

## COURSE DESCRIPTION – ACADEMIC YEAR 2022/2023

<b>Course title</b>	<b>Machine Learning</b>
<b>Course code</b>	47574
<b>Scientific sector</b>	INF/01
<b>Degree</b>	Master in Energy Engineering (LM-33)
<b>Semester</b>	2
<b>Year</b>	1
<b>Credits</b>	6
<b>Modular</b>	No
<b>Total lecturing hours</b>	40
<b>Total lab hours</b>	20
<b>Attendance</b>	The attendance is not compulsory, but students are highly encouraged to attend both lectures and labs.
<b>Prerequisites</b>	Basics of Linear Algebra, Calculus and Statistics
<b>Course page</b>	<a href="https://ole.unibz.it/">https://ole.unibz.it/</a> and Team on MS Teams
<b>Specific educational objectives</b>	<p>The course belongs to the type "caratterizzanti – discipline informatiche" in the curricula "Data Analytics" and "Data Management".</p> <p>This course provides an introduction to machine learning concepts, techniques, algorithms and platforms. Topics include: preprocessing and feature selection, dimensionality reduction, supervised learning (regression, classification), unsupervised learning (clustering, association rule mining), deep learning and reinforcement learning. The course also discusses applications of machine learning to data in various domains.</p> <p>In this course, students will learn the most important machine learning concepts and methods. Along with the theoretical knowledge on the algorithms, students will gain practical skills for implementing data workflows and applying the algorithms to real-world problems for their performance evaluation.</p>
<b>Lecturer</b>	<a href="#">Giuseppe Di Fatta</a>
<b>Contact</b>	Piazza Domenicani 3, <a href="mailto:giuseppe.difatta@unibz.it">giuseppe.difatta@unibz.it</a>
<b>Scientific sector of lecturer</b>	ING-INF/05
<b>Teaching language</b>	English
<b>Office hours</b>	To be arranged beforehand by email.
<b>Lecturing Assistant (if any)</b>	<a href="#">Andrea Rosani</a>
<b>Contact LA</b>	Piazza Domenicani 3, <a href="mailto:andrea.rosani@unibz.it">andrea.rosani@unibz.it</a>
<b>Office hours LA</b>	To be arranged beforehand by email.
<b>List of topics</b>	<ul style="list-style-type: none"> <li>• Data Analysis</li> <li>• Model selection</li> <li>• Unsupervised learning</li> <li>• Supervised learning</li> <li>• Deep learning</li> <li>• Reinforcement learning</li> </ul>

<b>Teaching format</b>	Frontal lectures, lab assignments, project work.
<b>Learning outcomes</b>	<p>Knowledge and understanding:</p> <ul style="list-style-type: none"> <li>• D1.1 - Knowledge of the key concepts and technologies of data science disciplines</li> <li>• D1.7 - Knowledge of artificial intelligence techniques and methods for the implementation of intelligent systems</li> </ul> <p>Applying knowledge and understanding:</p> <ul style="list-style-type: none"> <li>• D2.1 - Practical application and evaluation of tools and techniques in the field of data science</li> <li>• D2.2 - Ability to address and solve a problem using scientific methods</li> <li>• D2.6 - Ability to apply innovative techniques of data mining and machine learning to extract knowledge from complex and heterogeneous data</li> </ul> <p>Making judgments</p> <ul style="list-style-type: none"> <li>• 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</li> </ul> <p>Communication skills</p> <ul style="list-style-type: none"> <li>• D4.1 - Ability to use English at an advanced level with particular reference to disciplinary terminology</li> <li>• D4.3 - Ability to structure and draft scientific and technical documentation</li> </ul>
<b>Assessment</b>	<ul style="list-style-type: none"> <li>• 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.</li> <li>• A final oral exam with questions on the content of the course.</li> </ul>
<b>Assessment language</b>	English
<b>Assessment Typology</b>	Monocratic
<b>Evaluation criteria and criteria for awarding marks</b>	<p><b>Evaluation criteria</b></p> <ul style="list-style-type: none"> <li>• Project: 50% of the mark</li> <li>• Final oral exam: 50% of the mark.</li> </ul> <p>Important note: both project and exam are required to be passed.</p> <p><b>Criteria for awarding marks</b></p> <p>Oral exam: ability to present and explain machine learning concepts, methods and algorithms. ability to select appropriate solutions for machine learning problems.</p> <p>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.</p>

<p><b>Required readings</b></p>	<ul style="list-style-type: none"> <li>• Introduction to Data Mining , by Pan-Ning Tang, M. Steinbach, A. Karpatne, V. Kumar. Pearson Education Ltd (2nd Edition, 2020).</li> </ul> <p>Subject Librarian: David Gebhardi, <a href="mailto:David.Gebhardi@unibz.it">David.Gebhardi@unibz.it</a></p>
<p><b>Supplementary readings</b></p>	<p>Recommended books for supplementary material and reference:</p> <ul style="list-style-type: none"> <li>• Machine Learning, Tom Mitchell, McGraw Hill, 1997</li> <li>• Pattern Recognition and Machine Learning, by Christopher M. Bishop, Springer (2006)</li> <li>• Data Mining and Machine Learning: Fundamental Concepts and Algorithms, by Mohammed J. Zaki and Wagner Meira, Jr, Cambridge University Press (2nd Ed.), 2020</li> <li>• Neural Networks and Deep Learning, by Charu C. Aggarwal, Springer (2018)</li> <li>• Deep Learning, by Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press (2016)</li> </ul>
<p><b>Software used</b></p>	<ul style="list-style-type: none"> <li>• Python and Jupyter Notebook (<a href="https://jupyter.org">https://jupyter.org</a>)</li> <li>• KNIME (<a href="https://www.knime.com">https://www.knime.com</a>)</li> </ul>