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.

METHODOLOGY

Met1: 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.

Met2: Interactive class: problem seminars

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

Met3: Interactive class: laboratory

Students must solve a case study using the commands and programs available to them in Matlab or by implementing the necessary algorithms.

Met4: Tutorials

The student ask the doubts generated during the classes. So, he can ask using differents ways: email, skype and direct if it was possible.

Met5: 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

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

- Dennis Jr., J.E. y Schnabel, R.B. 1996 Numerical Methods for Unconstrained Optimization and Nonlinear Equations, SIAM

- Epperson, J.F. 2007 An introduction to numerical methods and analysis, John Wiley & Sons

- Golub, G.H. y van Loan, C.F. 1996 Matrix Computations, John Hopkins University Press

- Lascaux, P. y Théodor, R. 2000 Analyse numérique matricielle appliquée à l'art de l'ingénieur, 1- Méthodes directes Dunod

- Quarteroni, A. y Saleri, F. 2006 Cálculo científico con Matlab y Octave. Springer

- Saad, Y. 1992 Numerical Methods for Large Eigenvalue Problems, Manchester University Press

- Van der Vorst, H.A. 2003 Iterative Krylov Methods for Large Linear Systems, Cambridge University Press

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SKILLS

Basic:

CG3 (Methodologies Met1 Met2 Met3 Met4): 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 (Methodologies Met2 Met3 Met4): 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 (Methodologies Met1 Met2 Met3): To be able to select a set of numerical techniques, languages and tools, appropriate to solve a mathematical model.

Numerical simulation specialization:

CS2 (Methodologies Met1 Met2 Met3 Met4): 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 suing computers algorithms developed in the theoretical part of the subject. 10 points. Skills to evaluate: CG3, CG5, CE4 and CS2.

Oral presentation

The clarity with which the ideas and conclusions of the work done are exposed is assessed. 10 points. Skills to evaluate: CG3, CG5, CE4 and CS2.

Objective test

Test in which the knowledge and skills acquired by students are evaluated. 50 points. Skills to evaluate: CG3, CG5, CE4 and CS2.

Summary

The ability to synthesize the student will be assessed. 5 point. Skills to evaluate: CG5.

Problem solving

Correctness and clarity of the solutions presented will be assessed. 10 points. Skills to evaluate: CG3, CG5, CE4.

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. Skills to evaluate: CG3, CG5, CE4 and CS2

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. Skills to evaluate: CG3, CG5, CE4 and CS2.
