MATH-453 **Computational linear algebra**

Kressner Daniel

Cursus	Sem.	Type
Computational and Quantitative Biology		Opt.
Computational science and Engineering	MA2, MA4	Opt.
Computational science and engineering minor	E	Opt.
Data Science	MA2, MA4	Opt.
Ing.-math	MA2, MA4	Opt.
Mathématicien	MA2	Opt.
Statistics	MA2, MA4	Opt.

Language of teaching	English
Credits	5
Session	Summer
Semester	Spring
Exam	Written
Workload	150h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	2 weekly
Number of positions	

Summary

This course provides an overview of advanced 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
Theory foundations. Krylov subspace methods. Probabilistic analysis. Singular value problems. Preconditioned iterative methods.
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

Lectures + exercise sessions

Expected student activities

Students are expected to attend lectures and participate actively in class and exercises. Exercises will include both theoretical work and programming assignments. Students also complete a substantial project (possibly in small groups) that likewise include theoretical and numerical work.

Assessment methods

20% of the grade will be based on projects, 80% of the grade will be based on a written exam

Resources

Moodle Link

- https://go.epfl.ch/MATH-453