



UNIVERSITÀ  
DEGLI STUDI DI MILANO-BICOCCA

## COURSE SYLLABUS

### Intelligent Monitoring and Control Systems

2324-2-F9102Q010

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#### Aims

The course presents artificial intelligence techniques for designing, training and effectively deploying intelligent systems for a wide range of industrial applications. After the description of standards and certifications of the legislation in industrial monitoring, design techniques for intelligent systems are presented, ranging from the collection of training data to the main learning methods. The course also presents a number of use cases, tools and environments for their implementation.

#### Contents

The course includes both theoretical and practical sessions. The theoretical part presents the current trends for deploying intelligent monitoring systems, the relevant tasks for industrial scenarios and the main techniques used to optimize AI-based systems. The practical part equips students with the skills to analyze, design, and solve real-world problems.

#### Detailed program

- Legislation in the field of industrial monitoring: standards and certifications
- Description of intelligent systems for industrial automation, robotics, power distribution grids, automotive, and transport systems
- Artificial intelligence: current trends, applications, and major challenges
- Artificial Intelligence for industrial processes
- Data augmentation and transfer learning techniques
- Explainable methods for industrial applications
- Generative modeling for control systems and industrial scenarios

- Image quality assessment (IQA) techniques
- Detection and segmentation
- Defect analysis of products and production lines and anomaly detection
- Self-supervised Learning (SSL) for intelligent systems
- Attention networks and memory for anomaly detection
- Continual learning for control and optimization
- Predictive maintenance for industrial components
- Federated learning and graph-based methods for control systems
- Unimodal and multimodal learning, and information fusion
- Optimization and memory efficiency for edge computing

A detailed list of topics of each lesson is presented and regularly updated on the course site.

## **Prerequisites**

The student should have basic knowledge of computer programming and algorithms, as well as mathematics, notions of probability theory and statistics, and linear algebra. It is also advisable to be familiar with basic concepts in artificial intelligence, machine learning, image and signal processing, and pattern recognition.

## **Teaching form**

The course consists of frontal lessons and exercises carried out in the laboratory. The exercises will allow the student to experiment, under various operating scenarios, with the techniques introduced in class. Students can verify experimentally the learned concepts and perform critical judgment.

## **Textbook and teaching resource**

Goodfellow, Ian; Bengio, Yoshua; Courville, Aaron, Deep Learning. Cambridge: MA, MIT Press, 2016. Jeremy Howard, Sylvain Gugger, Deep Learning for Coders with fastai and PyTorch, O'Reilly Media, Inc., 2020. Online resources and handouts provided throughout the lectures available on the official course website.

## **Semester**

First semester.

## **Assessment method**

The exam consists of developing a small project focusing on one or more topics presented in the course. Students are asked to present and discuss their project, and answer a few questions about the topics addressed in class. The presentation should focus on the selected task, the methodology used to solve it, and the achieved results.

Students are also expected to address, in a critical fashion, all the issues dealt with during its development. The mark is expressed in thirtieths.

## **Office hours**

Via appointment by email.

## **Sustainable Development Goals**

QUALITY EDUCATION

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