SYLLABUS
COURSE DESCRIPTION YEAR 2024/2025

COURSE TITLE	**Intelligent Agents**
COURSE CODE	76252
SCIENTIFIC SECTOR	INF/01
DEGREE	Bachelor in Computer Science
SEMESTER	1st
YEAR	3rd
CREDITS	12
MODULAR	Yes

TOTAL LECTURING HOURS	120
TOTAL LAB HOURS	80
ATTENDANCE	Attendance is not compulsory, but highly recommended as many labs require an adequate software and hardware infrastructure; non-attending students should contact the lecturer at the start of the course to get support and agree on the modalities of the independent study.
PREREQUISITES	It is preferable that students have already done the Software Engineering course and have basic mathematical knowledge in Discrete Mathematics and Linear Algebra.
COURSE PAGE	https://ole.unibz.it/

SPECIFIC EDUCATIONAL OBJECTIVES	• Type of course: "attività formativa caratterizzante" • Scientific area: "informatica" **MODULE 1: Knowledge Representation** The aim of this module is to introduce students to basic topics, methods, and theories in the field of Knowledge Representation. Specifically, the module studies Knowledge Representation as a central area of symbolic artificial intelligence. A detailed coverage of classical first-order logic (syntax, semantics, model theory, proof theory) as a tool to formulate knowledge will be followed by an introduction to Description Logics (DLs). DLs will be used as a foundation to express formal ontologies (resp. knowledge bases). Finally, the module will discuss a number of important reasoning scenarios with knowledge and ontologies, including planning, non-monotonicity and common sense reasoning, and will introduce further non-classical reasoning approaches.

	MODULE 2: **Intelligent Agents Project** The module will introduce the student to different AI techniques to support human decision making in complex domains, and to build autonomous systems. The main part of the module will be devoted to the design and development of software, using the introduced AI methods, to solve proposed challenges. The purpose of this active participation is to gain a better understanding of different approaches to AI, and to focus the course on the more problematic aspects emerging from the application of the taught concepts. The general aim of the module is to provide the student with a toolbox of computational instruments and methodologies enabling the tackling of a variety of practical problems. The hands-on approach will complement the understanding of the main concepts with the necessary know-how to deploy concrete solutions.

MODULE 1	**Knowledge Representation**
MODULE CODE	76252A
MODULE SCIENTIFIC SECTOR	INF/01
CREDITS	6
LECTURER	Oliver Kutz
SCIENTIFIC SECTOR OF THE LECTURER	INF/01
TEACHING LANGUAGE	**German**
OFFICE HOURS	By previous email appointment: Oliver.Kutz@unibz.it NOI, B1 Building, Faculty of Engineering
TEACHING ASSISTANT	Same as lecturer
OFFICE HOURS	-
LIST OF TOPICS COVERED	• Propositional and First-Order Languages • Individuals and Relations • Knowledge Representation and Logic • Knowledge-Based Systems: Description Logics and Ontologies • Non-classical Logic and Formal Reasoning • Common-Sense Knowledge
TEACHING FORMAT	Frontal lectures, exercises in lab, support for projects.

MODULE 2	**Intelligent Agents Project**
MODULE CODE	76252B
MODULE SCIENTIFIC SECTOR	INF/01
CREDITS	6
LECTURER	Sarah Winkler
SCIENTIFIC SECTOR OF THE LECTURER	INF/01
TEACHING LANGUAGE	**English**
OFFICE HOURS	By previous email appointment: winkler@inf.unibz.it NOI, B1 Building, Faculty of Engineering
TEACHING ASSISTANT	Same as lecturer
OFFICE HOURS	-
LIST OF TOPICS COVERED	• AI paradigms: symbolic approaches vs. learning-based approaches • Overview of main AI techniques: exact and approximate methods, handling imperfect information, use and model of domain knowledge • Tools and programming techniques for the development of AI systems • Symbolic approaches: planning and search, constraint solving, description logic and ontologies, multi-agent models • Learning-based approaches: supervised vs. unsupervised and reinforcement learning, neural networks • Hands-on programming projects covering the above topics
TEACHING FORMAT	Frontal lectures, interactive labs sessions, and project assignments (partially carried out during lab sessions).

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 develop small and medium size programs using different programming languages and paradigms. • Be able to adopt programming techniques of artificial intelligence to solve problems of computer science. **Ability to make judgments** • Be able to collect 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. **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. **Ability to learn** • 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: 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, theories, and methods studied during the course. • MODULE 2 (50% of the final exam): The assessment for the module is based on the following points: 1. **lab assignments**, focused on specific topics taught in the module. They are meant to motivate students to study throughout the semester and consolidate the concepts taught in class; 2. **final oral presentation**, based on a specific topic among the ones covered in the module. Lab assignments should be carried out in groups of 2 or 3 students; members of the groups should be the same for the whole duration of the course and must be agreed among the participants during the first week of lectures. Students joining the course after the first week should arrange their membership within one of the existing groups, or create a new group in the case of several late enrolments. For the final presentation, each student should select one of the topics presented during the course and present technical aspects of it that have not been covered (e.g. specific state-of-the-art techniques, or applications). This activity requires independent study, selection of appropriate additional literature and/or material,

	and the delivery of a coherent presentation outlining the key aspects with the necessary support material (e.g. slides and/or multimedia). The same assessment applies to non-attending students.
ASSESSMENT LANGUAGE	German and English
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 to 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% of total mark. 100% written exam. Written exam: clarity of answers; being able to master the terminology and definitions introduced in the course; being able to solve basic exercises or summarise and exemplify theoretical concepts. ● MODULE 2: 50% of total mark. Evaluation of the module is based on 2 parts: 1. Lab assignments (60%), group based assessment based on: original contribution, technical quality of the deliverables, documentation and presentation, and ability to work in a team. 2. Oral presentation (40%), individual assessment based on: ability to: independently deepening the knowledge on a specific topic, summarise the relevant information, and establish relationships between different topics; as well as the clarity of the presentation. Each assignment will be separately evaluated and the overall assessment for the labs will be the average among them. If one assignment is not handed in within the required deadline it will count as 0. The evaluation of the lab assignments to be at least 50% of the available marking is a prerequisite for the admission to the oral presentation. The topic for the oral presentation should be agreed with the lecturer and must be coherent with the syllabus of the course.

REQUIRED READINGS	MODULE 1: ● David Poole and Alan Mackworth. Artificial Intelligence: Foundations of Computational Agents (3rd Edition). Cambridge University Press, 2023. ISBN: 9781009258197 https://artint.info/3e/html/ArtInt3e.html MODULE 2: ● Stuart Russell, Peter Norvig. Artificial Intelligence: A Modern Approach (3rd edition). Prentice Hall (Dec 2009) Subject Librarian: David Gebhardi, David.Gebhardi@unibz.it
SUPPLEMENTARY READINGS	MODULE 1: ● Franz Baader, Ian Horrocks, Carsten Lutz, Uli Sattler. An Introduction to Description Logics. Cambridge University Press, 2017. Supplementary readings will be posted on the course website. MODULE 2: ● Luger, George F. Artificial Intelligence: Structures and Strategies for Complex Problem Solving. 6th ed. Boston: Pearson Addison-Wesley, 2009. Additional material covering specific topics could be provided during the course.
SOFTWARE USED	MODULE 1 - Protégé Editor - DL Reasoners - Theorem provers MODULE 2: The course will require extensive use of publicly available software tools. Most of the programming will be done using Python and the domain-specific languages (DSL) required to use the tools. The required software will be made available on a Linux based virtual machine, and details will be provided for installing them on your own PC (support will be limited to Linux).