UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

# SYLLABUS DEL CORSO

# Advanced Human-System Interfaces

**2526-1-F9103Q043-F9103Q04301**

## Aims

***Knowledge and understanding***

The student will understand how to model human-computer interaction by exploiting data originating from different sources.
In particular, the student will learn more about different types of signals acquired with contact sensors, or sensors in the environment, such as sensors that acquire physiological or electrophysiological signals, physical (speech, face, ...) and motion signals.
The student will learn how to integrate these signals into advanced human-machine interfaces, such as brain-computer interfaces.

***Applied knowledge and understanding***

Students will be stimulated for discussion during frontal and laboratory activities. The main focus during these interactions is to increase the ability to clearly, consciously and unambiguously communicate technical content, ideas, and problems. These skills fostered in itinere will be assessed through an oral examination.

***Making judgements***

Students through laboratory activities and required assignments will be able to assess their own preparation and level of understanding of theoretical aspects.

***Communication skills***

Students will be stimulated to discussion during frontal and laboratory activities. The main focus during these interactions is to increase the ability to clearly, knowledgeably and unambiguously communicate technical content, ideas, problems. These skills fostered in itinere will be assessed through an oral examination test.

***Learning skills***

The structure of teaching in which theoretical lectures, and laboratory experiences alternate in parallel, guides in learning an effective study and learning method.

## Contents

The course contents are:

1. Affective Computing
2. Physical, Physiological and Electrophysiological Signals
3. Sensing Technologies
4. Pose and motion estimation
5. Soft and hard multimodal biometric systems
6. Brain Computer Interfaces

## Detailed program

Affective Computing

- History and definition of affective computing
- Theories of Emotions, emotion models and Measurements
- Emotion recognition and affective computing
- Design of proper experiments

Physical, Physiological and Electrophysiological Signals

- External Signals: voice, gesture, face, behaviour, eye movement
- Internal signals: heart beat, perspiration, respiration, muscle activity and brain waves

Sensing Technologies:

- Overview of sensing technologies
- Wearable sensing
- Processing and analysis of sensing data

Basics of pose and motion estimation

- Modeling body segments
- Modelling joints across body segments

Pose estimations based on cameras

- Marker-based and markerless methods
- Feature extractions and fitting a body model

Pose estimation based on Inertial Measurement Units (IMUs)

- Basics of IMUs
- Filtering and integration

Motion estimation based on Electromyography (EMG)

- Basics of EMGs
- Filtering to estimate muscle activity

Biometric systems

- Biometric signals
- 1-to N and 1-to-1 systems
- Behavioral biometrics & continuous user authentication

Brain Computer Interfaces

- EEG signals
- BCIs from research labs to real life applications
- Real-Life Wearable EEG-Based BCI

Lab Activities:
Data collection using different devices (Leap motion, 3D cameras (both TOF and structured light), EEG, GSR, PPG, EMG, etc.);
pre-processing and feature-extraction;
emotion and gesture recognition.

## Prerequisites

no prerequisites

## Teaching form

The course consists of lectures (32 hours of didactic teaching DE), and practical activities (24 hours of interactive didactic DI).
Several exercises will be carried out during the practical activities to verify the new expertise acquired. Lectures and practical activities will be held in presence.

## Textbook and teaching resource

Slides and material uploaded on the eLearning platform
Review papers on the presented topics
Journal and conference articles, relevant for the state of the art
Codes and exercises of the practical activities

## Semester

Second semester

## Assessment method

The exam is composed of two parts, equally weighted:

1. An oral exam to verify the preparation on all contents of the course,
2. The evaluation of assigments administered during the practical activities, Those who are not able to carry out the assigments, have to develop a practical activity, defined with the teachers.

## Office hours

send email for arranging an appointment

## Sustainable Development Goals

INDUSTRY, INNOVATION AND INFRASTRUCTURE