UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Digital Technologies in Medicine

2627-1-H4104D053

Aims

The main **objective** of the course is to enable students to acquire and deepen their knowledge on:

1. computer related methodologies and technologies employed in medical informatics and to apply those methods in solving problems arising in different areas of medicine and the health-care system;
2. theoretical and practical knowledge necessary to understand and analyze the characteristics of medical images;
3. human modelling techniques starting from diagnostic images and 3D scanning systems up to 3D printing of body parts and organs.

Expected Learning Outcomes (Dublin Descriptors)
1. Knowledge and understanding
At the end of the course, students will have acquired knowledge regarding:

- Fundamental concepts of medical informatics, healthcare information systems, database management systems (DBMS), telemedicine, and digital health communication protocols.
- The physical and operating principles of the main medical imaging modalities (X-ray, CT, MRI, and ultrasound) and the structure of the digital DICOM standard as well as core image processing algorithms, visual perception principles, and foundational concepts of Artificial Intelligence (Machine Learning and Deep Learning) applied to the segmentation and classification of biological structures in medical images.
- Theoretical concepts and systems for human morphological, postural, and movement acquisition (including 3D scanners and motion capture devices), as well as dvanced technologies, materials, and digital methodologies for 3D printing in medicine, numerical simulation, and Virtual/Augmented Reality application contexts.

2. Applying knowledge and understanding
Students will be able to:

- Apply computer methodologies, software applications, and data management technologies to solve

technical or organizational problems arising within healthcare systems.
- Utilize dedicated open-source software applications to visualize, manipulate, pre-process, and perform quantitative processing or 3D rendering of digital medical images.
- Generate, manipulate, and configure detailed 3D geometric models of the human body, specific anatomical districts, and organs starting from diagnostic images or external 3D scanning systems.
- Coordinate the baseline workflow required to transition from raw clinical/imaging data to virtual simulations or physical 3D printed anatomical models.

3. Making judgements
Students will develop the ability to:

- Critically evaluate the quality, integrity, and limitations of medical data, informatics systems, and diagnostic digital images.
- Independently select the most appropriate group of digital technologies, image processing frameworks, or 3D modelling techniques based on specific clinical, simulation, or research objectives.
- Critically assess the reliability, accuracy, and clinical limitations of artificial intelligence tools, virtual reality environments, and 3D-printed organ models within medical procedures.

4. Communication skills
Students will be able to:

- Communicate technical specifications, medical image characteristics, data workflows, and 3D project pipelines clearly and rigorously using proper interdisciplinary terminology.
- Discuss digital health solutions, technical requirements, and computational findings effectively within interdisciplinary clinical and technical teams.

5. Learning skills
Students will acquire the skills to:

- Autonomously explore, test, and master new software packages, digital platforms, and innovative technical workflows in the expanding fields of medical informatics, imaging, and 3D digital modelling.
- Keep up to date with the rapid technological advancements and emerging clinical applications of AI, virtual simulation, and bio-fabrication by independently consulting scientific literature, guidelines, and technical manuals.

Contents

The course is composed by three modules dealing with:

1. **Basic computer science**: data, information, and communication; information systems and DBMS; Telemedicine and Internet for healthcare.
2. **Medical Imaging**: generation of digital images, medical image characteristics, basics of medcial image processing and artificial intelligence-based approaches to improve image quality, 3D rendering.
3. **Human modelling**: techniques and tools to create 3D geometric model of human body and anatomical districts at different level of details according to the domain of application.

Detailed program

The detailed course program is provided in the Syllabus of the respective module.

Prerequisites

Basic knowledge in mathematics, algebra and physics.

Teaching form

Frontal lessons in class and in the laboratory; use of dedicated SW tools.

Textbook and teaching resource

Please refer to the Syllabus of the specific modules.

Semester

First semester.

Assessment method

Written and oral exams. Please refer to the Syllabus of each specific module.

Office hours

Please refer to the Syllabus of each specific module.

Sustainable Development Goals

GOOD HEALTH AND WELL-BEING | QUALITY EDUCATION | GENDER EQUALITY