



— OBJECTIVES —

The primary objective of this course is to equip students with a solid foundation in machine learning, focusing on both theoretical understanding and practical applications. Students will be introduced to a variety of machine learning algorithms, leveraging some of the major libraries. Through this hands-on approach, they will gain a deeper understanding of how each algorithm functions, when to use them, and how to interpret their results. Students will learn to critically evaluate the advantages and limitations of machine learning compared to classical approaches, enabling them to make informed decisions based on the specific requirements of a given problem. In addition to learning how to choose the most appropriate machine learning algorithm, they will be adept at applying machine learning to complex, real-world problems in astronomy and beyond, with the confidence to tackle new challenges using data-driven techniques.

— EVALUATION —

The evaluation of the course will be carried out through two in-class written exams (one for each part) and a small take-on project:

- A 30 minute written exam (part 1 only, 25%)
- A 1 hour written exam (part 2 only, 40%)
- A small take-home project (part 1 only, 35%)

— MAIN PROGRESSION STEPS —

The course is divided into two parts. The first one is dedicated to the basics of Machine Learning, offering a broad introduction to the topic and the presentation of some of

the classical algorithms that are regularly used in the field. The second part will cover the topic of artificial intelligence and the question of neural networks in particular.

— BIBLIOGRAPHY & RESOURCES —

- Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 3rd Edition, Géron (2022)
- Statistics, Data Mining, and Machine Learning in Astronomy, Ivezić et al. (2019)

— CONTACT —

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Content

— Part. 1 - The basics of Machine Learning —

by MÉDÉRIC BOQUIEN

- Why data science and machine learning
- Vocabulary (TN, TP, FN, FP, training vs test samples, regression vs classification, supervised vs unsupervised, etc.)
- Clustering
- Support vector machines
- Decision trees
- Random forests and ensemble learning
- Dimension reduction

— Part. 2 - Artificial Intelligence —

by VANNA LISA COLI

- Introduction to Artificial Intelligence and data
- Multi-Layer Perceptron
- Convolutional Neural Networks
- Data issues and bias in using AI methods