FSF3580 Numerical Linear Algebra 7.5 credits

Numerisk linjär algebra

This is a translation of the Swedish, legally binding, course syllabus.

Establishment

Course syllabus for FSF3580 valid from Spring 2019

Grading scale

G

Education cycle

Third cycle

Specific prerequisites

This course is designed for PhD students in applied and computational mathematics, but it is suitable also for other PhD students with a background in computation with mathematical interests. The students are expected to have taken basic and a continuation course in numerical analysis or acquired equivalent knowledge in a different way.

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

After completion of the course, the students are expected to be able to:

- apply, extend and generalize the main numerical methods: Arnoldi's method, Rayleigh quotient iteration, GMRES, CG, BiCG, CGN, QR-method, scaling-and-squaring, Denman-Beavers algorithm and Parlett-Schur
- interpret, apply and generalize convergence theory for the iterative algorithms:- Characterization of convergence order and convergence factors of all covered methods- Explicit min-max-bounds and condition number bounds for Arnoldi, GMRES, CG, CGN and QR-method
- relate and motivate how (or why not) the methods in this course can be used in their PhD topic

Course contents

In this course the students will learn a selection of the most important numerical methods and techniques from numerical linear algebra. This includes detailed understanding of state-of-the-art iterative algorithms as well as improvements and variants. Convergence theory and practical implementation issues for specific problems are addressed. The course consists of a number of blocks:

1. Numerical methods for large-scale eigenvalue problems
2. Numerical methods for large-scale linear systems of equations
3. Numerical methods for functions of matrices
4. Numerical methods for matrix equations
5. Individual project related to numerical linear algebra

Disposition

Lectures, Homeworks, Individual project

Course literature

The course literature of SF2524 is a subset of the literature of this course. The course literature consists of selected parts of:

- SF2524: Golub and Van Loan, Matrix computations, 4th edition, SIAM publications, 2013
- SF2524: Trefethen, Bau, Numerical linear algebra, SIAM publications, 1997
- SF2524: Lecture notes on the convergence of the Arnoldi method, E. Jarlebring 2014
- SF2524: Lecture notes on the QR-method, E. Jarlebring 2014
- SF3580: Lecture notes on the Numerical methods for the Lyapunov equation, E. Jarlebring 2014
- SF3580: Additional research papers

Examination

- LAB1 - Laboratory work, 3.5 credits, grading scale: P, F
- TEN1 - Written exam, 4.0 credits, grading scale: P, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

If the course is discontinued, students may request to be examined during the following two academic years.

The examination will consist of mandatory elements:

1. homeworks (including additional questions only for SF3580)
2. oral and written presentation of the project
3. written exam

If the homeworks are handed in on associated deadlines, the exam can be done in the form of a take-home exam, otherwise a the examination is by regular written exam (4 hours).

Other requirements for final grade

Laborations completed
Written exam completed

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.