COURSE DESCRIPTION – ACADEMIC YEAR 2020/2021

Course title	**Advanced Topics in Machine Learning**
Course code	73021
Scientific sector	ING-INF/05
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 students are highly encouraged to attend both lectures and labs.
Prerequisites	Having some fundamentals of Machine Learning is a plus, but the course will be self-contained.
Course page	https://ole.unibz.it/

Specific educational objectives	The course belongs to the type "caratterizzanti – discipline informatiche" in the curricula "Data Analytics" and "Data Management". This course provides an introduction to deep learning and its applications. Topics include: training deep learning neural networks; computer vision and image classification with Convolutional Neural Networks; sequence models, representation and generative learning, and deep reinforcement learning. In this course, students will learn about the most important deep learning neural networks. Students will gain the theoretical and practical know-how needed to understand and use deep learning.

Lecturer	Roberto Confalonieri
Contact	Faculty of Computer Science, Domenikanerplatz 3 - Piazza Domenicani, Office 2.11, roberto.confalonieri@unibz.it
Scientific sector of lecturer	INF/01
Teaching language	English
Office hours	Wednesday 14:00-16:00, to be arranged beforehand by email.
Lecturing Assistant (if any)	--
Contact LA	--
Office hours LA	--
List of topics	• Computer vision • Image classification • Convolutional Neural Networks (CNN) • Training Neural Networks • Understanding and visualizing Convolutional Neural Networks • Deep Reinforcement Learning
Teaching format	• Frontal lectures • Lab exercises

	• Group projects

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 Learning skills • D5.2 - Ability to autonomously keep oneself up to date with the developments of the most important areas of data science

Assessment	The assessment is based on: • **lab assignments**, which are focused on specific topics taught in the course. They are meant to motivate students to study throughout the semester and consolidate the theoretical concepts taught in class; • a **group project**, which evaluates if the students acquired the expected deep learning knowledge and skills; and • an **oral** exam, which evaluates the students' understanding of the theoretical concepts taught in class by reviewing and discussing the group project.
Assessment language	English
Assessment Typology	Monocratic
Evaluation criteria and criteria for awarding marks	**Evaluation criteria:** (i) up to **10** points will be awarded to the solutions of the lab assignments; (ii) up to **60** points will be awarded to the group project; (iii) up to **30** points will be awarded to the oral exam. In order to enroll for the oral exam, the students must have been awarded at least **30** points on (i) and (ii) together.

	Evaluation criteria for awarding marks: • **lab assignments:** ability to apply programming and deep learning techniques in specific tasks; • **group project:** ability to apply deep learning techniques, creativity, ability to work in team and solve problems collaboratively; • **oral exam:** ability to summarise deep learning concepts learned during the course and the group project, correctness and clarity of answers.

Required readings	Lecture notes and python notebooks will be handed out during the course. Subject Librarian: David Gebhardi, David.Gebhardi@unibz.it
Supplementary readings	Suggested books: • Ian Goodfellow, Yoshua Bengio and Aaron Courville. 2016. Deep Learning. MIT Press. http://www.deeplearningbook.org Available at UNIBZ library, Permanent link: https://ubz-primo.hosted.exlibrisgroup.com/permalink/f/pok0fm/39UBZ_ALMA_DS21185783980001241 • Aurélien Géron. 2019. Hands-On Machine Learning with Scikit-Learn, Keras, and Tensorflow. 2nd edition. Available through O' Reilly Safari Books Online, Permanent Link: https://ubz-primo.hosted.exlibrisgroup.com/permalink/f/pok0fm/39UBZ_ALMA_DS51192939070001241 Christopher M. Bishop. 2006. Pattern Recognition and Machine Learning (Information Science and Statistics). Springer-Verlag, Berlin, Heidelberg. ISBN: 978-0-387-31073-2 Available at UNIBZ library, Permanent link: https://ubz-primo.hosted.exlibrisgroup.com/permalink/f/pok0fm/39UBZ_ALMA_DS21104542330001241
Software used	The lab exercises will be done using *Python* or *Mathlab*, or other software tools.