



UNIVERSITÀ  
DEGLI STUDI DI MILANO-BICOCCA

## COURSE SYLLABUS

### Physical Sensors and Systems for Biomedical Imaging

2425-2-F9102Q020

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#### Aims

The main aims of the course are three: i) to understand the physical principles on which medical imaging is based; ii) to familiarize with the main medical imaging techniques and understand their operating principles; iii) to acquire the practical capabilities to reconstruct and analyze medical images through standard and AI programming techniques.

#### Contents

The course will cover the fundamentals of medical imaging, including different types of imaging techniques such as radiography, CT, MRI, PET and ecography. In addition, the course will delve into the classical and AI techniques to interpret, reconstruct and analyze medical images provided by these instrumentations.

#### Detailed program

- Introduction to biomedical imaging and the physical principles underlying different imaging techniques
- Radiography and Computed tomography (CT): physics of photon interaction with matter, and operating principles
- Magnetic resonance imaging (MRI): physics of magnetism and nuclear resonance, and operating principles
- Nuclear medicine (PET and SPECT): physics of radioactive decays, and operating principles
- Ultrasound imaging, ecography, eco-Doppler: physics of wave and sound propagation and of the doppler effect, and operating principles
- Python environment for medical imaging: basic python concepts and available packages for medical imaging manipulation.
- Case study: medical image classification, comparison between different NN.- Case study: medical image

segmentation using a Unet

## **Prerequisites**

Knowledge of basic physics, python and standard machine learning techniques

## **Teaching form**

The classes will be in the form of frontal lectures and of computer laboratories in which students could work in groups.

## **Textbook and teaching resource**

The main resource will consist of the slides and other materials (such as scientific papers) provided by the teachers during the lectures. Some recommended, but not mandatory, textbooks are:

J.T. Bushberg, J.A. Seibert, E.M. Leidholdt, J. Boone, The essential physics of medical imaging, LIPPINCOTT WILLIAMS & WILKINS, a WOLTERS KLUWER business

F. Chollet, Deep Learning with Python (ISBN: 9781617294433)

Other potentially interesting readings are:

P. Seutens, Fundamentals of Medical Imaging, Cambridge University Press

A.G. Webb, Introduction to Biomedical Imaging, IEEE Press, Wiley

Ian Goodfellow and Yoshua Bengio and Aaron Courville; Deep Learning; MIT Press;  
<http://www.deeplearningbook.org>

## **Semester**

First semester

## **Assessment method**

The assessment methods will consist of an oral or written examination about the theoretical concepts dealt during the frontal lectures and of a brief project on image reconstruction or analysis that should be discussed in the form of a presentation.

(Exam modalities will be better defined next).

## **Office hours**

Students can write an email to the teachers whenever they want in order to arrange an appointment.

## **Sustainable Development Goals**

GOOD HEALTH AND WELL-BEING

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