DMA-SAP-431 APPLIED LINEAR ALGEBRA

SEMESTER: Spring

CREDITS: 6 ECTS (4 hrs. per week)

LANGUAGE: English

DEGREES: SAPIENS program

Course overview

This is a foundation course in linear algebra. By its nature, linear algebra has many applications in abstract mathematics and in real life. We will present theoretical concepts with their motivation and applications.

The class time will be devoted to lectures where the students should gain an understanding of basic concepts and methods, realize connections between various parts of linear algebra and eventually build a global picture of linear algebra. The material we cover is also meant as an introduction to a more abstract level of learning or using mathematics.

Prerequisites

Basic knowledge of Calculus and Algebra.

Course contents and methodology

Methodology

Lecture, solving calculation problems during exercises.

Contents

1. **LINEAR SYSTEMS (Chapter 1 in [1]).**
   - 1.1 Systems of Linear Equations
   - 1.2 Row Reduction and Echelon Forms
   - 1.3 Vector Equations
   - 1.4 The Matrix Equation Ax=b
   - 1.5 Solution Sets of Linear Systems
   - 1.6 Applications of Linear Systems
   - 1.7 Linear Independence

2. **VECTOR SPACES (Chapters 2 and 4 in [1]).**

   4.1 Vector Spaces and Subspaces
   2.8 Subspaces of $\mathbb{R}^n$
   2.9 Dimension and Rank
   4.3 Linearly Independent Sets; Basis
   4.4 Coordinate Systems
   4.5 The Dimension of a Vector Space
   4.5 Change of Basis

3. **LINEAR TRANSFORMATIONS (Chapters 1 and 4 in [1]).**

   1.8 Introduction to Linear Transformations
   1.9 The Matrix of a Linear Transformation
   4.2 Null Spaces and Linear Transformations

4. **EIGENVALUES AND EIGENVECTORS (Chapter 5 in [1]).**

   5.1 Eigenvectors and Eigenvalues
   5.2 The Characteristic Equation
   5.3 Diagonalization
   5.4 Eigenvectors and Linear Transformations
   5.5 Discrete Dynamical Systems

5. **ORTHOGONALITY (Chapter 6 in [1]).**

   6.1 Inner Product, Length, and Orthogonality
   6.2 Orthogonal Sets
   6.3 Orthogonal Projections
   6.4 The Gram-Schmidt Process

6. **QUADRATIC FORMS (Chapter 7 in [1]).**

   7.1 Diagonalization of Symmetric Matrices
   7.2 Quadratic Forms
   7.3 Constrained Optimization
   7.4 The Singular Value Decomposition

Textbooks

[1] *Linear Algebra and its Applications*, 4th Edition, David C. Lay (basic bibliography).

[2] *Linear Algebra with Applications,* 4th Edition, Otto Bretscher (additional bibliography).

Grading

The overall grade will be obtained as follows:

- Three midterms (15%, 25% and 35% respectively)
- Homework (25%)

The students whose grades are less than 5 or those who want to improve their previous grades will do a final exam the last day of the course. Their final grade will be the maximum between the grade obtained in this final exam and the result of computing 70% of the final exam and 30% of the homework.

The students who fail the course will have the chance to do an extraordinary exam. The grade obtained in this exam will be their definitive grade.

The exams are all closed notebook, closed textbook and no calculator. The course will not be graded on a curve, i.e., there is no bound on the numbers A's, B's, C's, etc.

Use of AI

The use of AI to create entire works or relevant parts, without citing the source or the tool, or without explicit permission in the assignment description, will be considered plagiarism and will be regulated in accordance with the University General Regulations