

Numerical Methods for Large Systems of Equations

ECTS: 3 ECTS

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UNIVERSITY WHERE THE COORDINATOR IS: UDC

HAVE YOU GIVEN PERMISSION TO RECORD YOUR CLASSES? Yes

SUBJECT CONTENTS

1. Storage Formats of hollow matrices in computers.
 - Storage profile, CSR, CSC and random.
 - Choice of format.
 2. Numerical solution of large systems of linear equations.
 - Methods of decline: the method of conjugate gradient (CG).
 - The CGNR and CGNE methods. Krylov methods.
 - Preconditioning techniques.
 3. Numerical solution of large systems of nonlinear equations.
 - Review of the Newton's method.
 - Strategies for global convergence.
 - Newton-Krylov methods.
 - Broyden method.
 4. Numerical approximation of eigenvalues and eigenvectors.
 - Location of eigenvalues.
 - Conditioning of an eigenvalue problem.
 - Power methods. Rayleigh quotient iteration.
 - The QR method.
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METHODOLOGY

Lab practices

In these practices we will solve problems presented in the lectures using Matlab.

Oral presentation

Students will present orally the conclusions of their mentored essays. This presentation will be considered in the evaluation.

Objective test

The final exam comprises two parts. In the first part students will carry out a series of exercises proposed and will answer some theoretical questions. In the second part, students must solve a case study using the commands and programs available to them in Matlab or by implementing the necessary algorithms. Students will present a summary of the studied methods. This summary will be taken into account in the assessment.

Lecture

In the lectures the teacher will present the theoretical contents of the subject with the help of illustrative examples in order to motivate students and to help the understanding and assimilation of contents. The teacher will be supported by dynamic presentations that students can download in advance from Moodle. Throughout the course, students must solve several problems. These problems will be considered in the evaluation.

Tutored projects

Students will do an essay in order to apply the knowledge acquired during. This essay will be taken into account in the assessment.

LANGUAGE USED IN CLASS: Spanish

IS IT COMPULSORY TO ATTEND CLASS? Students can attend via conference system.

BIBLIOGRAPHY

Templates for the solution of linear systems: building blocks for iterative methods. Barret 1994. Ed. Siam

Solving Nonlinear Equations with Newton's Method. Kelley 2003. Ed. Siam

Numerical Linear Algebra. Trefethen 1997. Ed. Siam

Iterative Methods for Sparse Linear Systems. Saad 2003. Ed. Siam

SKILLS

Basic:

CG3: To be able to integrate knowledge in order to state opinions using information that even incomplete or limited, include reflecting on social and ethical responsibilities linked to the application of their knowledge.

CG5: To have the appropriate learning skills to enable them to continue studying in a way that will be largely self-directed or autonomous, and also to be able to successfully undertake doctoral studies.

Specific:

CE4: To be able to select a set of numerical techniques, languages and tools, appropriate to solve a mathematical model.

Numerical simulation specialization:

CS2: To adapt, modify and implement software tools for numerical simulation.

WILL YOU BE USING A VIRTUAL PLATFORM? Yes. Moodle (UDC).

WILL YOU BE USING ANY SPECIFIC SOFTWARE? Yes. MATLAB.

CRITERIA FOR THE 1ST ASSESSMENT OPPORTUNITY

Over 100 points distribution would be:

Lab practices

The student must know how to implement using computers algorithms developed in the theoretical part of the subject. 10 points.

Oral presentation

The clarity with which the ideas and conclusions of the work done are exposed is assessed. 10 points.

Objective test

Test in which the knowledge and skills acquired by students are evaluated. 50 points.

Summary

The ability to synthesize the student will be assessed. 5 point.

Problem solving

Correctness and clarity of the solutions presented will be assessed. 10 points.

Tutored projects

The ability of the student to apply the concepts and methods studied in the course and their capacity for independent learning and critical thinking, creativity and originality of the work presented will be assessed. 15 points.

CRITERIA FOR THE 2ND ASSESSMENT OPPORTUNITY

Over 100 points distribution would be:

Objective test: test in which the knowledge and skills acquired by students are evaluated. 100 points.
