UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Medical Imaging & Big Data

2526-2-FDS01Q026-FDS01Q030M

Aims

Knowledge and Understanding: Students will gain foundational knowledge of medical imaging modalities and the theoretical underpinnings of image formation. They will explore the current landscape of AI applications in radiology, including both established clinical tools and areas of ongoing research.

Applying Knowledge and Understanding: Through hands-on laboratory sessions using Jupyter notebooks, students will apply AI techniques to medical imaging data. They will learn to implement and evaluate algorithms capable of quantitative, operator-independent image analysis.

Making Judgements: Students will critically assess the challenges inherent in medical image analysis, such as ambiguous observables, limited datasets, and complex validation procedures. They will develop the ability to evaluate the reliability and clinical relevance of AI-driven diagnostic tools.

Communication: The course will foster the ability to clearly communicate technical findings and clinical implications of AI in medical imaging to both specialist and non-specialist audiences.

Learning Skills: By engaging with both theoretical content and practical exercises, students will develop the skills necessary for independent learning and research in the interdisciplinary field of AI and medical imaging.

Contents

Introduction of medical imaging, image pre-processing, common machine and deep learning applications in this field including both image processing and automated classification

Detailed program

- Medical imaging: most common techniques, fields of application, properties of the different images
- Image pre-processing: techniques to optimize inputs for subsequent applications
- Deep learning based image denoising
- Image segementation: recognition of structures or targets using Deep or machine learning
- Features extraction for machine learning
- Predictive models
- Analysis of real world application: medical literature related to AI/ML algorithms

Prerequisites

- Python programming language: most lab experiences will be on jupyter notebooks
- Statistics related to regression and classification, their metrics and the most common classifiers/regressors
- Basics of deep learning related to imaging

Teaching form

10 Lectures for a total of 25 hours (5x 3 hours, 5x 2 hours)

The course includes 7 hours of theory and 18 hours of laboratory experiences.

In each lecture, the beginning will be dedicated to theory (face-to-face delivery), while the rest of the lecture will be dedicated to hands on interactive in presence computer programming experiences.

Textbook and teaching resource

Slide decks and programming tutorials provided by the tutor
Scientific papers provided by the tutor

Book: Zhou, K., Greenspan, H., & Shen, D. (Eds.). (2017). Deep learning for medical image analysis. Academic Press.

Semester

Second semester

Assessment method

The exam will consist of two tests.

A group project about medical image analysis will be used to test the students' ability to put the techniques learned in class in practice. The student's ability to develop an end-2-end analysis pipeline and to correctly interpret the results will be assessed. The vote (out of thirty) will weigh 40% on the final judgment.

Students, individually, will also be required to discuss a scientific paper related to the topic of AI in medicine, as an oral presentation. The vote (out of thirty) will weigh 60% on the final judgment.

No in-course evaluations are planned.

Office hours

By email request

Sustainable Development Goals

GOOD HEALTH AND WELL-BEING | QUALITY EDUCATION | INDUSTRY, INNOVATION AND INFRASTRUCTURE