**Digital Data Processing**

*Academic Year*: 2023/2024

*Professor*: Matteo Frosi

*Language*: English

**COURSE OBJECTIVES AND EXPECTED LEARNING RESULTS**

The main purpose of the course is to introduce students to an appropriate theoretical and practical knowledge of the topics of machine learning and, optionally, deep learning. Thanks to modern technologies and the enormous amount of data that companies have available, ad-hoc prediction models are increasingly in demand, especially in the agri-food sector. With a view to a future working environment for the students, the various topics will be dealt broadly, but not in depth, given the vastness of studies that have emerged in recent decades. Furthermore, the various themes will be accompanied by case studies, allowing students to understand and evaluate possible applications in the real world. At the end of the course, students will be able to:

1. Know the meaning and the theoretical bases of the topics of machine learning and, optionally, deep learning, knowing how to describe the various topics covered (e.g., regression and classification).
2. Analyze case studies and be able to independently identify appropriate algorithms and methodologies to address the various problems and requests.
3. Evaluate potential applications in the agri-food sector that can be managed/solved through the methods studied.

**COURSE PROGRAM**

The course will be addressed, broadly, as follows:

1. Agriculture 4.0, the need for technologies and introduction to data processing.
2. Supervised learning and regression.
3. Supervised learning and classification.
4. Unsupervised learning and clustering.
5. Deep learning and neural networks [OPTIONAL].

**STUDY MATERIAL AND BIBLIOGRAPHY**

* Bishop, Christopher M., and Nasser M. Nasrabadi. *Pattern recognition and machine learning*. Vol. 4. No. 4. New York: Springer, 2006.
* Faul, Anita C. *A concise introduction to machine learning*. CRC Press, 2019.
* Witten, Ian H., et al. "Practical machine learning tools and techniques." *DATA MINING*. Vol. 2. 2005.
* Chatterjee, Jyotir Moy, et al., eds. *Internet of Things and Machine Learning in Agriculture: Technological Impacts and Challenges*. Vol. 8. Walter de Gruyter GmbH & Co KG, 2021.
* Goodfellow, Ian, Yoshua Bengio, and Aaron Courville. *Deep learning*. MIT press, 2016.

**TEACHING METHOD**

The various theoretical concepts, together with the case studies, will be addressed in class, usually through presentations (an integral part of the study material), in the order described in the paragraph of the course program. At the end of each topic, a Python practical lesson will be carried out in which toy examples will be studied, to put into practice what has been seen during the lessons. Students are invited to explore the literature, looking for publications and documents related to the various methodologies in the agri-food sector.

**ASSESSMENT METHOD AND CRITERIA**

The knowledge learned by students will be tested with a written examination, worth 30 points. The exam will consist of a set of questions that require the students to write their answers in a limited time and space. The exam will test the recall, comprehension, analysis, synthesis and evaluation of the students regarding the content of the course. The written test will also require the subtends to demonstrate their writing abilities, such as clarity, coherence and organization.

**WARNINGS AND PREREQUISITES**

As this is an introductory course to the topics of data mining, machine learning, no prerequisites are needed to follow the content. However, a review of the fundamentals of algebra and statistics is recommended.

**SCHEDULE AND PLACE OF RECEPTION OF STUDENTS**

Professor Matteo Frosi is available after each lesson held in Cremona and to receive students, by appointment, also through remote meetings (Zoom or Microsoft Teams).