UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Embedded Systems for Biomedical Applications

2526-2-F9102Q013

Aims

Biomedical embedded systems are devices used in clinical settings to derive useful information of patients' health status (i.e. sleep and activity indicators from a smartwatch, heart signals from an ECG…). The acquired signals must then be appropriately processed to remove noise and to highlight relevant features for the purposes of accurate diagnosis and monitoring.
The aim of the course is to get the students familiar with these systems: their design principles, for the identification and acquisition of the most appropriate signal for each specific condition, as well as AI-based algorithms for signal processing and classification regarding the most important biomedical applications.
A series of laboratories using Python/MATLAB programming language will provide further knowledge on the course topics.

Contents

Main components of biomedical embedded systems.
Data acquisition and signal processing of biomedical instrumentation.
Machine and deep learning algorithms for signal processing and classification purposes.
Examples in the healthcare context.
Lab classes on artificial intelligence algorithms using Python/MATLAB language.

Detailed program

• Overview of biomedical embedded systems and their design principles: from sensors to visualization
• Biomedical signal processing: from pre-processing to machine learning approaches for events detection and classification

• Principles of networked biomedical embedded systems
• Security, privacy and data protection
• Patient safety and medical devices certification
• Examples of devices and AI-based methodologies in different biomedical application contexts
• Principles of AI approaches for medical image processing
• Python/MATLAB laboratories aimed at applying machine/deep learning approaches to process/classify biomedical signals

Prerequisites

Basics of programming; algorithms; linear algebra; elements of statistics.

Teaching form

Lectures (hours/year in lecture theatre): 32 (DE)
Laboratory (hours/year in lecture theatre): 24 (DI)
Practicals/Workshops (hours/year in lecture theatre): 0
Lessons and laboratories will be held in presence and students' attendance is highly recommended.

Textbook and teaching resource

Slides will be made available on the course website after the lessons, where appropriate reference will be provided to papers that will constitute study material.
P.A.H. Williams, A.J. Woodward. Cybersecurity vulnerabilities in medical devices: a complex environment and multifaceted problem. Medical Devices: Evidence and Research, pages 305-316, 2015. [Available online] DOI: 10.2147/MDER.S50048

For consultation:
• A.G. Webb. Principles of Biomedical Instrumentation. Cambridge University Press, 2018. DOI: 10.1017/9781316286210
• Goodfellow, Y. Bengio, A. Courville. Deep Learning, MIT Press, 2016.

Semester

First semester

Assessment method

The exam consists in a written test regarding all course topics and laboratory activities.
In case of positive evaluation of the written test, an optional oral examination can be sustained to improve the final

rank.
No intermediate tests are planned.

Office hours

Contact by mail to arrange an appointment.

Sustainable Development Goals

GOOD HEALTH AND WELL-BEING