Numerical Methods

Course number	MATH-AD 214
Credit hours	4
Class times	Tu Th 8:15-9:30
Location	DTC, Room N-109
Instructor	Erwan Biland, `erwan.biland@laposte.net`
Office hours	Sama 1310, Tu Th 10:00-12:00
Pre-requisites	Multivariable Calculus (MATH-AD 112)

Course description

Contents

Numerical analysis explores how mathematical problems can be analyzed and solved with a computer. As such, the subject has very broad applications in mathematics, physics, engineering, finance, and the life sciences. This course gives an introduction to this subject. Theory and practical examples using Matlab are combined to study topics from simple root-finding procedures to differential equations and the finite element method.

Course text

An Introduction to Numerical Analysis, Endre Suli & David Mayers, Cambridge University Press, 2004, ISBN 0 521 00794 (required).
Scientific Computing with MATLAB and Octave, Alfio M. Quarteroni & Fausto Saleri, Springer, any edition (optional).
Prior knowledge of Matlab is not required, but it will be used as the main language for the course. If you have experience with compiled languages (Fortran, C, C++), Matlab will be easy to learn and use, and comes with a great help facility. You will not be required to learn and use a compiled language.

Intended schedule

TBA

Teaching and learning methods

This will be a lecture course, with lab component. Computing on your own will form an essential part of the learning process and you will be exposed to Linux, Matlab, compiled languages, LaTex, and other tools commonly used by computational scientists. Assignments will be mostly done in Matlab.

Outcomes assessment

Expected outcomes

At the end of the course, successful students will able to:

- Analyze key properties of numerical algorithms such as stability and convergence by applying standard techniques

- Classify types of algebraic equations and select appropriate methods for finding approximate numerical solutions
- Solve for eigenvalues of large symmetric matrices
- Recognize and distinguish common pitfalls in numerical computing
- Apply fitting methods such as polynomial approximation to data sets
- Compare the properties of various numerical integration schemes
- Differentiate between the use of the 2-norm and the ?-norm in approximating functions
- Derive and evaluate numerical methods for solving differential equations
- Create, test, and apply Matlab programs which implement a range of numerical algorithms
- Describe and contrast the advantages of implicit versus explicit methods for different categories of initial value problems
- Recall the definition of the finite element method for solving differential equations and write Matlab programs that carry out the method for some specific equations
- Present and explain a significant topic in numerical methods for a final project

Assessment and grading policy

There will be regular assignments, a midterm exam and a final project. Students will also present sections of the textbook in class. The assignments will be mostly computational, but some will be theoretical problems. The final project will consist of research on a topic that is related to the class material and that you choose in discussion with the instructor. The final exam will consist of a presentation of your project to the class and submission of final project written report.

The midterm exam will take place on Thursday, October 31, during class. The project presentations will take place on Tuesday, December 10, and Thursday, December 12, during class. The project report must be submitted by Sunday, December 15, 23:59.

Homework (mean of 13 best grades)	30 %
Presentation of textbook sections (2)	10 %
Midterm exam	30 %
Final project (presentation 15 %, report 15 %)	30 %

Letter grades will be determined according to the following table.

Percent score	>92	90-92	87-89	83-86	80-82	75-79
Letter grade	A	A-	B+	B	B-	C+
Percent score	70-74	65-69	60-64	50-59	<50	
Letter grade	C	C-	D+	D	F	