UAB
Universitat Autònoma de Barcelona

Computational Logic

Code: 106569
ECTS Credits: 6

2025/2026

Degree	Type	Year
Artificial Intelligence	FB	1

Contact

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Teachers

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

There are no prerequisites.

Objectives and Contextualisation

As a knowledge representation formalism, a reasoning system, an analytical tool, or even a programming language, the function of logic in artificial intelligence (AI) has been prominent since the inception of the discipline. The objective of this course is, therefore, to delve into the role of logic within AI, by providing students with an understanding of its fundamental concepts, techniques, and methods. This will enable them to proficiently apply logic across these varying facets of AI.

Competences

- Analyse and solve problems effectively, generating innovative and creative proposals to achieve objectives.
- Develop critical thinking to analyse alternatives and proposals, both one's own and those of others, in a well-founded and argued manner.
- Identify, understand and apply the fundamental concepts and techniques of knowledge representation, reasoning and computational learning for the solution of artificial intelligence problems.
- Know, understand, use and apply appropriately the mathematical foundations necessary to develop systems for reasoning, learning and data manipulation.

- Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
- Work independently, with responsibility and initiative, planning and managing time and available resources, and adapting to unforeseen situations.

Learning Outcomes

1. Analyse and solve problems effectively, generating innovative and creative proposals to achieve objectives.
2. Develop critical thinking to analyse alternatives and proposals, both one's own and those of others, in a well-founded and argued manner.
3. Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
4. Understand problem modelling for logic programming languages and how to resolve them using satisfiability-based algorithm.
5. Understand the basic notions and mathematical foundations of classical logical formalisms, automatic reasoning techniques and argumentation in AI.
6. Understand the usefulness of theorem provers for solving problems represented in a logical language.
7. Work independently, with responsibility and initiative, planning and managing time and available resources, and adapting to unforeseen situations.

Content

Part I. Propositional Logic (Truth-functional Logic, TFL)

I.1 Syntax of TFL (alphabet, connectives, sentences...).

I.2 Semantics of TFL (truth-functional connectives, characteristic truth tables, complete truth tables, partial truth tables...).

I.3 Natural language formalization in TFL (and its limitations).

I.4 Reasoning in TFL (e.g., rules, tree-search algorithms...).

I.5 Normal Forms and Logic Data Structures.

Part II. First-Order Logic (FOL)

II.1 Syntax of FOL (quantifiers, formulas, sentences...).

II.2 Semantics of FOL (extensionality, interpretations...).

II.3 Natural language formalization in FOL (and its limitations).

II.4 Resolution for TFL (transform formulas into normal forms).

II.5 FOL and Databases

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes

Type: Directed			
Exercise in class	30	1.2	2, 6, 3
Introduction and discussion of the main theoretical concepts	12	0.48	5
Type: Supervised			
Assimilation of theoretical concepts	10	0.4	1, 6
Reinforcement and follow-up in the resolution of exercises	12	0.48	2
Type: Autonomous			
Autonomous work and readings	38	1.52	7
Preparing and solving exercises	42	1.68	2, 6, 3, 7

The course methodology is based on short lectures by the professor, problem-solving during class time (specifically, students will engage in individual or group practices to reinforce their learning of the lesson and do evaluative exercises), and flipped learning (that is, students will complete the lectures with readings and work at home). In some classes, time will be kept for reviewing and correcting the evaluative practices.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Evaluative tests	50%	4	0.16	1, 4, 5, 7
Exam	50%	2	0.08	1, 2, 6, 3, 7

Assessment can be carried out in either of the two ways described below.

Continuous assessment

On the one hand, students must individually complete two in-class assessment tests (P1 and P2) during regular class hours. On the other hand, they will take a final individual exam (FE) covering the content of Parts I and II. To be eligible for continuous assessment, students must have completed at least one assessment test and the FE. The final grade for the course in this modality will be determined as follows (all grades are out of 10): If grade_FE < 4, the student will not have passed the continuous assessment and, if the relevant conditions are met, may take the resit exam (see the Resit Exan section). Otherwise, the final grade will be calculated using the following formula: final_grade = max{0.5 * grade_FE + 0.25 * grade_P1 + 0.25 * grade_P2, grade_FE}.

Single assessment

The student will individually complete the FE and two additional exercises (E1 and E2), one corresponding to each of the tests from the other assessment modality. The final grade for the course in this modality will be

determined as follows: If grade_FE < 5 or grade_E1 < 5 or grade_E2 < 5, the student will not have passed the single assessment and, if the relevant conditions are met, may take the resit exam (see the Resit section). Otherwise, the final grade will be calculated using the following formula: final_grade = 0.5 * grade_FE + 0.25 * grade_E1 + 0.25 * grade_E2.

Resit Exan

To be eligible for the resit, students must have completed the FE and at least one assessment test (continuous assessment) or one additional exercise (single assessment). The resit will consist of an individual final resit exam (FRE). To pass the course in this modality, grade_FRE must be greater than or equal to 5. The final grade will be:
final_grade = grade_FRE.

Review of grades

After each assessment activity, the teaching staff will inform students via Moodle about the grades obtained and the procedure and date for the review.

Honours distinction

Honours distinctions will be awarded to students with a final grade of 10. If there are more students with this grade than the number of honours distinctions assigned to the course, an additional test will be held to determine the recipients.

Not assessable

The student will receive the qualification "Not assessable" if they do not attend more than one assessment activity (continuous assessment) or if they do not attend the January exam (single assessment).

Repeat students

No differentiated treatment is foreseen for repeat students.

Use of Artificial Intelligence (AI)

In this course, the use of AI technologies is not permitted at any stage. Any work that includes AI-generated content will be considered a breach of academic integrity and may result in partial or total penalties on the activity grade, or more severe sanctions in serious cases.

Irregularities

Any irregularity that may significantly alter the grade of an activity will result in a grade of zero for that activity. In the case of multiple irregularities, the final grade for the course will be zero, regardless of any disciplinary proceedings.

Adaptation to online format

If tests or exams cannot be held in person, they will be adapted to an online format made available through the UAB's virtual tools (the original weighting will be maintained). Homework, activities, and class participation will be carried out via forums, wikis, and/or discussions on Teams, etc. The teaching staff will ensure that students can access these virtual tools or will offer feasible alternatives.

Bibliography

Basic bibliography:

Teacher's notes (available at the Campus Virtual and updated throughout the course).

Complementary bibliography:

M. Ben-Ari: *Mathematical Logic for Computer Science.* Springer, 2012.

J. van Benthem, H. van Ditmarsch, J. van Eijck, J. Jaspars. *Logic in Action*. Open Course Project, 2016, https://www.logicinaction.org/.

P. D. Magnus, *Forallx*, University at Albany. With additions under a Creative Commons License by T. Button, J. R. Loftis, and R.Trueman, 2021, http://forallx.openlogicproject.org/.

H. Zhang, J. Zhang, *Logic in Computer Science.* Springer, 2025.

Software

To be determined.

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	711	English	first semester	afternoon
(TE) Theory	71	English	first semester	afternoon