UNIVERSIDAD DE CASTILLA - LA MANCHA

GUÍA DOCENTE

1. General information

Course: LOGIC
Code: 42310
Type: BASIC
ECTS credits: 6
Degree: 405 - DEGREE IN COMPUTER SCIENCE ENGINEERING (TA)
Academic year: 2023-24
Center: 15 - FACULTY OF SOCIAL SCIENCES AND INFORMATION TECHNOLOGIES
Group(s): 60
Year: 2
Duration: First semester
Main language: Spanish
Second language: English
Use of additional languages:
English Friendly: Y
Web site:
Bilingual: N

Lecturer: **YOEL ARROYO RODRÍGUEZ PERAL** - Group(s): **60**

Building/Office	Department	Phone number	Email	Office hours
2.20	TECNOLOGÍAS Y SISTEMAS DE INFORMACIÓN		Yoel.Arroyo@uclm.es	Tuesday: 10-13; Wednesday: 15-18

2. Pre-Requisites

Although the development of the subject is self-contained and no prerequisites are required, it is recommended to have taken the subject Algebra and Discrete Mathematics, since the concept of application formalizes relevant logical concepts (such as, for example, interpretation, model and logical operation), and the algebraic concepts of set and relation are associated with the logical predicate, while conjunctive operations are also linked to logical operations.

3. Justification in the curriculum, relation to other subjects and to the profession

Symbolic logic or mathematical logic studies logic using mathematical notions and techniques. Most computer scientists recognize the intimate connection between logic and computer science, comparable in importance to the relationship between mathematical analysis or calculus and physics. Logic can be said to represent "the calculus of computer science" because of the magnitude of its impact in this area, which is even greater than it has historically had in the field of mathematics itself. In contrast to the natural sciences, computer science relates to processes that are synthetic, since most of them are a human creation. This difference may provide an explanation as to why logic has found, in computer science, so many and so justified applications, ranging from hardware design to software engineering, including AI or the semantic web, which endows Web pages with supplementary information that allows the use of semantic search criteria, deductive mechanisms, consistency or completeness constraints, etc.

From a general perspective, logic has played different roles in the field of computer science:

1. As a source of languages and systems for reasoning, due to its deductive capacity.
2. As a source of tools and techniques for analysis and substantiation.

From a more concrete perspective, the study of logic provides techniques to tackle different problems, both theoretical and practical, in the field of computer science:

1. Logic has been used as a tool for knowledge representation, by translating the natural language, in which a problem is described, into the formal language of logic. It has also been used as an aid in the definition of more elaborate techniques for knowledge representation.
2. Logic has been used to provide a model for computation. The lambda-calculus and the reduction of lambda-expressions to normal forms, or Horn's clause logic and the SLD resolution principle represent idealized visions of the idea of computation.
3. Logic has also been used to establish a formal description of the meaning (semantics) of programming languages and in the formal specification and verification of programs. The development of deductive methods (operational semantics) are at the basis of the implementation techniques of programming languages.
4. Logic has long been known to be effective as a language for database management, representation and interrogation, and for natural language understanding.
5. The connections between Boolean logic and digital circuits are also very popular. Boolean algebra constitutes the theoretical support on which modern computers are implemented.
6. Recent is the use of logics for protocol analysis (Web services, cryptographic protocols, etc.), where there are specific restrictions regarding the privacy, integrity, authenticity or secrecy of the information being stored and manipulated.
7. Moreover, it is important to highlight its important practical implications as logic-based theory, techniques and tools are having an increasing impact on the resolution of numerous computational problems in industry.

Finally, the influence of type theory in the development of programming languages, the effectiveness of logic in the analysis of computational complexity, the support provided by epistemic logic (or knowledge logic) to reasoning mechanisms in multi-agent systems, the role of temporal logic in the field of automatic verification, and the connections between logic programming and automatic demonstration, to name but a few, justify the inclusion of logic in the curriculum of computer engineering.

Logic is part of the **Mathematical Foundations of Computer Science** subject of the curriculum and supports the following subjects.

Basic Formation:

- Programming Fundamentals I and II
- Computer Technology

Common to the Computer Science Branch:

- Programming Methodology

- Concurrent and Real Time Programming
- Databases
- Intelligent Systems

4. Degree competences achieved in this course

Course competences

Code	Description
BA03	Ability to understand basic concepts about discrete mathematics, logic, algorithms, computational complexity, and their applications to solve engineering problems.
INS01	Analysis, synthesis, and assessment skills.
INS02	Organising and planning skills.
INS05	Argumentative skills to logically justify and explain decisions and opinions.
PER01	Team work abilities.
PER04	Interpersonal relationship skills.
SIS01	Critical thinking.
SIS03	Autonomous learning.
SIS04	Adaptation to new scenarios.
SIS05	Creativity.
SIS09	Care for quality.
UCLM02	Ability to use Information and Communication Technologies.
UCLM03	Accurate speaking and writing skills.

