Syllabus

Course Description

Course Title	Machine Learning
Course Code	73078
Course Title Additional	
Scientific-Disciplinary Sector	IINF-05/A
Language	English
Degree Course	Master in Computing for Data Science
Other Degree Courses (Loaned)	
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	90
Planned Office Hours	
Contents Summary	• Data Analysis • Model selection • Unsupervised learning • Supervised learning • Deep learning • Reinforcement learning

Course Topics	This course offers a comprehensive introduction to the fundamental concepts, techniques, and algorithms of machine learning, as well as some platforms commonly used in practice. Students will explore introductory topics such as data preprocessing, followed by key methods in supervised and unsupervised learning, such as regression, classification, clustering and association rule mining. Moreover, Artificial Neural Networks are covered through the study of the perceptron and 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.
Keywords	Unsupervised Learning, Supervised Learning, Deep Learning, Reinforcement Learning
Recommended Prerequisites	Basics of Linear Algebra, Calculus and Statistics.
Propaedeutic Courses	
Teaching Format	Frontal lectures, lab assignments, project work.
Mandatory Attendance	Although attendance is not compulsory, students are highly encouraged to attend both lectures and labs.
Specific Educational Objectives and Learning Outcomes	The course belongs to the type "caratterizzanti – discipline informatiche" in the curricula “Data Analytics” and “Data Management”. 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. Knowledge and understanding: • D1.1 - Knowledge of the key concepts and technologies of data science disciplines • D1.7 - Knowledge of artificial intelligence techniques and methods for the implementation of intelligent systems

	Applying knowledge and understanding: • D2.1 - Practical application and evaluation of tools and techniques in the field of data science • D2.2 - Ability to address and solve a problem using scientific methods • D2.6 - Ability to apply innovative techniques of data mining and machine learning to extract knowledge from complex and heterogeneous data 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 • D4.3 - Ability to structure and draft scientific and technical documentation
Specific Educational Objectives and Learning Outcomes (additional info.)	
Assessment	- A project, which consists in applying machine learning algorithms to real-world data, describing the algorithms and the adopted workflow, and presenting the results of an experimental analysis. - A final oral exam with questions on the content of the course.
Evaluation Criteria	Evaluation criteria • Project: 50% of the mark • Final oral exam: 50% of the mark. Important 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). Subject Librarian: David Gebhardi, David.Gebhardi@unibz.it
Supplementary Readings	Recommended books for supplementary material and reference: Machine Learning, Tom Mitchell, McGraw Hill, 1997 Pattern Recognition and Machine Learning, by Christopher M. Bishop, Springer (2006) Data Mining and Machine Learning: Fundamental Concepts and Algorithms, by Mohammed J. Zaki and Wagner Meira, Jr, Cambridge University Press (2nd Ed.), 2020 Neural Networks and Deep Learning, by Charu C. Aggarwal, Springer (2018) Deep Learning, by Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press (2016)
Further Information	Software used: - Python and Jupyter Notebook (https://jupyter.org) - KNIME (https://www.knime.com)
Sustainable Development Goals (SDGs)	Quality education