UCLouvain

lmat1151

2024

Numerical analysis : tools and software of calculus

5.00 credits	30.0 h + 45.0 h	Q1

Teacher(s)	Van Schaftingen Jean ;
Language :	French > English-friendly
Place of the course	Louvain-la-Neuve
Prerequisites	Prerequirements to follow the course LMAT1151 are the courses LMAT1131 and LMAT1121. In particular : knowledge of basic notions of linear algebra (vector spaces, matrices, eigenvalues and eigenvectors, determinant, rank) and analysis (convergence, continuity and differentiability, integrals).
Main themes	Sources of numerical errors, direct and iterative methods to solve linear systems of equations, iterative methods to solve non-linear equations, least square approximation, numerical integration.
Learning outcomes	**At the end of this learning unit, the student is able to :** 1 Contribution of the course to learning outcomes in the Bachelor in Mathematics programme. By the end of this activity, students will have made progress in: - Recognise and understand a basic foundation of mathematics. -- Choose and use the basic tools of calculation to solve mathematical problems. -- Recognise the fundamental concepts of important current mathematical theories. -- Establish the main connections between these theories, analyse them and explain them through the use of examples. - Identify, by use of the abstract and experimental approach specific to the exact sciences, the unifying features of different situations and experiments in mathematics or in closely related fields (probability and statistics, physics, computing). - Show evidence of abstract thinking and of a critical spirit. -- Argue within the context of the axiomatic method Recognise the key arguments and the structure of a proof. -- Construct and draw up a proof independently. -- Evaluate the rigour of a mathematical or logical argument and identify any possible flaws in it. -- Distinguish between the intuition and the validity of a result and the different levels of rigorous understanding of this same result. Learning outcomes specific to the course. By the end of this activity, students will be able to: - Understand which are the possible sources of errors in a numerical method. - Solve numerical problems using Matlab. - Apply direct and iterative methods to solve linear systems. - Solve a linear system in the least square sense. - Understand the main idea of some methods of numerical integration.
Evaluation methods	• 40% for practical assignments submitted, • 60% for the open book oral exam. The practical assignment mark can only be obtained during the course quadrimester and will therefore have their mark attached to all the sessions of the entire academic year.
Teaching methods	• Theoretical sessions aimed at introducing the fundamental methods and concepts of numerical analysis and motivating them by showing examples and applications, through group discussions and presentation by the professor, • Computer lab sessions work to implement and use numerical methods on Python in the SciPy ecosystem, with code and graphics being submitted for evaluation, • Online discussion forum.
Content	This activity will address the following topics : • complexity of numerical algorithms, • floating-point representation, arithmetic and error,

	• numerical differentiation and integration, • solution nonlinear equations, • solutions of linear systems, • introduction to numerical integration of ordinary differential equations.
Inline resources	Course materials (lecture notes and exercises) will be published on Moodle.
Faculty or entity in charge	MATH

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Minor in Mathematics	MINMATH	5		🔍
Bachelor in Mathematics	MATH1BA	5		🔍