5. Objectives or Learning Outcomes

Course learning outcomes

Description

Knowledge of logic of propositions and logic of predicates with a syntactic and semantic approach.

Understanding of the use of induction definition method (recursion) and its particular importance in computer programming.

Knowledge of formal characteristics of logic: correccion, consistency, completion, and decidability.

Additional outcomes

Use automatic tools for formula evaluation and deduction support: evaluation of truth tables, interpretation of predicate logic formulas and verification of deductions.

Use deductive calculus (natural deduction) to perform deductions.

Know some logic programming system.

Understand the importance and usefulness of logic in the field of computer science.

6. Units / Contents

Unit 1: Introduction

- **Unit 1.1** Presentation of the course
- **Unit 1.2** Introduction to Logic

Unit 2: Propositional Logic

- **Unit 2.1** Semantics
- **Unit 2.2** Axiomatic calculus and formal properties
- **Unit 2.3** Natural deduction calculus

Unit 3: Predicate Logic

- **Unit 3.1** Semantics
- **Unit 3.2** Axiomatic calculus and formal properties
- **Unit 3.3** Natural deduction calculus

Unit 4: Principle of Resolution and Other Logics

- **Unit 4.1** The Resolution Principle
- **Unit 4.2** Other Logics

7. Activities, Units/Modules and Methodology

Training Activity	Methodology	Related Competences (only degrees before RD 822/2021)	ECTS	Hours	As	Com	Description
Class Attendance (theory) [ON-SITE]	Lectures	BA03	0.9	22.5	N	-	
Individual tutoring sessions [ON-SITE]	Combination of methods	BA03	0.18	4.5	N	-	
Study and Exam Preparation [OFF-SITE]	Self-study	BA03 INS01 INS02	2.1	52.5	N	-	
Other off-site activity [OFF-SITE]	Practical or hands-on activities	BA03 INS01 INS05 PER01 PER04	0.6	15	N	-	
Problem solving and/or case studies [ON-SITE]	Problem solving and exercises	BA03 INS01 INS02 INS05 PER01 PER04 SIS01 SIS03 SIS04 SIS05 SIS09 UCLM02 UCLM03	0.6	15	Y	N	
Writing of reports or projects [OFF-SITE]	Self-study	BA03 INS01 INS02 PER01 PER04	0.9	22.5	Y	N	
		BA03 INS01 INS02 INS05					

Laboratory practice or sessions [ON-SITE]	Practical or hands-on activities	PER01 PER04 SIS01 SIS03 SIS04 SIS05 SIS09 UCLM02 UCLM03	0.42	10.5	Y	Y	
Project or Topic Presentations [ON-SITE]	Lectures	BA03 INS01 INS05 SIS01 SIS05 SIS09 UCLM02 UCLM03	0.1	2.5	Y	N	
Final test [ON-SITE]	Assessment tests	BA03 INS01 INS05 SIS01 SIS05 SIS09 UCLM02 UCLM03	0.2	5	Y	Y	
		Total:	**6**	**150**			
		Total credits of in-class work: 2.4					**Total class time hours: 60**
		Total credits of out of class work: 3.6					**Total hours of out of class work: 90**

As: Assessable training activity
Com: Training activity of compulsory overcoming (It will be essential to overcome both continuous and non-continuous assessment).

8. Evaluation criteria and Grading System

Evaluation System	Continuous assessment	Non-continuous evaluation*	Description
Final test	55.00%	55.00%	Compulsory and recoverable activity to be performed on the date scheduled for the final exam of the ordinary call.
Theoretical papers assessment	15.00%	15.00%	Delivery of medium complexity problems, solved, and theory questions. Non-compulsory and recoverable activity to be done before the end of the teaching period. Students of non-continuous mode will be evaluated of this activity through an alternative system in the ordinary call.
Practicum and practical activities reports assessment	20.00%	20.00%	Evaluates the laboratory practices. Compulsory and recoverable activity to be done in the laboratory sessions. Non-continuous students will be evaluated of this activity through an alternative system in the ordinary call.
Oral presentations assessment	10.00%	10.00%	It corresponds to an essay on a topic (to be selected from a list of available topics). This is a non-compulsory and recoverable activity to be done in the theory/laboratory sessions. For non-continuous mode students, an alternative deadline will be agreed in the ordinary call.
Total:	**100.00%**	**100.00%**	

According to art. 4 of the UCLM Student Evaluation Regulations, it must be provided to students who cannot regularly attend face-to-face training activities the passing of the subject, having the right (art. 12.2) to be globally graded, in 2 annual calls per subject , an ordinary and an extraordinary one (evaluating 100% of the competences).

