

ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

103000364 - Logic Programming

DEGREE PROGRAMME

10AJ - Master Universitario En Inteligencia Artificial

ACADEMIC YEAR & SEMESTER

2024/25 - Semester 1

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1. Description

1.1. Subject details

Name of the subject	103000364 - Logic Programming
No of credits	5 ECTS
Type	Optional
Academic year of the programme	First year
Semester of tuition	Semester 1
Tuition period	September-January
Tuition languages	English
Degree programme	10AJ - Master Universitario en Inteligencia Artificial
Centre	10 - Escuela Tecnica Superior De Ingenieros Informaticos
Academic year	2024-25

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Jose Francisco Morales Caballero	2101	josefrancisco.morales@upm.es	Sin horario.
Manuel De Hermenegildo Salinas (Subject coordinator)	2212	manuel.hermenegildo@upm.es	Sin horario.
M. Carmen Suarez De Figueroa Baonza	2201	mdelcarmen.suarezdefigueroa@upm.es	Sin horario.

* The tutoring schedule is indicative and subject to possible changes. Please check tutoring times with the faculty member in charge.

3. Skills and learning outcomes *

3.1. Skills to be learned

CEIA6 - Formalización de especificaciones, demostración de propiedades de los programas y diseño de programas con razonamiento o la utilización de la lógica misma como lenguaje de programación

CG18 - Capacidad de trabajar y comunicarse también en contextos internacionales

CG7 - Especificación y realización de tareas informáticas complejas, poco definidas o no familiares.

CG11 - Adquirir conocimientos científicos avanzados del campo de la informática que le permitan generar nuevas ideas dentro de una línea de investigación.

3.2. Learning outcomes

RA41 - Desarrollar un programa lógico a partir de especificaciones y mejorar la eficiencia del mismo y manejar con soltura sistemas de P y sus extensiones.

RA39 - Identificar áreas de utilización y fronteras de la programación lógica, en especial dentro del campo de la Inteligencia Artificial

RA40 - Identificar características de la programación lógica (PL) y sus extensiones que puedan resultar beneficiosas o perjudiciales para la resolución de un problema.

RA44 - Saber manejar fuentes bibliográficas y valorar su importancia para desarrollar trabajos escritos innovadores o que reflejen el estado del arte en programación lógica

RA43 - Diseñar extensiones de la PL de cuño propio para la resolución de ciertos problemas, originando distintas tareas de investigación

RA47 - Ser capaz de manejar los términos y realizar exposiciones en público en lengua inglesa sobre la temática de la materia.

* The Learning Guides should reflect the Skills and Learning Outcomes in the same way as indicated in the Degree Verification Memory. For this reason, they have not been translated into English and appear in Spanish.

4. Brief description of the subject and syllabus

4.1. Brief description of the subject

This course presents **logic programming**, one of the fundamental programming paradigms (together with functional, imperative, and object-oriented programming). It is based on the use of logic as a practical language for programming applications. The course starts by presenting techniques for problem representation and problem solving using pure logic programming. The next step is programming with contemporary versions of Prolog, as well as efficient programming in this language, with special emphasis on applications in artificial intelligence. The course also presents an introduction to **constraint logic programming**, and some advanced topics. It is fundamentally a practical, programming-oriented course in which the students will complete a number of programming assignments using an advanced programming system which allows programming with pure logic programming, Prolog, functions, higher-order, constraints, and several other extensions.

4.2. Syllabus

1. Introduction

- 1.1. Problem solving and automated theorem proving
- 1.2. What is (C)LP?

2. Pure Logic (relational) Programming

- 2.1. Syntax and semantics
- 2.2. Resolution, unification, controlling search
- 2.3. Data structures
- 2.4. Recursive programming
- 2.5. Graphs, automata

3. Prolog

- 3.1. Execution model
- 3.2. Arithmetic
- 3.3. Data structures

- 3.4. Meta-programming, higher order, aggregation predicates
- 3.5. Program inspection and modification
- 3.6. Cut and negation
- 3.7. Incomplete data structures, grammars
- 3.8. [Optional] Techniques for efficient Prolog programming
- 4. Introduction to Constraint Logic Programming (CLP)
 - 4.1. Constraint satisfaction
 - 4.2. Basic constraint programming techniques (Q/R and finite domains)
- 5. [Optional] (C)LP theory
 - 5.1. Review of first-order predicate logic
 - 5.2. Resolution
 - 5.3. Fundamental results
 - 5.4. Semantics of (constraint) logic programs

5. Schedule

5.1. Subject schedule*

Week	Type 1 activities	Type 2 activities	Distant / On-line	Assessment activities
1	1.1 y 1.2 Duration: 02:00 Lecture			
2	2.1 y 2.2 Duration: 02:00 Lecture			
3	2.3 Duration: 01:00 Lecture 2.1-2.3 Duration: 01:00 Problem-solving class			
4	2.4 Duration: 02:00 Lecture			Practical programming exercises 1 Individual work Progressive assessment Not Presential Duration: 00:00
5	2.5 Duration: 02:00 Lecture			
6	2.4-2.5 Duration: 01:00 Problem-solving class 3.1-3.2 Duration: 01:00 Lecture			Practical programming exercises 2 Individual work Progressive assessment Not Presential Duration: 00:00
7	3.3 Duration: 02:00 Lecture			
8	3.4 Duration: 02:00 Lecture			
9	3.5 Duration: 01:00 Lecture 3.1-3.5 Duration: 01:00 Problem-solving class Actividades Transversales Duration: 02:00 Additional activities			

