Syllabus

Course Description

Course Title	Machine Learning
Course Code	27503
Course Title Additional	
Scientific-Disciplinary Sector	INFO-01/A
Language	English
Degree Course	Master in Data Analytics for Economics and Management
Other Degree Courses (Loaned)	Loaned from course 73078 - Master in Computing for Data Science (LM-18)
Lecturers	Dr. Andrea Rosani, Andrea.Rosani@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/43727 Prof. Giuseppe Di Fatta, Giuseppe.DiFatta@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/46582
Teaching Assistant	
Semester	Second semester
Course Year/s	1
CP	6
Teaching Hours	40
Lab Hours	20
Individual Study Hours	-
Planned Office Hours	18
Contents Summary	This course offers a comprehensive introduction to the core concepts, techniques, and algorithms of machine learning, as well as some platforms commonly used in practice. Students will explore essential topics such as data preprocessing—including data manipulation, transformation, feature selection, and dimensionality reduction— followed by key methods in supervised learning like regression and classification. The course covers unsupervised

	learning approaches such as clustering and association rule mining. Moreover, Artificial Neural Networks are covered through the study of the perceptron, the multi-layer perceptron. An overview of deep networks and multi-task deep learning is provided. Foundational ideas, principles and applications of Reinforcement Learning are also covered. Throughout the course, students will not only develop a solid understanding of the theoretical underpinnings of these algorithms but also acquire practical skills in implementing data workflows, applying machine learning methods to real-world data, and evaluating model performance. Applications across diverse domains are discussed to illustrate the impact and versatility of machine learning.
Course Topics	The main topics include: • Data Analysis • Model selection • Unsupervised learning • Supervised learning • Deep learning • Reinforcement learning
Keywords	Machine Learning, Data Analysis, Data Mining, Data Science
Recommended Prerequisites	Basics of Linear Algebra, Calculus and Statistics
Propaedeutic Courses	
Teaching Format	Frontal lectures, lab assignments, project work.
Mandatory Attendance	The attendance is not compulsory, but students are highly encouraged to attend both lectures and labs.
Specific Educational Objectives and Learning Outcomes	Intended Learning Outcomes (ILO) ILO 1 Knowledge and understanding: ILO 1.1 Students acquire programming skills specifically geared towards data analysis and statistical methodologies aimed at implementing models and analysing large datasets.In particular, IT knowledge is oriented towards machine learning methods, knowledge of modern data management and storage techniques, including data from sources that are heterogeneous in type and structure, such as spatio-temporal data and high-dimensional data, including in cloud environments, and the implementation of algorithms for massive data.

	ILO 2 Applying knowledge and understanding: ILO 2.1 Ability to apply and implement, through the development of algorithms, techniques for analysing large datasets and spatial and temporal data, under conditions of uncertainty, in order to ensure the usefulness, quality and effectiveness of the analysis. ILO 2.2 Ability to use IT technologies, techniques and methodologies for the acquisition, management, integration, analysis and visualisation of large datasets, in order to ensure scalability in terms of the volume and speed of dataset acquisition. These skills relate in particular to large database and dataset management systems and related visualisation techniques, models and languages for expressing data semantics, learning techniques, decision-making models, information system organisation, web search techniques and data flow management techniques. ILO 3 Making judgements: ILO 3.1 The student acquires the ability to apply acquired knowledge to interpret data in order to make directional and operational decisions in a business context. ILO 3.2 The student acquires the ability to apply acquired knowledge to support processes related to production, management and risk promotion activities and investment choices through the organisation, analysis and interpretation of complex databases. ILO4 Communication skills: ILO 4.1 The student acquires the ability to communicate effectively in oral and written form the specialised content of the individual disciplines, using different registers, depending on the recipients and the communicative and didactic purposes, and to evaluate the formative effects of his/her communication. ILO 5 Learning skills: ILO 5.1 The student acquires knowledge of scientific research tools. He/she will also be able to make autonomous use of information technology to carry out bibliographic research and investigations both for his/her own training and for further education. Furthermore, through the curricular teaching and the activities related to the preparation of the final thesis, she will be able to acquire the ability

	- to identify thematic connections and to establish relationships between methods of analysis and application contexts; - to frame a new problem in a systematic manner and to implement appropriate analysis solutions; - to formulate general statistical-econometric models from the phenomena studied.
Specific Educational Objectives and Learning Outcomes (additional info.)	
Assessment	• A project, which consists in applying/implementing machine learning algorithms to real-world data, describing the approach and the adopted solution, and presenting the results of an experimental analysis (ILOs 1.1, 2.1, 2.2, 3.1, 3.2, 4.1, 5.1). • A final oral exam with questions on the content of the course (ILOs 1.1, 2.1, 3.1, 3.2, 4.1, 5.1).
Evaluation Criteria	• Project: 50% of the final mark • Oral exam: 50% of the final mark Note: both project and exam are required to be passed. Criteria for awarding marks Oral exam: ability to present and explain machine learning concepts, methods and algorithms. Ability to select appropriate solutions for machine learning problems. Project: ability to implement data workflow to apply machine learning algorithms to real-world problems, correctness and clarity of the solution, experimental results, ability to solve machine learning problems with the appropriate technique.
Required Readings	• Introduction to Data Mining, by Pan-Ning Tang, M. Steinbach, A. Karpatne, V. Kumar. Pearson Education Ltd (2nd Edition, 2020).
Supplementary Readings	• Machine Learning, Tom Mitchell • Pattern Recognition and Machine Learning, Christopher Bishop
Further Information	
Sustainable Development	Quality education

Goals (SDGs)	