COURSE DESCRIPTION – ACADEMIC YEAR 2024/2025

Course title	**Algorithms for Data Science**
Course code	73053
Scientific sector	INF/01
Degree	Master in Computational Data Science (LM-18)
Semester	1
Year	2
Credits	6
Modular	No

Total lecturing hours	40
Total lab hours	20
Attendance	Attendance is not compulsory but recommended. Non-attending students must contact the lecturer at the start of the course to agree on the modalities of the independent study. Exam modalities for non-attending students are the same as for attending students.
Prerequisites	Knowledge of Data Structures, and of Algorithms to access and manage different data structures is highly recommended.
Course page	https://ole.unibz.it/ and TEAMS

Specific educational objectives	The course belongs to the type "caratterizzanti – discipline informatiche". The aim of the course is to provide students with the fundamental skills needed to develop algorithms using data structures, analyze their correctness and efficiency, and to understand the computational techniques used when looking for an optminal solution. The students will be able to: • design programs that use computer resources efficiently; • being aware of optimazation techniques; • realize that there are problems that are computationally impractical or even impossible to solve by a computer; • look for approximate solutions in case the problem is hard computationally. The course is devoted to identify clean algorithmic formulations when solving complex problems from different areas of computation. Students will learn how to devise efficient algorithms for different kinds of problems. In particular, students will be trained to apply different algorithmic strategies when problems to solve can be encoded by means of Graphs. When a problem ask for an optimal solution, the student will be able to use Linear Programming techniques to solve them. Concerning the notions of computability and complexity, the students will acquire a strong formal tool to recognize when a problem is inherently complex, independently of any algorithm developed to solve the problem. Since many natural problems in computer science are NP-complete, the development of methods to deal with intractable problems has become a crucial issue in the study of algorithms. Thus,

	the course presents various solutions to tackle inherently complex problems by either designing an exact algorithm or try to approximate the problem itself.

Lecturer	Alessandro Artale
Contact	Office: POS 2.03 Faculty of Engineering, POS Building, Piazza Domenicani 3, artale@inf.unibz.it
Scientific sector of lecturer	INF/01
Teaching language	English
Office hours	During the lecture time span, Tuesday 16:00 - 18:00, arrange beforehand by email.
Lecturing Assistant (if any)	--
Contact LA	--
Office hours LA	--
List of topics	• Introduction to Algorithm complexity and basic Graph notions • Algorithms on Graphs • Net-Flow Algorithms • Algorithms for numerical optimization: Linear Programming • Fundamentals of computational complexity • Heuristic and approximation strategies for solving hard problems
Teaching format	Frontal lectures, exercices during the lab

Learning outcomes	Knowledge and understanding: • D1.1 - Knowledge of the key concepts and technologies of data science disciplines • D1.2 - Understanding of the skills, tools and techniques required for an effective use of data science • D1.11 - Knowledge of the main algorithms for data analysis, and of elements of the complexity theory Applying knowledge and understanding: • D2.2 - Ability to address and solve a problem using scientific methods • D2.4 - Ability to develop programmes and use tools for the analysis and management of data and related infrastructures Making judgments • D3.2 - Ability to autonomously select the documentation (in the form of books, web, magazines, etc.) needed to keep up to date in a given sector Communication skills • D4.1 - Ability to use English at an advanced level with particular reference to disciplinary terminology. Learning skills • D5.3 - Ability to deal with problems in a systematic and creative way and to appropriate problem solving techniques.

Assessment	Written exam. • In the written 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 ability to learn and the acquired learning skills will be assessed by the written exam. The exam modalities for non-attending students are the same as for attending students.
Assessment language	English
Assessment Typology	Monocratic
Evaluation criteria and criteria for awarding marks	Final Written Exam 100% Written exam questions will be evaluated in term of correctness, clarity of answer, quality of argumentation, problem solving ability.

Required readings	**Algorithm Design.** Jon Kleinberg and Éva Tardos. Pearson, 2005. **Linear Programming and Network Flow.** Mokhtar S. Bazaraa, John J. Jarvis and HanifD.Sherali. Wiley Subject Librarian: David Gebhardi, David.Gebhardi@unibz.it
Supplementary readings	--
Software used	--