Computational linear algebra

Summary
This course provides an overview of state-of-the-art techniques for solving large-scale linear algebra problems, as they typically arise in applications. A central goal of this course is to give the ability to choose a suitable solver for a given application.

Content

Introduction
Sources of large-scale linear algebra problems. Recap of required linear algebra concepts.

Eigenvalue problems

Linear systems
Direct sparse factorizations. Krylov subspace methods and preconditioners.

Matrix functions
Theory and algorithms.

Keywords
linear systems, eigenvalue problems, matrix functions

Learning Prerequisites

Required courses
Linear Algebra, Numerical Analysis

Learning Outcomes

By the end of the course, the student must be able to:
• Choose method for solving a specific problem.
• Prove the convergence of iterative methods.
• Interpret the results of a computation in the light of theory.
• Implement numerical algorithms.
• Describe methods for solving linear algebra problems.
• State theoretical properties of numerical algorithms.

Teaching methods
Ex cathedra lecture, exercises in the classroom and with computer

Expected student activities
Attendance of lectures.
Completing exercises.
Completing a miniproject.
Solving problems on the computer.

Assessment methods
Oral examination.
Dans le cas de l’art. 3 al. 5 du Règlement de section, l’enseignant décide de la forme de l’examen qu’il communique aux étudiants concernés.

Resources
Bibliography
Lecture notes will be provided by the instructor. Complimentary reading:

Ressources en bibliothèque
• Finite elements and fast iterative solvers / Elman
• Matrix computations / Golub
• Iterative methods for sparse linear systems / Saad