SF1530 Applied Linear Algebra 7.5 credits

Tillämpad linjär algebra

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

Establishment

Course syllabus for SF1530 valid from Autumn 2013

Grading scale

A, B, C, D, E, FX, F

Education cycle

First cycle

Main field of study

Technology

Specific prerequisites

For non-program students: Basic university qualification.

Language of instruction

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

Intended learning outcomes

A general aim with the course is that the student should develop a good understanding of basic mathematical concepts within algebra and geometry and be able to use these to mathematical model engineering and scientific problems.

The student should develop skills in, using computers, illustrating central concepts and solving applied problems by means of functions from the library of the programming language. Furthermore, the student should be able to visualise and present the results in a clear way.

On completion of the course, the student should

- know and be able to use central concepts and methods such as: vector space, inner-product space, subspace, linear depending and independent, dimension, bases, norms, internal product, orthogonality, projection, Gram-Schmidt's method,
- know and be able to use central concepts within geometry in R3, such as: cross product, straight lines, planes, normals, surfaces, volumes,
- know and be able to use the L2 norm and polynomials as basis functions
- be familiar with definitions and concept for matrices such as: rank, null space, row space, column space, singularity, norms, symmetry, orthogonality,
- be able to calculate the inverse analytical for small matrices and with existing software for larger matrices,
- be able to solve linear equation systems analytically with Gauss elimination and pivoting for small systems and know and be able to use existing software for larger systems
- know various types of matrix factorization and be able to apply LU factorization
- be familiar with the concept of condition number and understand its relevance and calculate this with existing software,
- be familiar with the complexity for Gauss elimination for full and sparse matrices
- be able to calculate eigenvalues and eigenvectors analytically for small systems and for larger systems using existing software and be able to account for its relevance and connection to physical examples
- be able to use eigenvalues and eigenvectors to decide if a matrix is diagonalizable
- know and be able to use the spectral theorem
- be able to formulate the least squares method to solve inconsistent linear equation systems and solve smaller problems by hand and larger problems using existing software. Furthermore be able to account for important concepts as the residual, orthogonality, and give a geometric interpretation of a least square solution in lower dimensions,
- know and be able to count with complex numbers and their polar form,
- be able to use the induction axiom to be able to verify simple relationships
- know and be able to use the fundamental theorem about relationship between factorisations of polynomial and zeros of the algebra.

Course contents

Basic ideas and concepts: vector, matrix, linear systems of equations, Gauss elimination, matrix factorization, complexity, vector geometry with inner product, cross product, determinant and vector space, linear independent, basis, linear transformation, eigenvalue, eigenvector, the least squares method, orthogonality, inner-product space, Gram-Schmidt's method, complex numbers, the inductions axiom, the fundamental theorem of the algebra.

Computational aspects: Solution to linear equation systems, Gauss elimination, the LU-factorization, condition number, full and sparse matrices, complexity, the least squares method, calculation of eigenvalues, eigenvectors and graphical visualization of results.

Course literature

Announced no later than 4 weeks before the start of the course on the course web page.

Examination

- LABB - Laboratory Work, 1.0 credits, grading scale: P, F
- TEN1 - Examination, 4.0 credits, grading scale: A, B, C, D, E, FX, F
- LABA - Laboratory Work, 2.5 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.

· LABA - Laboratory sessions, 2.5 credits, grading scale: P, F

· LABB - Laboratory sessions, 1.0 credits, grading scale: P, F

· TEN1 - Examination, 4.0 credits, grading scale: A, B, C, D, E, FX, F

In this course, the code of honour of the school is applied,
see: http://www.sci.kth.se/institutioner/math/avd/na/utbildning/hederskodex-for-studenter-och-larare-vid-kurser-pa-avdelningen-for-numerisk-analys-1.357185

Other requirements for final grade

A written examination (TEN1; 4 credits). Laboratory assignments with oral and written presentation (LABA and B; 3.5 credits).

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.