UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Practical Class: New Technologies for Neuropsycology

2526-2-F5108P019

Learning area

Introduction to the design, development, and testing of bioengineering methodologies and technologies, artificial intelligence, and neurorobotics in neuropsychology.

Learning objectives

Knowledge and Understanding (through theoretical lectures):

- Acquire principles related to the design of advanced systems for neurorehabilitation and personal assistance in neuropsychology.
- Acquire methodologies for the theoretical and experimental development of protocols mediated by robotics and artificial intelligence for neurorehabilitation and personal assistance in neuropsychology.
- Develop the ability to engage in dialogue and collaborate within multidisciplinary teams of neuropsychologists, bioengineers, and neurorobotics specialists for the design of advanced technologies and systems supporting therapies and personal assistance.

Applied Knowledge and Understanding (through individual work, group work, and classroom activities):

- Understand the operating principles of technology-based systems for neuropsychological applications mediated by neurorobotics and artificial intelligence.
- Apply knowledge of design and testing methodologies for neuropsychological protocols based on neurorobotics and bioengineering.
- Develop applied understanding of the languages and methods of bioengineering and neurorobotics as used in neuropsychology.

Independent Judgment (through classroom activities):
The course fosters the development of critical and reflective thinking in the analysis of diagnostic, therapeutic, and

personal assistance tools based on advanced neurorobotics and artificial intelligence technologies.
Through clinical case discussions, simulations, and guided readings, students acquire tools to assess the potential of technology applications in neuropsychology, with a focus on analyzing risks, benefits, and clinical objectives.

Communication Skills (through group work):
The course aims to develop the ability to define clinical and engineering specifications for the design of technological systems clearly and ethically in clinical-professional contexts and within interdisciplinary teams involving bioengineers and neurorobotics experts.
Special attention is given to the interaction between technology and patients, to technology acceptance, and to its proper use, promoting effective communication with patients and explaining and facilitating understanding of the technology and its use according to the principles of human-centered design.

Learning Skills:
The course provides theoretical and practical tools to promote autonomous learning and continuous updating in the field of technology for neuropsychological applications.
Students are encouraged to reflect critically on design and testing methodologies of technological systems, learning to select relevant scientific sources and to integrate interdisciplinary knowledge, including through the study of recent articles in English and the acquisition of documentation related to patents and inventions from major databases.

Contents

Introduction to the design and development of methodologies and technologies in bioengineering, biorobotics, and neurorobotics applied to neuropsychology.
Research methodologies, clinical innovation, and experimentation of new protocols based on advanced technologies and digital therapies.
Analysis of specific case studies involving the use of advanced tools in neuropsychology, aimed at developing cross-disciplinary skills for collaboration with bioengineers and neurorobotics experts.

Detailed program

Introduction to bioengineering, robotics, neurorobotics, and artificial intelligence applied to medicine, diagnosis, neurorehabilitation, and personal assistance in chronic conditions.
Introduction to digital therapies.
Critical analysis of a selected set of scientific articles to provide an overview of the scientific literature in the field of bioengineering and biorobotics applied to neuropsychology.
Methodologies for the design and experimental evaluation of advanced instrumentation for the development of research protocols in neuropsychology.
The relationship between technology and the patient, technology acceptance, motivation and engagement, and human-centered design.
Comparative analysis of theoretical and experimental neurorobotics methodologies.
Case studies of autonomous, teleoperated, and wearable neuro-robots and their applications in neuropsychology.
Scientific questions regarding the development of cognitive robots, the challenges posed to neuropsychology, and how robotics and bioengineering may provide innovative solutions.

Prerequisites

The course is intended for Master's students in Neuropsychology, but there are no specific prerequisites.

Teaching methods

Teaching activities will be conducted in person and in Italian.
Lectures will alternate with group discussions of clinical material.
Clinical cases will be presented through texts and videos.
Hours of teaching activities organized as lectures (Didactic Delivery): 50% of the total.
Hours of teaching activities including in-class discussions, case presentations, group work, and exercises (Interactive Didactics): 50% of the total.
Type of teaching activity: lecture.

Assessment methods

The exam will be conducted in person.
Assessment will be based on the development of an individual or group project on topics covered in the course, with the aim of proposing an original idea to address a clinical need.
The exam will consist of a presentation of the project, after which the instructor may ask questions related to the project and to the course content.
Evaluation criteria include: the originality and quality of the project presentation (individual or group), the accuracy of the responses to the instructor’s questions, and the mastery of the models and methodologies taught during the course.
Erasmus students may contact the instructor to arrange the possibility of studying with an English-language bibliography and/or taking the exam in English.

Textbooks and Reading Materials

Supplementary materials (slides, articles):
Slides are essential for passing the exam and will be uploaded online prior to each lecture.
Additional references may be provided during the lessons.

Reference articles for case studies:
Wudarczyk, Olga A. et al, Bringing Together Robotics, Neuroscience, and Psychology: Lessons Learned From an Interdisciplinary Project Frontiers in Human NeuroscienceArticleOpen Access2021

Materials and scientific documentation will be available on the ICUB platform https://icub.iit.it

Materials and scientific documentation on wearable neurorobotic platforms https://www.santannapisa.it/en/institute/biorobotics/wearable-robotics-laboratory

Digital Health: 2025 Anno Cruciale https://www.healthtech360.it/salute-digitale/digital-health-2025/
Virtual Coaching Activities for Rehabilitation in Elderly https://cordis.europa.eu/article/id/442791-virtual-rehabilitation-coach-at-home
Spencer Finn, Theodore Aliyianis, Brooke Beattie, Lysa Boissé Lomax, Garima Shukla, Stephen H Scott, Gavin P Winston, Robotic assessment of sensorimotor and cognitive deficits in patients with temporal lobe epilepsy, Epilepsy & Behavior, Volume 151, 2024

Kaylin Russell, Aneri Bhatt, Kelsea Rackham, Ty Vernon, Online social interaction skill group for adolescents on the autism spectrum: Preliminary outcomes of the START Connections program, Research in Autism Spectrum Disorders, Volume 114, 2024, Article 102397
Minhwa Hwang, Seonghyeon Lee, Ga Eun Park, Yeon-Hwan Park, Effectiveness of a digital health coaching self-management program for older adults living alone with multiple chronic conditions: a randomized controlled trial, Geriatric Nursing, Volume 65, 2025

Sustainable Development Goals

GOOD HEALTH AND WELL-BEING