Fakultät für Ingenieurwesen
Facoltà di Ingegneria
Faculty of Engineering

COURSE DESCRIPTION – ACADEMIC YEAR 2025/2026

Course title	**Machine Learning**
Course code	73078
Scientific sector	ING-INF/05
Degree	Master in Computing for Data Science (LM-18)
Semester	2
Year	1
Credits	6
Modular	No

Total lecturing hours	40
Total lab hours	20
Attendance	Although attendance is not compulsory, students are highly encouraged to attend both lectures and labs.
Prerequisites	Basics of Linear Algebra, Calculus and Statistics
Course page	A dedicated team on MS Teams

Specific educational objectives	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. 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.

Lecturer	Giuseppe Di Fatta
Contact	Office B1.5.18, Faculty of Engineering, NOI Techpark, Via Bruno Buozzi, 1 giuseppe.difatta@unibz.it
Scientific sector of lecturer	ING-INF/05
Teaching language	English
Office hours	To be arranged beforehand by email.
Lecturing Assistant (if any)	Andrea Rosani

Contact LA	Office B1.5.24, Faculty of Engineering, NOI Techpark, Via Bruno Buozzi, 1 Andrea.Rosani@unibz.it
Office hours LA	To be arranged beforehand by email.
List of topics	• Data Analysis • Model selection • Unsupervised learning • Supervised learning • Deep learning • Reinforcement learning
Teaching format	Frontal lectures, lab assignments, project work.

Learning outcomes	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

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. • A final oral exam with questions on the content of the course.
Assessment language	English
Assessment Typology	Monocratic
Evaluation criteria and criteria for awarding marks	**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)
Software used	• Python and Jupyter Notebook (https://jupyter.org) • KNIME (https://www.knime.com)