



UNIVERSITÀ  
DEGLI STUDI DI MILANO-BICOCCA

## COURSE SYLLABUS

### Artificial Vision

2526-2-F9102Q046

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#### Aims

Provide a robust understanding of some significant problems in computer vision and solutions, in particular for (autonomous or quasi-autonomous) cyberphysical systems

#### Contents

Introduction to computer vision for (autonomous) cyberphysical systems.

#### Detailed program

- Geometry of image formation (cameras are bearing-only sensors)
- Calibration of the projection parameters
- Technological aspects of image formation
- Model-based vision (monocular object recognition and localization)
- 3D reconstruction of points by leveraging more than one image at the same time (stereoscopy)
- 3D reconstruction of points by leveraging more than one image at different time instants (optical flow, feature tracking, structure from motion)
- Sensors capable to natively give out depth information: LiDARs and 3D cameras, both structured light and ToF
- Depth from monocular DNN-based techniques
- Bayesian discrete time filtering (Kalman, EKF, UKF, gaussian mixtures, IF, histogram, particle)
- Panoptic (semantic multi-instance) segmentation of images
- Observer localization problem, classical techniques and DNN-based techniques
- SLAM (Simultaneous Localization and Mapping) problem and its sub-problems (incremental SLAM, loop

detection, relocation, loop closure), classical techniques and DNN-based techniques

## **Prerequisites**

Linear 3D geometry (lines, planes).  
Linear algebra.  
Digital image processing.  
Deep Neural Networks.

## **Teaching form**

Classes and practices, both programming and hands-on.  
The scheduled activities are: 32 hours of lessons in dispensing mode and/or in interactive mode, 24 hours of laboratory in interactive mode.

## **Textbook and teaching resource**

- Selected parts from well-known textbooks like, e.g.,
- David A. Forsyth and Jean Ponce, "Computer Vision: A Modern Approach" 2nd edition, Pearson, 2012
- Andrea Fusiello, "Computer Vision: Three-dimensional Reconstruction Techniques", Springer 2024
- Emanuele Trucco, Alessandro Verri, "Introductory techniques for 3D Computer Vision", Prentice Hall, 1998
- Other material, like e.g., tutorials, review papers, etc. for the less consolidated parts.

## **Semester**

1st semester

## **Assessment method**

Oral exam

## **Office hours**

Please, send an email for arranging an appointment.

# Sustainable Development Goals

SUSTAINABLE CITIES AND COMMUNITIES | RESPONSIBLE CONSUMPTION AND PRODUCTION

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