UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

# COURSE SYLLABUS

# Advanced Artificial Intelligence, Machine Learning and Deep Learning

**2324-1-F9102Q009**

## Aims

Recent developments in Artificial Intelligence and Machine Learning have changed how we work and live by assuming a significant role in the industry, education, and, more generally, in today's culture. This course will provide the student with different graduate-level techniques that underpin the development of recent "smart" applications in this field.

## Contents

First, we will design systems able to justify black box decisions: the challenge is to get explainations in modern applications. We will then enhance the models with suitable features. The challenge is to learn adequate representation for downstream activities and transfer learning. Finally, we will deal with information processing through memories and attentional mechanisms.

## Detailed program

A) Explainable Artificial Intelligence (XAI):
Interpretability, Explainability and Foundationals of XAI. Post hoc explanations

B) Representation Learning:
Neural Embeddings; Learning representations with Autoencoders; Disentanglement and invariant Representations; Graph representation learning.

C) Reasoning with Attention & Memory:
Reasoning over Knowledge Graphs; Translational and semantic based embedding. Attention & Memory Mechanisms.

D) Transfer, Federated and Continual learning

## Prerequisites

Most of the prerequisites will be briefly recalled in classes. However, basic knowledge of Linear algebra, Calculus, and Probability are warmly recommended. Basic programming skills are fundamentals. Python programming language is strongly recommended.

## Teaching form

During the lectures, main concepts, theories, and algorithms will be presented and discussed. Through the labs, students will consolidate the proposed models by implementing assignments under the teacher's supervision. Attending class and labs is HIGHLY recommended.

## Textbook and teaching resource

A) Suggested texts (Specialized papers and further resources will be provided during the course)

- Zhang, Aston, et al. "Dive into deep learning." arXiv preprint arXiv:2106.11342 (2021).
- Murphy, Kevin P. Machine learning: a probabilistic perspective. MIT press, 2012.
- Heaton, Jeff. "Ian Goodfellow, Yoshua Bengio, and Aaron Courville: Deep learning." (2017).
- Russell, Stuart J. Artificial intelligence a modern approach. Pearson Education, Inc., 2010. (and subsequent editions)

## Semester

Second

## Assessment method

Grading will be based on both lab assignments and project presentation.

## Office hours

Please contact for an appointment

## Sustainable Development Goals

QUALITY EDUCATION