UNIVERSITÀ
degli STUDI
di CATANIA

Syllabus Master's Degree Course in Medicine and Surgery

ARTIFICIAL INTELLIGENCE, MACHINE LEARNING AND BIG DATA

Third year, first semester (3 academic credits [CFU])

Teachers

Subject	Academic credits (CFU)	Lecturer
Artificial intelligence, machine learning and big data	3	PULVIRENTI Alfredo

Learning outcomes

Subject	Learning outcomes
Artificial intelligence, machine learning and big data	By the end of the course, students are expected to: • Understand the foundational concepts of artificial intelligence, supervised and unsupervised machine learning, and big data analytics. • Recognize the applications, limitations, and ethical considerations of AI and ML in biomedical research and clinical practice. • Develop the ability to critically interpret AI-driven models and big data outputs in health-related contexts. At the end of the course the student will understand the principles and scope of artificial intelligence and machine learning, and their integration into biomedical data analysis and decision support systems.

Prerequisites

Subject	Prerequisites
Artificial intelligence, machine learning and big data	Attainment of the educational objectives set by prerequisite courses.

Course contents

Subject	Course contents
Artificial intelligence, machine learning and big data	• Introduction artificial intelligence and machine learning • supervised, unsupervised learning • reinforcement learning

	• Introduction to neural networks and deep learning
	• Model training, validation, and overfitting
	• Evaluation metrics: accuracy, sensitivity, specificity, AUC, PR
	• Introduction to big data, Frequent set mining, similarity computation.
	• Sources of biomedical big data: electronic health records, omics data, imaging
	• Data preprocessing and feature selection and dimensionality reduction
	• AI in diagnostic support, prognostic modeling, and personalized medicine
	• Regulatory and ethical aspects of AI in healthcare
	• Challenges in AI explainability, bias, and transparency
	• Tools and platforms for machine learning in medicine

Assessment methods

Subject	Assessment methods
Artificial intelligence, machine learning and big data	The final assessment of acquired knowledge is conducted by an oral exam. The grade is expressed on a scale of thirty, up to a maximum of 30/30 cum laude (with honors). The final grade is determined by the weighted average of the scores obtained in the course subjects.
	The oral examination consists of an interview during which questions will cover at least three different topics from the course curriculum. The assessments aim to evaluate: i) the level of knowledge in the disciplines; ii) the ability to apply this knowledge to solve specific problems related to the disciplines (autonomous problem-solving); iii) clarity of expression; iv) proficiency in medical-scientific language. The assessment of learning can also be conducted remotely if the conditions necessitate it.
	For the assignment of the final grade, the following parameters will be considered:
	• Score 29-30 with honors: The student demonstrates an in-depth knowledge of the topics, promptly and correctly integrates and critically analyzes presented situations, independently solving even highly complex problems. They possess excellent communication skills and command medical-scientific language proficiently.
	• Score 26-28: The student has a good understanding of the topics, is able to integrate and critically and logically analyze presented situations, can fairly independently solve complex problems, and presents topics clearly using appropriate medical-scientific language.
	• Score 22-25: The student has a fair understanding of the topics, although it may be limited to the main areas. They can integrate and critically analyze presented situations, although not always in a linear fashion, and present topics fairly clearly with moderate language proficiency.
	• Score 18-21: The student has minimal knowledge of the topics, possesses modest ability to integrate and critically analyze presented situations, and presents topics sufficiently clearly, although their language proficiency may be underdeveloped.

	• Exam not passed: The student lacks the minimum required knowledge of the core content of the course. Their ability to use specific language is minimal or nonexistent, and they are unable to independently apply acquired knowledge.

Examples of common questions and/or exercises

Subject	Examples of common questions and/or exercises
Artificial intelligence, machine learning and big data	• What is the difference between supervised and unsupervised learning? • What does overfitting mean in a machine learning model? • Which metrics are most appropriate to evaluate a diagnostic algorithm? • How can AI models introduce bias into clinical decision-making? • Give an example of a healthcare application of big data analytics. • Why is model interpretability important in medicine? • What types of data are typically used in training a clinical ML model? • Exercise: Analyze a simplified dataset using a basic decision tree or logistic regression model. • Exercise: Identify potential ethical risks in deploying AI-based tools in a hospital setting.

Reference texts

Subject	Textbooks
Artificial intelligence, machine learning and big data	Mining of Massive Datasets Hardcover, Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman http://infolab.stanford.edu/~ullman/mmds/book.pdf Any additional educational material (slides, videos, handouts, etc.) will be distributed or indicated during the lessons.

Course format

Subject	Course format
Artificial intelligence, machine learning and big data	Teaching will be primarily delivered through in-person lectures, combining theoretical instruction with practical exercises. If teaching is conducted in blended or remote mode, appropriate adjustments will be made to ensure alignment with the objectives and content outlined in the Syllabus.

Attendance

Subject	Attendance
Artificial intelligence, machine learning and big data	Mandatory attendance.

Course schedule

Subject	Course schedule
Artificial intelligence, machine learning and big data	Students may refer to the recommended textbooks to identify the correspondence between the topics covered in the syllabus and the relevant chapters.