UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Medical Imaging & Big Data

2627-2-FDS02Q026-FDS02Q02602

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 a small project to be carried out individually. Datasets and tasks will be provided. The

project will be completed at home before the exam date.

A week before the oral exam date, students will submit a report (mandatorily limited to 6 pages) about the techniques that they used to solve the task and the results.
In an oral discussion, they will be asked questions about the choices performed in the project and what has been written in the report.

The exam will be scored using the following rubric:

1. **Technical quality (max 11pts)** This will evaluate the metrics chosen, data pipeline (both statistical handling and technical pre-processing), results presentation.
2. **Report clarity (max 11 pts)** The report will be evaluated according to its clarity, its focus on the most relevant choices, and the quality of the explanation for the technical choices
3. **Answers to questions (max 10 pts)** The students should demonstrate that they have full knowledge of the material presented and that they can defend the choices made.

The vote will be the sum of the points. Students exceeding 30 pts will be considered for the *cum laude* grade.

Office hours

By email request

Sustainable Development Goals

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