

Academic Year: (2024 / 2025)

Review date: 26-04-2024

Department assigned to the subject: Mathematics Department

Coordinating teacher: MOLERA MOLERA, JUAN MANUEL

Type: Compulsory ECTS Credits : 3.0

Year : 1 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Proficiency in undergraduate mathematics (Linear Algebra, in particular)

OBJECTIVES

- Use of advanced methods of Linear Algebra for analysing big data
- Understanding the fundamentals of certain algorithms used in big data, in order to interpret the results, their meaning and validity

Learning results:

- Deep review of basic linear algebra: linear systems, vectors and matrices, including matrix diagonalization and linear transformations
- Review/Learning of orthogonality concepts in linear algebra, including orthogonal matrix diagonalization and applications
- Learning of the singular value decomposition (SVD) of a real matrix, including applications

DESCRIPTION OF CONTENTS: PROGRAMME

1. Matrices
 - (a) Matrix Operations
 - (b) Change of Basis Matrix
 - (c) Matrix of a Linear Transformation
2. Linear Systems of Equations
 - (a) LU factorization
 - (b) Cholesky factorization
 - (c) Applications: Iterative Methods
3. Diagonalization
 - (a) Diagonalization
 - (b) Orthogonal Diagonalization
 - (c) The Power Method
 - (d) Markov processes
4. Least Squares Problems
 - (a) Data fitting
 - (b) Orthogonal projections and Least square problems
 - (c) QR factorization
 - (d) Constrained LSP
5. Singular Value Decomposition
 - (a) Singular Value Decomposition

- (b) The pseudoinverse
- (c) Principal component analysis

LEARNING ACTIVITIES AND METHODOLOGY

This course is in FLIPPED CLASSROOM format:

- The students must visualize some videos and answer a quiz about the videos before attending the class
- In the class, there'll be a review of the theoretical concepts of the videos, and some problems will be solved
- The students must solve extra problems as homework

Tutorials are available

ASSESSMENT SYSTEM

% end-of-term-examination:	40
% of continuous assessment (assignments, laboratory, practicals...):	60

1. Day-to-day to assesment, C.

The grade C will be obtained from Quizzes (Q), 30%, and Tasks (T), 70%:

$$C = 0.3*Q + 0.7*T.$$

2. Final exam, E, and final grade G.

-- If $C \geq 5$ there are two options:

1. You can decide not to take the final exam. The final grade will be $G=5$.

2. If you want to get more than a 5 on your final grade you will have to take necessarily the final exam. In that case your final grade will be

$$G = \max\{0.6*C + 0.4*E, 5, E\}, \text{ where } E \text{ is the final exam grade.}$$

-- If $C < 5$ you will have to take necessarily the final exam to pass the course. The grade, in that case, will be

$$G = E.$$

BASIC BIBLIOGRAPHY

- Timothy Sauer Numerical Analysis 2e, Pearson, 2012
- W. Keith Nicholson Linear Algebra with Applications, Lyryx, Open Edition, 2021
- David C. Lay, Steven R. Lay, Judi J. McDonald Linear Algebra and Its Applications, Pearson; 5 edition, 2016
- Lloy N. Trefethen; David Bau, III Numerical Linear Algebra, SIAM, 1997

ADDITIONAL BIBLIOGRAPHY

- Carl D. Meyer Matrix Analysis and Applied Linear Algebra, SIAM, 2010
- Cleve Moler Numerical Methods with Matlab, SIAM, 2004
- David Watkins Fundamentals of Matrix Computations, 3rd Ed, Wiley, 2010

- James W. Demmel Applied Numerical Linear Algebra, SIAM, 1997

BASIC ELECTRONIC RESOURCES

- Marc Peter Deisenroth, A Aldo Faisal, and Cheng Soon Ong . Mathematics for Machine Learning: <https://mml-book.github.io/>