Teaching Guide				
Identifying Data				2023/24
Subject (*)	Reasoning and Planning		Code	614544003
Study programme	Máster Universitario en Intelixencia Artificial			
Descriptors				
Cycle	Period	Year	Type	Credits
Official Master's Degree	1st four-month period	First	Obligatory	6
Language	English			
Teaching method	Face-to-face			
Prerequisites				
Department	Ciencias da Computación e Tecnoloxías da Información			
Coordinador	Cabalar Fernandez, Jose Pedro	E-mail	pedro.cabalar@udc.es	
Lecturers	Cabalar Fernandez, Jose Pedro Moret Bonillo, Vicente	E-mail	pedro.cabalar@udc.es vicente.moret@udc.es	
Web				
General description				

Study programme competences / results	
Code	Study programme competences / results
A6	CE05 - Ability to design and develop intelligent systems through the application of inference algorithms, knowledge representation and automated planning
A7	CE06 - Ability to recognise those problems that require a distributed architecture, not predetermined during the system design, suitable for the implementation of multiagent systems
A8	CE07 - Ability to understand the consequences of the development of an explainable and interpretable intelligent system
A9	CE08 - Ability to design and develop secure intelligent systems, in terms of integrity, confidentiality and robustness
B1	CG01 - Maintaining and extending theoretical foundations to allow the introduction and exploitation of new and advanced technologies in the field of AI
B2	CG02 - Successfully addressing each and every stage of an AI project
B3	CG03 - Searching and selecting that useful information required to solve complex problems, with a confident handling of bibliographical sources in the field
B6	CB01 - Acquiring and understanding knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, frequently in a research context
B7	CB02 - The students will be able to apply the acquired knowledge and to use their capacity of solving problems in new or poorly explored environments inside wider (or multidisciplinary) contexts related to their field of study
B8	CB03 - The students will be able to integrate different pieces of knowledge, to face the complexity of formulating opinions (from information that may be incomplete or limited) and to include considerations about social and ethical responsibilities linked to the application of their knowledge and opinions
B9	CB04 - The students will be able to communicate their conclusions, their premises and their ultimate justifications, both to specialised and non-specialised audiences, using a clear style language, free from ambiguities
C2	CT02 - Command in understanding and expression, both in oral and written forms, of a foreign language
C3	CT03 - Use of the basic tools of Information and Communications Technology (ICT) required for the student's professional practice and learning along her life
C4	CT04 - Acquiring a personal development for practicing a citizenship under observation of the democratic culture, the human rights and the gender perspective
C5	CT05 - Understanding the importance of the entrepreneurial culture and knowledge of the resources within the entrepreneur person's means
C6	CT06 - Acquiring abilities for life and healthy customs, routines and life styles
C7	CT07 - Developing the ability to work in interdisciplinary or cross-disciplinary teams to provide proposal that contribute to a sustainable environmental, economic, political and social development

C8	CT08 - Appreciating the importance of research, innovation and technological development in the socioeconomic and cultural progress of society

Learning outcomes			
Learning outcomes	Study programme competences / results		
Conocer los conceptos fundamentales de la lógica de predicados	AC5 AC6 AC7 AC8	BC1 BC3 BC6 BC7 BC8 BC9	CC2 CC3 CC4 CC7 CC8
Knowing and undertanding the concepts of imprecision and uncertainty versus certainty	AC5 AC6 AC7 AC8	BC1 BC3 BC6 BC7 BC8 BC9	CC2 CC3 CC5 CC8
Knowing the main imprecise reasoning models and how to apply them to problem solving in AI	AC5 AC6 AC7 AC8	BC1 BC2 BC3 BC6 BC7 BC8 BC9	CC2 CC3 CC4 CC5 CC6 CC7 CC8
Knowing how to model and solve basic planning problems	AC5 AC6 AC7 AC8	BC1 BC2 BC3 BC6 BC7 BC8 BC9	CC2 CC3 CC4 CC5 CC7 CC8

Contents	
Topic	Sub-topic
Unit 1. Introduction	- knowledge representation (KR), reasoning about actions - example-based methodology, declarative problem solving - KR goals, elaboration tolerance, STRIPS language - frame problem and inertia, non-monotonic reasoning, KR topics
Unit 2. Propositional Reasoning.	- propositional logic, syntax and semantics, set of models - entailment, inconsistence, tautology, deduction theorem, weaker/stronger formulas - deduction/abduction/induction, from language to formulas, the SAT problem - computational complexity, NP-completeness - SAT solvers, Conjunctive Normal Form (CNF)

