



UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Signal, audio, and image processing and understanding

2526-114R-2-04

Title

Signal, Audio, and Image Processing and Understanding

Teacher(s)

Simone Bianco
Luigi Celona
Flavio Piccoli
Paolo Napoletano

Language

English

Short description

You must enrol at least one week before the first lecture.
If you are unable to enrol, send an email to the teacher(s).

This course bridges classical signal processing and contemporary machine learning for multimodal data. Students will learn the mathematical foundations of digital, audio, and image signals; explore modern deep architectures that

operate on them; and understand how to fine-tune large foundation models using Low-Rank Adaptation (LoRA) techniques.

A preliminary list of topics is:

- Digital Signal Fundamentals:
 - Sampling theory, quantization, DFT/FFT, digital filters.
- Audio Signal Processing and Understanding:
 - Spectrograms, pitch and timbre features, compression, speech representation, psychoacoustics.
- Image Signal Processing and Understanding:
 - Image formation, color spaces, filtering, feature extraction, compression, and enhancement.
- From Signals to Deep Representations:
 - Spectral embeddings for signal data, CNNs, autoencoders, transformers and foundation models.
- Low-Rank Adaptation (LoRA) and Parameter-Efficient Fine-Tuning:
 - Concept, matrix decomposition, training efficiency, applications in large vision/audio models.

Evaluation will be based on a simple group project to realize in a dedicated day (like a brief hackathon) on a topic selected by the student in coordination with lecturer(s).

CFU / Hours

2 CFU, 16 hours

Teaching period

February 2026

Sustainable Development Goals

QUALITY EDUCATION
