UNIVERSITY OF GOTHENBURG

DEPARTMENT OF MATHEMATICAL SCIENCES

NFMV018 Classic papers in numerics, 7.5 credits

Klassiska artiklar i numerik, 7,5 högskolepoäng

Third-cycle level / Forskarnivå

Confirmation

This syllabus was confirmed by the Department of Mathematical Sciences on 2021-04-29, and is valid from Spring semester 2021.

Responsible Department
Department of Mathematical Sciences, Faculty of Science

Entry requirements

General knowledge in numerical analysis or computational mathematics.

Learning outcomes

By completing this course, the student will

- improve her/his communication skills (oral and written),
- broaden her/his knowledge in the fields of numerical analysis and computational mathematics,
- get a historical background on some classical results presented during a university curriculum in mathematics.

Course content

The original idea for the present course comes from Nick Trefethen, University of Oxford (see the webpage
https://people.maths.ox.ac.uk/trefethen/classics.html for details).

The main goal of the course is to present classic papers in the general field of numerical analysis. In order to get 7.5 credit points, each participant must

- present at least one paper,
- prepare a short written report (1-2 pages) for the other participants, where the authors, the results and the main ideas of the paper are presented. This should be sent out ca. 5 days

prior to the presentation,
- be active in participating in all presentations.

Depending on the number of participants, one could imagine having the course once a week or every two weeks.

The definitive schedule will be decided with the participants input.

Types of instruction

Reading of papers and preparation of presentation, under the guidance of the course teachers.

Language of instruction
The course is given in English.

Grades

The grade Pass (G) or Fail (U) is given in this course.

The grading scale comprises Fail (U) and Pass (G) with the addition of Pass with distinction (VG) for master students.

Types of assessment

Assessment will be based on an oral presentation and a written report.

Course evaluation

The course evaluation is carried out together with the students at the end of the course, and is followed by an individual, anonymous survey. The results and possible changes in the course will be shared with the students who participated in the evaluation and to those who are beginning the course.

Other information

Teachers: David Cohen (course leader and examiner), Mohammad Asadzadeh, Larisa Beilina, Annika Lang, Stig Larsson, Anders Logg, Klas Modin,
Axel Målqvist.

A list of carefully selected papers is provided at the beginning of the course.
Possible examples of papers are
* J. W. Cooley, J. W. Tukey, *An algorithm for the machine calculation of complex Fourier series*.
This paper presents the idea of the fast Fourier transform (FFT). From wikipedia: "Fast Fourier transforms have been described as the most important numerical algorithm[s] of our lifetime". It is a short and relatively easy to read paper.
* J. Crank, P. Nicolson, *A practical method for the numerical evaluation of solutions of partial differential equations of the heat-conduction type*.
This paper introduces and analyses one of the first finite difference method for parabolic PDEs.

* N. Metropolis, S. Ulam, *The Monte Carlo method*.
This is the first time that one uses a probabilistic approach to solve deterministic problems. Applications are in all sciences
(computational biology, engineering, finance, physical sciences, etc.).
* E. Hairer, C. Lubich, G. Wanner, *Geometric numerical integration illustrated by the Störmer-Verlet method*.
This paper gives a nice summary of the state of the art numerical methods for ODEs.
* C. De Boor, *On calculating with B-splines*.
This is the first paper on splines and its uses in car design.
* Y Saad, M. H. Schultz, *GMRES: A generalized minimal residual algorithm for solving nonsymmetric linear systems*.
This paper presents an iterative method for the numerical solution of nonsymmetric systems of linear equations.
* E. N. Lorenz, *Predictability: Does the Flap of a Butterfly's Wings in Brazil Set Off a Tornado in Texas?*.
Early reference on chaos theory.