Unit 3. Rule-based Reasoning	- Closed World Assumption (CWA), positive programs, least model, TP immediate consequences - default negation, program reduct, stable models - examples getting stable models, stratified programs - choice rules, constraints, splitting - Here-and-There (HT) - Equilibrium models, strong equivalence
Unit 4. Relational Reasoning	- grounding, deductive databases, Datalog, domain independence, safety - Hamiltonian cycles, Answer Set Programming (ASP), GDT methodology - Pooling, terms, reification, aggregates - Optimisation - ASP applications and solvers
Unit 5. Temporal Reasoning and Planning	- telingo, switches example, simulation, postdiction, planning - missionaries and cannibals, the blocks world - abduction, explanation, diagnosis - temporal equilibrium logic - survey on AI planning
Unit 6. Terminological Reasoning	Description Logics
Unit 7. Reasoning with inaccurate information	- Categorical models - Probabilistic models - Cuasi-probabilistic models - Certainty factors - Theory of Evidence - Fuzzy Logic - Vectorial Approaches - Quantum Models

Planning				
Methodologies / tests	Competencies / Results	Teaching hours (in-person & virtual)	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A6 A7 A8 A9 B2 B3 B6 B8 B9 C2 C6	21	42	63
Objective test	A6 A7 A8 A9 B3 B6 B7 B8 B9 C2	3	21	24
Laboratory practice	A6 A7 A8 A9 B1 B2 B3 B7 B8 C3 C4 C5 C6 C7 C8	21	42	63
Personalized attention		0		0
(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.				

Methodologies	
Methodologies	Description
Guest lecture / keynote speech	Classes of concepts and foundations with small exercises
Objective test	Individual exam
Laboratory practice	Practical work, normally in groups, with tools of reasoning and planning

Personalized attention	
Methodologies	Description

Laboratory practice Guest lecture / keynote speech Objective test	Tutorials and remote guidance by e-mail or online platform (Teams, moodle, etc)

Assessment			
Methodologies	**Competencies / Results**	**Description**	**Qualification**
Laboratory practice	A6 A7 A8 A9 B1 B2 B3 B7 B8 C3 C4 C5 C6 C7 C8	Submission of one or several practical assignments	49.5
Guest lecture / keynote speech	A6 A7 A8 A9 B2 B3 B6 B8 B9 C2 C6	Depending on how the course evolves, a part of the exam could be consolidated by submitting solved exercises along the lecture classes period	0.5
Objective test	A6 A7 A8 A9 B3 B6 B7 B8 B9 C2	An individual exam consisting of several exercises that will be assessed up to a maximum of 50 points. *Requirement* a minimum grade of 20 points in the exam must be achieved to pass the course. If that minimum grade inside the exam is not achieved, the final total grade for the course will be truncated to 4.8 (that is 48%) if the addition of all qualifications are above that number.	50

Assessment comments

Sources of information	
Basic	
Complementary	- Michael Gelfond and Yulia Kahl (2014). Knowledge Representation, Reasoning, and the Design of Intelligent Agents: The Answer-Set Programming Approach. Cambridge University Press - Martin Gebser, Roland Kaminski, Benjamin Kaufmann, and Torsten Schaub (2012). Answer Set Solving in Practice. Morgan and Claypool Publishers - Vladimir Lifschitz (2019). Answer Set Programming. Springer - Chitta Baral (2003). Knowledge Representation, Reasoning and Declarative Problem Solving. Cambridge University Press - Stuart Russell and Peter Norvig (2021). Artificial Intelligence: a Modern Approach (4th ed). Pearson, Prentice Hall

Recommendations
Subjects that it is recommended to have taken before
Subjects that are recommended to be taken simultaneously
AI Fundamentals/614544001
Subjects that continue the syllabus

AI in Health /614544022
Computational Aspects of Cognitive Science/614544006
Intelligent Robotics II/614544020
Language Modelling/614544009
Explainable and Trustworthy AI/614544004
Multiagent Systems/614544005
Web Intelligence and Semantic Technologies/614544010
Knowledge and Reasoning under Uncertainty/614544007
Process Mining/614544025
Other comments

(*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.