SYLLABUS
COURSE DESCRIPTION

COURSE TITLE	**Mathematics I**
COURSE CODE	76201
SCIENTIFIC SECTOR	MAT/02
DEGREE	Bachelor in Computer Science
SEMESTER	1st
YEAR	1st
CREDITS	12
MODULAR	Yes

TOTAL LECTURING HOURS	80
TOTAL LAB HOURS	40
PREREQUISITES	There are no prerequisites.
COURSE PAGE	https://ole.unibz.it/

SPECIFIC EDUCATIONAL OBJECTIVES	• Type of course: “di base” for L-31 • Scientific area: “Formazione matematica-fisica” for L-31 MODULE 1: The aim of this module is to present a rather comprehensive treatment of linear algebra and its applications. It covers vector and matrix theory to some degree of mathematical logic and rigor, emphasizing topics useful in other disciplines such as solving linear equations and computing determinants and eigenvalues of matrices. The course also provides practice in using linear algebra to think about problems in computer science, and in actually using linear algebra computations to address these problems. MODULE 2: The aim of the course is to provide students with an understanding of the formal foundations of classical logical languages and related methodologies to reason over formal logical theories. An overview of the proof methods based on logics, and useful in mathematics and computer science, will be given. The course will also demonstrate the ability to use logic as a tool for representation and reasoning in computer science. The students will be trained to apply the induction principle to various computer science settings and in particular to check the correctness of Algorithms via the notion of Loop Invariant. Furthermore, methods to analyse and describe the main

	properties of Relations, Functions, Graphs and Trees will also be studied as well as the principles governing the complex mathematical notion of Cardinality of a set including the notion of countably infinite sets.

MODULE 1	**Linear Algebra**
MODULE CODE	76201A
MODULE SCIENTIFIC SECTOR	MAT/02
CREDITS	6
LECTURER	Bruno Carpentieri, http://www.inf.unibz.it/~bcarpentieri/
SCIENTIFIC SECTOR OF THE LECTURER	MAT/08
TEACHING LANGUAGE	English
OFFICE HOURS	Office 310, Bruno.Carpentieri@unibz.it, By appointment via email.
TEACHING ASSISTANT	Bruno Carpentieri, Piazza Domenicani, 3 – Office 3.10, Bruno.Carpentieri@unibz.it Simone Ugolini, Piazza Domenicani, 3 – Office 1.04, Simone.Ugolini@unibz.it
OFFICE HOURS	TBA
LIST OF TOPICS COVERED	• Algebra and numbers: groups, rings and fields, real numbers, complex numbers, line and plane topology and geometry. • Vectors and matrices: 2 and 3 dimensional Euclidean spaces, vectors in arbitrary dimensions, systems of linear equations, matrices and Gaussian elimination. • Matrix analysis: triangular matrices, triangular factorization, symmetric and orthogonal matrices. • Abstract vector spaces: abstract vectors spaces, linear independence, generators, bases, inner products and orthogonality, polynomials, trigonometric functions, linear differential equations. • Linear operators: linear maps and operators, matrix representation, coordinate systems change of basis, general linear systems. • Spectral analysis: eigenvalues and eigenvectors, determinants, characteristic polynomials, Cayley-Hamilton theorem, orthogonal transformations and matrices, diagonalization, Schur's theorem.
TEACHING FORMAT	Frontal lectures, exercises in lab.

