FACULDADE DE
CIÊNCIAS E TECNOLOGIA
UNIVERSIDADE D
COIMBRA

Knowledge, Reasoning and Planning

Mini-Project 2

2025/2026

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Project Description

This practical project aims for each group of students to conceive and implement in Python and Planning Domain Definition Language (PDDL) an intelligent room management system for the Department of Informatics Engineering (DEI) at the University of Coimbra. The system manages the allocation and scheduling of department rooms for lectures and exams. It should run in the console and provide a text-based interface for interacting with the different components.

The implementation must include a comprehensive ontology using the `owlready2` package that represents the room management domain for DEI, including (but not limited to) the following classes:

- **Base**: Room, RoomBooking, Person (with subclasses Teacher and Student), Activity (with subclasses Lecture and Exam), Course, Equipment.
- **Inferred**: At least five inferred classes with their first-order logic formulas (e.g., AvailableRoom, OverBookedRoom, ConflictingBooking).

The ontology should be capable of supporting complex queries and reasoning about room availability, booking conflicts, equipment requirements, capacity constraints, and temporal relationships between bookings. It is up to the students to define the object and data properties needed to support such operations.

The system must also include two distinct intelligent agents that use the ontology as their knowledge base to make autonomous decisions about room management. One agent must be able to handle room bookings, i.e., processesing booking requests, finding suitable rooms based on capacity and equipment requirements, checking for time conflicts, and assigning rooms while respecting priorities. **The students must propose the behavior and purpose of the second agent.**

Finally, students must apply automated planning with PDDL to solve a complex room scheduling problem: schedule the exams for a semester by allocating all exams to appropriate rooms considering their capacity and avoiding

time and booking conflicts. Moreover, the `unified-planning` package must be used to generate the valid plans. This planning component does not need to interact with the ontology. In other words, the domain and problem should be manually defined in the corresponding PDDL files.

The project must also include a two-page report created with the IJCAI template, which is available at https://www.ijcai.org/authors_kit. Students may use either the LaTeX or Microsoft Word format. The report must not include code and should cover the following topics:

- Description of the ontology base classes, properties, and inferred classes with their first-order logic formulas.
- Description of the agents reasoning process, decision rules, and interaction with the ontology.
- Description of the PDDL domain and problem files.

Rules and Important Dates

Each project must be implemented by a group of two students. All members of a group will receive the same grade unless there are exceptional disparities in contribution (particularly noticeable in the defenses). Projects will be evaluated against the same criteria for all groups and students: ontology quality and completeness; agent intelligence and reasoning; correctness of the automated planning implementation; and how complete, organized, and well-written the report is.

The deadline to submit the project with all deliverables (code and report) is January 11, 2026. This deadline is final, and all deliverables must be submitted via InforEstudante. After the submission deadline, the students will present and defend their projects (a detailed schedule will be released afterwards). Projects that are not submitted to defense will be graded 0%.