Title: Deep Learning: Principles, Methodologies and Applications

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Indicative period: January-May 2022 (interested students should contact the teacher as soon as possible in order to define the schedule of the lessons)

ABSTRACT.

In the last decade, we experienced an immense spread of digital information and autonomous devices, and their rate of production and distribution is exponentially increasing as we speak. For this huge flood of heterogeneous and complex data and systems to become valuable and with a significant impact on our lives, more effective and efficient data analysis techniques need to be developed. The realization of intelligent systems with high-level reasoning skills has therefore become one of the most crucial elements to take a substantial step towards technological advancement in a countless number of contexts, ranging from computer science, medicine, industry, agriculture and robotics to marketing, finance, security and human assistance, to name a few. In this process, Deep Learning (DL) has emerged as one of the most important key technologies, capable of unlocking applications and solutions previously unthinkable. This has become possible thanks to the powerful set of algorithms, strategies and software frameworks that have been developed within the DL context.

The first objective of this course is to introduce and discuss the principles of Deep Learning, focusing on its foundations and characteristics. Afterward, different DL paradigms will be covered, including Convolutional Neural Networks, Recurrent Neural Networks and Deep Reinforcement Learning. Finally, the course will provide practical advice and best practices to consider in a Deep Learning project. To this end, a series of case studies will be examined, with code implementations developed using the Pytorch framework.

PROGRAM

- Introduction to Deep Learning: Basic principles, motivations and general characteristics.
- Convolutional Neural Networks: Foundations and applications.
- Recurrent Neural Networks.
- Deep Learning without supervision information: unsupervised, self-supervised and weakly supervised deep learning.
- Generative Models: Generative Adversarial Networks and Variational Autoencoders.
- Deep Reinforcement Learning.
- Practical Aspects of a Deep Learning project.
- Case studies and practical examples with code.