Fakultät für Ingenieurwesen
Facoltà di Ingegneria
Faculty of Engineering

SYLLABUS
COURSE DESCRIPTION YEAR 2024/2025

COURSE TITLE	**Artificial Intelligence**
COURSE CODE	76251
SCIENTIFIC SECTOR	INF/01
DEGREE	Bachelor in Computer Science
SEMESTER	2nd
YEAR	2nd
CREDITS	12
MODULAR	Yes

TOTAL LECTURING HOURS	60
TOTAL LAB HOURS	60
ATTENDANCE	Attendance is not compulsory; non-attending students may contact the lecturer at the start of the course to get support on the modalities of the independent study
PREREQUISITES	Module 1: Knowledge and skills in Programming, Discrete Mathematics, and Linear Algebra are strongly recommended. Module 2: Knowledge and skills in Programming, and Probability Theory and Statistics are strongly recommended.
COURSE PAGE	https://ole.unibz.it/

SPECIFIC EDUCATIONAL OBJECTIVES	• Type of course: "attività formativa caratterizzante" • Scientific area: "informatica" **MODULE 1 Foundations of Artificial Intelligence**: This course is about the study of the design of intelligent computational agents, and the emergence of Artificial Intelligence as an integrated science. The focus is on an intelligent agent acting in an environment. The course starts with simple agents acting in simple, static environments and gradually increases the power of the agents to cope with more challenging worlds. The course explores several dimensions of complexity introducing, gradually and with modularity, what makes building intelligent agents challenging. This is made concrete by repeatedly illustrating the ideas with different agent tasks, such as a delivery robot and a diagnostic assistant: the science of Artificial Intelligence is developed together with its engineering applications. The agent we want the student to envision is a hierarchically designed agent that acts intelligently in a stochastic environment that it can only partially observe

	- one that reasons about individuals and relationships among them, has complex preferences, learns while acting, takes into account other agents, and acts appropriately given its own computational limitations. **MODULE 2 Machine Learning in Practice**: This course is about Machine Learning techniques. The frontal lectures will focus on basic supervised and unsupervised techniques and the labs will be about applying and comparing these techniques on real datasets. Students will first learn how to represent data and deal with different types of features. Then, they will dive into learning supervised approaches for creating predictive models and unsupervised approaches for creating data clusters. For both approaches, the objective is to evaluate the quality of the created models and focus on the different problems related to data generalizability. The largest part of the course will be dedicated to the implementation of the learned models using Python libraries such as Scikit-learn and SciPy. The labs will give the opportunity to students to address different machine learning tasks and deal with datasets from various applications.

MODULE 1	**Foundations of Artificial Intelligence**
MODULE CODE	76251A
MODULE SCIENTIFIC SECTOR	INF/01
CREDITS	6
LECTURER	Enrico Franconi
SCIENTIFIC SECTOR OF THE LECTURER	INF/01
TEACHING LANGUAGE	English
OFFICE HOURS	Enrico.franconi@unibz.it Anytime in office POS 3.06, by previous appointment by email to the lecturer franconi@inf.unibz.it
TEACHING ASSISTANT	Same as lecturer
OFFICE HOURS	-
LIST OF TOPICS COVERED	• Artificial Intelligence and Agents • Searching for Solutions • Reasoning with Constraints • Propositions and inference • Planning with Certainty • Multiagent Systems and Games
TEACHING FORMAT	Frontal lectures, exercises in lab, assignments, case study analysis

MODULE 2	**Machine Learning in Practice**
MODULE CODE	76251B
MODULE SCIENTIFIC SECTOR	INF/01
CREDITS	6
LECTURER	Ivan Donadello
SCIENTIFIC SECTOR OF THE LECTURER	INF/01
TEACHING LANGUAGE	Italian
OFFICE HOURS	ivan.donadello@unibz.it Wednesday, 10:45 – 12:45, POS 2.08, Faculty of Computer Science, Piazza Domenicani 3. Take an appointment via e-mail, please.
TEACHING ASSISTANT	Same as lecturer
OFFICE HOURS	-
LIST OF TOPICS COVERED	• Data understanding and preprocessing • Classification: Decision Trees, Rule-based classification, KNN, Naïve Bayes, Support Vector Machines, Perceptron • Ensemble learning, boosting, bagging (Random Forests) • Evaluation of Machine Learning algorithms • Regression analysis • K-Means Clustering
TEACHING FORMAT	This is a project and lab-based module. It consists of frontal lectures, exercises in lab, case study analysis and the development of a project.

LEARNING OUTCOMES	**Knowledge and understanding** • Know the principles of artificial intelligence and potentials and limits of intelligent systems in various application domains. **Applying knowledge and understanding** • Be able to adopt programming techniques of artificial intelligence to solve problems of computer science.; • Ability to apply innovative techniques of machine learning to extract knowledge from unstructured data. **Making judgments** • Be able to work autonomously according to the own level of knowledge and understanding. • be able to collect and interpret useful data and to judge information systems and their applicability

	• be able to work autonomously according to the own level of knowledge and understanding. • Be able to take the responsibility for development of projects or IT consulting. **Ability to learn** • Have developed learning capabilities to pursue further studies with a high degree of autonomy. **Communication skills** • Be able to use one of the three languages English, Italian and German, and be able to use technical terms and communication appropriately. • Be able to structure and write technical documentation. • Be able to work in teams for the realization of IT systems. **Learning skills**: • Have developed learning capabilities to pursue further studies with a high degree of autonomy • Be able to follow the fast technological evolution and to learn cutting edge IT technologies and innovative aspects of last generation information systems.

ASSESSMENT	Final exam: the exam covers the topics addressed in MODULE 1 and MODULE 2 and consists of two parts:
	
	• MODULE 1 (50% of the final exam):
	  ○ Written exam: with verification questions, transfer of knowledge questions, and exercises. The written exam will be based on problem solving activities and on a deep understanding of the basic principles of the technologies studied during the course.
	
	• MODULE 2 (50% of the final exam):
	  ○ Written exam: with verification questions and problem-solving tests (40% of the final MODULE 2 grade)
	  ○ Assignments: consist in applying/implementing machine learning algorithms using real datasets, running experiments, and presenting the results (60% of the final MODULE 2 grade)

ASSESSMENT LANGUAGE	English (Module 1) Italian (Module 2)
EVALUATION CRITERIA AND CRITERIA FOR AWARDING MARKS	The exam is evaluated based on correctness of answers, clarity of answers, ability to summarize, evaluate, and establish relationships between topics, skills in critical thinking, quality of argumentation, problem solving ability. In order pass the exam, the students should get at least 18/30 in each module. The mark related to each part contributes to the final grade as follows: • MODULE 1: 50% • MODULE 2: 50% A positive evaluation of one module remains valid for all three regular exam sessions of the academic year.

REQUIRED READINGS	MODULE 1: David Poole and Alan Mackworth. Artificial Intelligence: Foundations of Computational Agents. Cambridge University Press, 3rdEdition, 2023. ISBN: 9781009258197. MODULE 2: Pang-Ning Tan, Michael Steinbach, Anuj Karpatne and Vipin Kumar. Introduction to Data Mining. Pearson, 2nd Edition, 2019. ISBN: 9780273775324.
SUPPLEMENTARY READINGS	MODULE 1: Stuart Jonathan Russell and Peter Norvig. Artificial Intelligence: A Modern Approach. Prentice Hall, 4th edition, 2020. ISBN: 9780134610993 MODULE 2: Aurelien Geron. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow. Safari, an O'Reilly Media Company, 2nd Edition, 2019.
SOFTWARE USED	Available from the course web page.