10	3.6-3.7 Duration: 02:00 Lecture			
11	3.8 Duration: 01:00 Lecture 3.6-3.8 Duration: 01:00 Problem-solving class Actividades Transversales Duration: 02:00 Additional activities			
12	4.1 Duration: 02:00 Lecture			Programming project Individual work Progressive assessment Not Presential Duration: 00:00
13	4.2 Duration: 01:00 Lecture 4.1-4.2 Duration: 01:00 Problem-solving class Actividades Transversales Duration: 02:00 Additional activities			
14	5.1-5.2 Duration: 02:00 Lecture			
15	5.3-5.4 Duration: 02:00 Lecture Actividades Transversales Duration: 02:00 Additional activities			
16				
17				Global Test - Assignments Turn-In Online test Progressive assessment and Global Examination Presential Duration: 02:00

Depending on the programme study plan, total values will be calculated according to the ECTS credit unit as 26/27 hours of student face-to-face contact and independent study time.

6. Activities and assessment criteria

6.1. Assessment activities

6.1.1. Assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
4	Practical programming exercises 1	Individual work	No Presential	00:00	0%	5 / 10	CGI1 CG7 CG18 CEIA6
6	Practical programming exercises 2	Individual work	No Presential	00:00	0%	5 / 10	CGI1 CG7 CG18 CEIA6
12	Programming project	Individual work	No Presential	00:00	0%	5 / 10	CG18 CEIA6 CGI1 CG7
17	Global Test - Assignments Turn-In	Online test	Face-to-face	02:00	100%	5 / 10	CGI1 CG7 CG18 CEIA6

6.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
17	Global Test - Assignments Turn-In	Online test	Face-to-face	02:00	100%	5 / 10	CGI1 CG7 CG18 CEIA6

6.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
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Global Test - Assignment Turn-In	Online test	Face-to-face	02:00	100%	5 / 10	CGI1 CG7 CG18 CEIA6
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6.2. Assessment criteria

Course evaluation system:

The normal evaluation system for the course, which is applied to all students, is by progressive evaluation.

- Being an eminently practical subject, in addition to various class exercises, evaluable practical assignments will be carried out during the course.
- These assignments must be carried out individually.
- The statements, instructions, information on the systems to be used, etc., will be sent by email and Moodle.
- The final grade of the course will be the average of the assignments. There is no minimum grade for each assignment and it is possible to carry out the second assignment even if the first one has not been delivered or approved.

Evaluation by global test:

The evaluation by global test will consist in the recovery of (turning in again) the assignments that had not been turned in or had been failed. Turning in the assignments at this time and getting a sufficient grade (≥ 5) will allow passing the course.

Extraordinary evaluation:

Those students who have not passed the course may take the extraordinary evaluation. This will also include the recovery of (turning in again) the assignments (with a grade ≥ 5) that had not been turned in or had been failed.

Sistema de evaluación de la asignatura:

El sistema normal de evaluación de la asignatura, que se aplica a todos los alumnos, es por evaluación progresiva.

- Al ser una asignatura eminentemente práctica, además de diversos ejercicios de clase, se realizarán prácticas evaluables durante el curso.
- Dichas prácticas se realizarán de forma individual.
- Los enunciados, instrucciones, información sobre los sistemas a utilizar, etc., se enviarán por correo electrónico y Moodle.
- La nota final del curso será la media de las prácticas. No hay nota mínima para cada práctica y es posible realizar cada práctica aunque no se haya entregado o aprobado otras.

Evaluación mediante prueba global:

La evaluación mediante prueba global consistirá en la recuperación de las prácticas que no se hubieran entregado o se hubieran suspendido anteriormente. La presentación de las prácticas obteniendo suficiente puntuación (≥ 5) permitirá superar la asignatura.

Evaluación extraordinaria:

Aquellos estudiantes que no hayan superado la asignatura podrán presentarse a la evaluación extraordinaria. Ésta consistirá también en la recuperación de las prácticas (con calificación ≥ 5) que no se hubieran entregado o se hubieran suspendido anteriormente.

7. Teaching resources

7.1. Teaching resources for the subject

Name	Type	Notes
"The Art of Prolog" (Second edition), Sterling & Shapiro, MIT Press, 1994.	Bibliography	
"From Logic Programming to Prolog", K. Apt, Prentice-Hall, 1997.	Bibliography	

``Prolog Programming for Artificial Intelligence", I. Bratko, Addison-Wesley Ltd. 1990 (2nd edition); 2000 (3rd edition).	Bibliography	
``Programming in Prolog", Clocksin & Mellish, 1981, Springer-Verlag.	Bibliography	
``Programming with Constraints: An Introduction", Marriott & Stuckey, MIT Press, 1998.	Bibliography	
``Essentials of Logic Programming", C. Hogger, 1990, Clarendon Press, Oxford.	Bibliography	
Sitio Moodle de la asignatura	Web resource	
Course web site	Web resource	http://www.clip.dia.fi.upm.es/prode
Ciao Prolog Playground	Web resource	https://ciao-lang.org/playground
Ciao Prolog programming system	Web resource	http://ciao-lang.org
Emacs programming environment for Ciao	Web resource	https://ciao-lang.org/install.html
Visual Studio Code programming environment for Ciao	Web resource	https://marketplace.visualstudio.com/items?itemName=ciao-lang.ciao-prolog-vsc
Aula	Equipment	
Sala de trabajo en grupo	Equipment	
Laboratorio: Centro de Cálculo	Equipment	

8. Other information

8.1. Other information about the subject

- This course is relevant to "Sustainable Development Goal Number 9" (Industry, Innovation, and Infrastructure) defined by the United Nations Program for Sustainable Development (www.undp.org) as related to innovation and research in information technology.