concept of scalar product.
- To Understand projections in a vector subspace.
- To know and understand the application of eigenvectors and eigenvalues.

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 bloc. 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

Methodology

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.

Activities

Title	Hours	ECTS	Learning outcomes
Type: Directed			
Theory: 26	26	1,04	
Problems: 12	12	0,48	
Type: Supervised			
Practice:	12	0,48	
Type: Autonomous			
Problem deliveries:	20	0,8	
Study of theory:	21	0,84	
Resolution of problems:	50	2	

Assessment

The subject will be evaluated by means of two partial exams and several deliveries of problems by the teaching staff that will be conveniently announced through the virtual campus. 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 (problem deliveries)

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.

Assessment activities

Title	Weighting	Hours	ECTS	Learning outcomes
First partial exam	40%	2	0,08	
Problem handouts	15%	1	0,04	
Second partial exam	45%	3	0,12	
Second chance exam	85%	3	0,12	

Bibliography

Basic:

- Otto Bretscher, . Pearson, 2013. Linear Algebra with Applications
- Enric Nart, Xavier Xarles, . Materials UAB, 2016. Apunts d'àlgebra lineal

Complementary:

- Marc Masdeu, Albert Ruiz, Apunts d'Àlgebra Lineal, UAB 2020.
- 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)