



UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Linear Algebra

2021-1-E4101B002

Learning objectives

The aim of the course is to introduce basic tools of linear algebra, propedeutic to other courses in the department's curricula.

Contents

1. Vector spaces
2. Matrices and their operations; determinant.
3. Vector spaces with inner product
4. Scalar product and Gram-Schmidt orthonormalization
5. Systems of linear equations
6. Linear maps
7. Matrix diagonalization, Symmetric matrices and spectral decomposition
8. Basics on conics and quadratic forms

Detailed program

Vector spaces, subvector spaces. Intersection and sum of subvector spaces. linear (in)dependence of a set of vectors. Generated subvector space. Bases and dimension of a vector space. Main theorems on bases, generators and linear independence. Grassmann theorem (on vector spaces).

Sum and product by scalars' structures of vectors and matrices. Matrix product and inverse matrix. Rank. Elementary operations: rank computation and derivation of the inverse of a matrix. Determinant: Laplace formula.

Systems of linear equations. Affine space of solutions. Elementary operations' application to Rouché-Capelli procedure. Cramer theorem. Application: inverse matrix formula. No solution case: anticipation of linear regression.

Inner and scalar products. Orthonormal set of vectors. Gram-Schmidt process.

Linear maps (a.k.a. homomorphisms). Kernel and image, Grassmann theorem (homomorphisms). Associated matrix to a homomorphism. Base change formula. Application: associated matrix to the projection with respect of canonical bases of \mathbb{R}^n and its connection with linear regression.

Diagonalization. Eigenvectors and eigenvalues. Symmetric matrices: spectral decomposition.

Time permitting: conics classification and one mention to quadratic forms.

Prerequisites

No formal prerequisites, but knowing some set theory is helpful, especially if this concerns sets endowed by algebraic structures (e.g. groups). Moreover, it is strongly advised to be able to perform proofs of elementary statements, and being able to use the induction process.

Teaching methods

Possibly classroom teachings in accordance with COVID distancing rules.

Lessons on the covered subjects are available to my Youtube channel "Animated Math" (english narration). Likely tutoring activities. Videoconference office hours.

Assessment methods

There will be a written examination consisting in a multiple-choice quiz. According to COVID distancing rules, there may be a supplementary written part in which students must exhaustively elaborate answers to questions, in written form.

The written exam(s) will determine the candidates admitted to the oral exam.

Those who passed the written part of the exam with a grade of 18 or above, may opt to record that as their final grade.

Those admitted with a grade less than 18 must pass a further examination, typically (but yet to be determined) consisting in a supplementary multiple choice/open question.

In the case it will not be possible to setup the written part of the exam with extended written answers, the professor may decide to choose a sample of the students admitted to the oral exam and switch their oral exam to an individual videoconference colloquium.

Textbooks and Reading Materials

Schlesinger. Algebra lineare e geometria. Zanichelli. Eserciziario associato

Anichini, Conti, Paoletti. Algebra lineare e geometria analitica. Pearson. Eserciziario associato.

Semester

second semester

Teaching language

italian/english