Evaluation criteria for the final exam:

Continuous assessment:

In the compulsory activities a minimum of 4 out of 10 must be obtained to consider the activity passed and to be able to approve the course. The evaluation of the activities will be global and, therefore, must be expressed by means of a single grade. If the activity consists of several sections, it can be evaluated individually, informing in writing at the beginning of the course about the evaluation criteria of each section. In the recoverable activities there is an alternative evaluation exam in the extraordinary call.

The final exam will be common for all the groups of theory/laboratory of the subject and will be graded by the teachers of the subject in a horizontal way, that is to say, each of the parts of the final exam will be evaluated by the same teacher for all the students.

The student approves the course if he/she obtains a minimum of 50 points out of 100 with the evaluations of each evaluation activity and passes all the compulsory activities.

For students who do not approve the course in the ordinary call, the grade of the passed activities will be kept for the extraordinary call. In the case of passed recoverable activities, the student will be able to take the alternative evaluation of those activities in the extraordinary call and, in that case, the final grade of the activity will correspond to the last grade obtained.

The grade of an activity obtained in any call of the current academic year, except for the final exam, will be retained for the next academic year at the request of the student, provided that it is equal to or higher than 5 (i.e., the activity is considered passed) and the training activities and evaluation criteria of the subject in the next academic year are not modified.

Failure to appear for the final exam will result in the grade of "Not presented". If the student has not passed any mandatory evaluation activity, the final grade in the course cannot exceed 4 out of 10.

Non-continuous evaluation:

Students who are unable to regularly attend the on-site training activities may request, at the beginning of the term, to take the non-continuous evaluation mode. Similarly, if a student who is taking the continuous evaluation mode, incurs in any circumstance that prevents him/her from regularly attending the classroom training activities, he/she may apply for the non-continuous evaluation mode. In this case, notification must be given before the date scheduled for the exams of the ordinary call, according to a deadline that will be informed at the beginning of the semester.

Specifications for the resit/retake exam:

Evaluation tests will be given for all recoverable activities.

Specifications for the second resit / retake exam:

It will have the same characteristics as the extraordinary call.

9. Assignments, course calendar and important dates

Not related to the syllabus/contents

Hours	hours

Unit 1 (de 4): Introduction	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	3.5
Other off-site activity [AUTÓNOMA][Practical or hands-on activities]	7.5

Unit 2 (de 4): Propositional Logic	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	8
Individual tutoring sessions [PRESENCIAL][Combination of methods]	1
Study and Exam Preparation [AUTÓNOMA][Self-study]	16
Other off-site activity [AUTÓNOMA][Practical or hands-on activities]	5
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	5
Writing of reports or projects [AUTÓNOMA][Self-study]	7.5
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	4.5

Unit 3 (de 4): Predicate Logic	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	8
Individual tutoring sessions [PRESENCIAL][Combination of methods]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	20
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	7.5
Writing of reports or projects [AUTÓNOMA][Self-study]	11
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	6

Unit 4 (de 4): Principle of Resolution and Other Logics	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	4.5
Individual tutoring sessions [PRESENCIAL][Combination of methods]	1.5
Study and Exam Preparation [AUTÓNOMA][Self-study]	13
Other off-site activity [AUTÓNOMA][Practical or hands-on activities]	2.5
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	2.5
Writing of reports or projects [AUTÓNOMA][Self-study]	4
Project or Topic Presentations [PRESENCIAL][Lectures]	2.5
Final test [PRESENCIAL][Assessment tests]	5

Global activity	
Activities	**hours**
Final test [PRESENCIAL][Assessment tests]	5
Class Attendance (theory) [PRESENCIAL][Lectures]	22.5
Individual tutoring sessions [PRESENCIAL][Combination of methods]	4.5
Study and Exam Preparation [AUTÓNOMA][Self-study]	52.5
Other off-site activity [AUTÓNOMA][Practical or hands-on activities]	15
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	15
Writing of reports or projects [AUTÓNOMA][Self-study]	22.5
Project or Topic Presentations [PRESENCIAL][Lectures]	2.5
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	10.5
Total horas:	150

10. Bibliography and Sources

Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
Julián Iranzo, Pascual	Lógica simbólica para informáticos	Ra-Ma		84-7897-619-1	2004	Manual básico de la asignatura
Barwise, J & Etchemendy, J.	Language, Proof and Logic	CSLI Publications		1-889119-08-3	2000	Manual complementario
Ben-Ari, Mordechai	Mathematical logic for computer science	Springer		1-85233-319-7	2001	Manual complementario
Deaño, Alfredo	Introducción a la lógica formal	Alianza Editorial		84-206-8011-7	1996	Manual complementario
Garrido, Manuel (1925-)	Lógica simbólica	Tecnos		84-309-2604-6	1997	Manual complementario