Numerical methods

spring - 2024

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January 8–12, 2024 (W-02)

Welcome to MA2501,

Numerical methods.

Lecturers:	Brynjulf Owren and Sondre Tesdal Galtung
Teaching assistants:	Oskar Goldhahn and Abdullah Abdulhaque
Learning assistant:	Jasper Steinberg

You will meet these five during the semester

About TMA4130

Most important info: All info posted on the webpage

https://wiki.math.ntnu.no/ma2501/2024v/start

- A basic introduction to Numerical methods

  Lectures: Wed 14-16 in EL4, Thu 08-10 in B1
  Exercises: Tue 14-16 in B1

- 4 obligatory assignments (at least 3 must be approved)
- 3 projects counting 30%
- Final exam counting 70%, date: June 5, 2024, 15–19

Work to be handed in

Due dates (tentative)

Hand-in	**Date**
Assignment 1	February 2
Project 1	February 16
Assignment 2	February 26
Project 2	March 22
Assignment 3	April 5
Project 3	April 15
Assignment 4	April 22

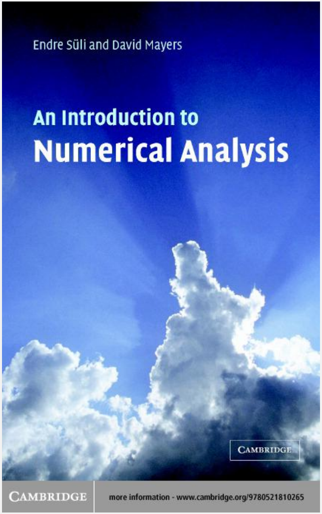
Official course description

Learning outcomes

1. **Knowledge.** The student is familiar with selected algorithms for numerical solution of linear and nonlinear equations, differential equations and integration, and knows how these algorithms are developed and analyzed. The student is familiar with central concepts such as error sources, convergence and stability
2. **Skills.** The student is able to choose a suitable numerical algorithm for a given mathematical problem, to implement this method, and to critically evaluate the result. Moreover, the student is capable of developing (further) simple numerical algorithms and to analyze these.

Text book

Süli and Mayers - An introduction to Numerical Analysis



- Some shorter notes will also be posted on the webpage
- The book can be found in electronic form – see link on course web page

Exercises (Assignments)

- Of the 4 given exercises one needs to have at least 3 approved to take the final exam.
- Deadlines for exercises are absolute, no extension will be given
- The given deadlines were tentative, follow any updates on the web pages
- The exercises involve some Python programming
- All exercises must be handed in by the ovsys system linked from the course web page.
- Exercise 1 is published before January 15, first exercise class is January 16.

Projects

There will be 3 projects

- Some may be individual and some may be group projects
- Submission through Inspera
- Counts 30% of the final grade (weighting of letter grades for exam + projects)

Assessment type:	Final (school) exam (70%)
Grades:	A–F
Theory questions:	Most likely “langsvar” problems
Programming:	Possibly “live programming” at the exam, but in any case, questions requiring programming skills must be expected.
Aids:	C: Specified printed and hand-written support material is allowed. A specific basic calculator is allowed.
Date of final exam:	June 5, 2024

Reference group

We need volunteers for the reference group

- Ideally, representation from each study programme involved
- Both men and women

It entails

- Participate in three meetings with the lecturers through the semester, each at most one hour
- A student writes a summary from each meeting
- Collect input from fellow students and notify the lecturers of problems and ideas for improvement
- At the end of the semester: write a report to the quality system of NTNU

If you are willing to contribute as a reference group member please contact the lecturer in the break or, send an email to brynjulf.owren@ntnu.no with your name and study programme.

Reference group report, MA2501

Lectures. Few students attended the lectures during the semester, especially towards the end. Students attending the lectures found the lectures to be interesting and valuable for the most part. Especially, short pdf-summaries made by the lecturers were appreciated by the students. However, some of those attending lectures have given feedback that difficult concepts could have been explained in more detail, and that some relevant concepts tested on the exercise sets were not explained at all.

Supervision. Few attended the additional lectures supervising the exercises and projects. There seem to be primarily two reasons for this. First, the few who attended the first few supervised lectures reported that the lecturer did not want to aid in directly solving tasks from the exercise set, but rather wanted to lecture on "related topics", which could help the student gain insight relevant to solve the exercises. This indirect approach was felt to be ineffective to solve the exercises on the exercise set, by the students attending the first few supervised lecturers. Second, students started working on the exercise sets (especially ex. set 2 & 3) primarily the week after they were supervised. Had they started earlier, they could have attended the supervised lectures.

Exercises. Many students have complained heavily about too demanding exercise sets during the semester. The three mandatory exercise sets were felt to require too much work (somewhere between 20 – 50 h for each exercise set, depending on the student). Furthermore, some of the tasks given were felt to be too challenging for a second-year course, as many students did not

What the course is about

Weekly topics (Preliminary plan)

Week	Date	Theme	Reference	Add. Material	Rec. Exerc.	Lecturer
2	10.01	Introduction to the course, principles of computational mathematics, learning outcome of the course.		pendel.ipynb		BO
	11.01	Floating point numbers, roundoff error, stability of problems and algorithms. Bisection method and Newton method.		floats		BO
3	17.01	Convergence of fixed point iterations.	1.1-1.4	Nonlinear systems		BO
	18.01	Brouwer's Theorem. Contraction mapping Theorem.	4.1-4.2	bisection.ipynb		BO
4	24.01	Newton's method for systems.	4.3-4.4			BO
	25.01	Solution of systems of linear equations with iterative methods.				BO
5	31.01	Least squares, condition numbers				BO
	01.02	Stability of linear systems, SVD				BO
6	07.02	Computing SVD. Householder transformations, computing QR.				SG
	08.02	Gaussian Elimination with pivoting.				SG
7	14.02	Polynomial interpolation.				SG
	15.02	Polynomial interpolation.				SG
8	21.02	Polynomial approximation.				SG
	22.02	Polynomial approximation.				SG
9	28.02	Numerical integration				BO
	29.02	Numerical integration				BO
10	06.03	Numerical Integration				BO
	07.03	Numerical Integration				BO
11	14.03	Initial value problems for ODEs				BO
12	20.03	Initial value problems for ODEs				SG
	21.03	Initial value problems for ODEs				SG
13	27.03	Easter - No lecture				-
	28.03	Easter . No lecture				-
14	03.04	Difference approximations				BO
	04.04	Boundary value problems				BO
15	10.04	Boundary value problems				SG
	11.04	Boundary value problems				SG
16	17.04	Repetition				BO
	18.04	Old exam questions				BO