Syllabus

Course Description

Course Title	Computational Mathematics
Course Code	76268
Course Title Additional	
Scientific-Disciplinary Sector	MATH-05/A
Language	Italian
Degree Course	Bachelor in Computer Science
Other Degree Courses (Loaned)	
Lecturers	Prof. Bruno Carpentieri, Bruno.Carpentieri@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/38064
Teaching Assistant	
Semester	Second semester
Course Year/s	3
CP	6
Teaching Hours	40
Lab Hours	20
Individual Study Hours	90
Planned Office Hours	18
Contents Summary	· Introduction to Computational Modelling and Finite Precision Computation · Matrix Factorization Methods: LU, Cholesky, and QR Factorization · Linear Algebra for Data Science: Principal Component Analysis (PCA) and Data Compression (SVD) · Linear and Nonlinear Regression Models · Iterative Methods for Nonlinear Regression and Optimization · The Google PageRank Problem and Numerical Eigenvalue Methods

Course Topics	· Introduction to Computational Modelling, Numerical Error, and Finite-Precision Computation · Numerical Linear Algebra: LU, Cholesky, and QR Factorization · SVD, Data Compression, and Principal Component Analysis · Least Squares, Linear and Nonlinear Regression, and Gauss–Newton Method · Dynamical Models: Numerical ODEs and Parameter Estimation · Eigenvalue Problems and the Google PageRank Model
Keywords	Computational modelling; numerical linear algebra; least squares; singular value decomposition; parameter estimation.
Recommended Prerequisites	
Propaedeutic Courses	
Teaching Format	The course includes frontal lectures and exercises.
Mandatory Attendance	Attendance is not mandatory but strongly recommended. Non-attending students should contact the lecturer at the start of the course to agree on the modalities of the independent study.
Specific Educational Objectives and Learning Outcomes	Knowledge and understanding: - D1.1: Have a solid knowledge of mathematical analysis, algebra, numerical calculus, discrete mathematics and elementary notion of logic that are in support of computer science. Applying knowledge and understanging: - D2.1: Be able to use the tools of mathematics and logic to solve problems. Ability to make judgments: - D3.2: Be able to work autonomously according to the own level of knowledge and understanding. Communication skills: - D4.1: Be able to use one of the three languages English, Italian and German, and be able to use technical terms and communication appropriately. Learning skills: - D5.1: Have developed learning capabilities to pursue further studies with a high degree of autonomy.
Specific Educational	

Objectives and Learning Outcomes (additional info.)	
Assessment	The written exam will include verification questions, transfer-of-knowledge questions, and exercises. The aim is to assess the extent to which students have acquired knowledge and understanding, are able to apply that knowledge, and can demonstrate critical judgment. The same assessment criteria apply to both attending and non-attending students.
Evaluation Criteria	The final written exam accounts for 100% of the grade and covers the entire program. Exam questions will be assessed based on correctness, clarity, quality of argumentation, and problem-solving ability. The same evaluation criteria apply to both attending and non-attending students.
Required Readings	· M. T. Heath, *Scientific Computing: An Introductory Survey*, revised 2nd ed., SIAM, 2018.
Supplementary Readings	· A. Greenbaum and T. P. Chartier, *Numerical Methods: Design, Analysis, and Computer Implementation of Algorithms*, Princeton University Press, 2012 · J. Shlens, "A Tutorial on Principal Component Analysis," 2014 · D. F. Griffiths and D. J. Higham, *Numerical Methods for Ordinary Differential Equations: Initial Value Problems*, Springer, 2010 · Lecture slides, selected articles, MATLAB documentation
Further Information	If the use of specific software is required, it will be communicated during class by the lecturer.
Sustainable Development Goals (SDGs)	Quality education