MODULE 2	**Logic and Discrete Mathematics**
MODULE CODE	76201B
MODULE SCIENTIFIC SECTOR	MAT/01
CREDITS	6
LECTURER	Oliver Kutz, http://www.inf.unibz.it/~okutz/
SCIENTIFIC SECTOR OF THE LECTURER	INF/01
TEACHING LANGUAGE	English
OFFICE HOURS	Office 303, Oliver.Kutz@unibz.it By appointment via email.
TEACHING ASSISTANT	Oliver Kutz, Piazza Domenicani, 3 - Office 303, Oliver.Kutz@unibz.it Ognjen Savkovic, , Piazza Domenicani, 3 - Office 2.02, savkovic@inf.unibz.it
OFFICE HOURS	By appointment via email.
LIST OF TOPICS COVERED	• Numbers and number theory: types of numbers, closure properties of Integer Numbers, prime numbers and factorization, fundamental theorem of arithmetic, induction principle and recursion, structural induction, applications of induction to CS: loop invariant • Sets, functions and counting: properties of sets, powersets, Russel paradox and Halting problem, functions: injections, surjections, bijections, cardinality of sets: countably infinite sets and uncountable sets • Relations and graphs: properties of relations (transitivity, reflexivity, symmetry, etc.), equivalence and partial order relations, trails, paths and circuits, graph isomorphisms • Propositional logic: syntax, semantics and Boolean algebra, logical inference, tableaux calculus • First-order logic: syntax, semantics and model theory, proof theory and logical inference, tableaux calculus: an algorithmic view on logic • Logic in computer science: applications of logic, logic as a modelling language
TEACHING FORMAT	Frontal lectures, exercises in lab, mid-term exam.

LEARNING OUTCOMES	**Knowledge and understanding** • Have a solid knowledge of the theoretical foundations of computer science; • Have a solid knowledge of mathematics, statistics, probability theory, logics and physics that are in support of computer science; **Applying knowledge and understanding** • Be able to use the tools of mathematics and logics to solve problems; **Making judgments** • Be able to work autonomously according to the own level of knowledge and understanding and to take the responsibility for development projects or IT consulting; **Communication skills** • To be able to use English technical terms and communication appropriately; • Be able to structure and write scientific documentation; **Ability to learn** • Have developed learning capabilities to pursue further studies with a high degree of autonomy; • Be able to learn the innovative features of state-of-the-art technologies and information systems;

ASSESSMENT	Written exam (with an optional mid-term written exam). In the written exam (including the optional mid-term exam) there will be verification questions, transfer of knowledge questions and exercises. The learning outcome related to knowledge and understanding, applying knowledge and understanding and those related to the student's ability to learn and apply the acquired learning skills, will be assessed by the written exam.
ASSESSMENT LANGUAGE	English

EVALUATION CRITERIA AND CRITERIA FOR AWARDING MARKS	• Mid-term Written Exam (optional, counts as 50% of the full mark)
	• Final Written Exam
	  o 50% covering a reduced program for students who passed the mid-term exam, or
	  o 100% covering the full program in case of failure or non-attendance of the Mid-term. Written exam questions will be evaluated in terms of correctness, clarity, quality of argumentation, problem solving ability.
	
	Note: In case of a positive mark in the mid-term exam the results can be kept , or the student can retake the 100% exam (in which case the results of the mid term will no longer be taken into consideration); this applies to all 3 regular exam sessions.

REQUIRED	MODULE 1:

READINGS	Gilbert Strang: Introduction to Linear Algebra, Fourth Edition MODULE 2: Mordechai Ben-Ari: Mathematical Logic for Computer Science, Springer-Verlag [Main book for Logic part] Susanna Epp: Discrete Mathematics with Applications, Cengage Learning, 4th edition. [Main book for Discrete Math part]
SUPPLEMENTARY READINGS	MODULE 1: Philip N. Klein: Coding the Matrix Linear Algebra through Applications to Computer Science, First Edition Carl D. Mayer: Matrix Analysis and Applied Linear Algebra MODULE 2: H. Enderton: A Mathematical Introduction to Logic, Academic Press. [Auxiliary book for Logic part] H. D. Ebbinghaus, J. Flum, W. Thomas: Mathematical Logic, Springer-Verlag. [Auxiliary book for Logic part] Kenneth Rosen: Discrete Mathematics and its Applications, McGraw-Hill, 7th edition. [Auxiliary book for Discrete Math part]
SOFTWARE USED	Matlab