



POLITÉCNICA

INTERNATIONAL
CAMPUS OF
EXCELLENCE

COORDINATION PROCESS OF
LEARNING ACTIVITIES
PR/CL/001



E.T.S. de Ingenieros
Informáticos

ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

103000364 - Logic Programming

DEGREE PROGRAMME

10AJ - Master Universitario En Inteligencia Artificial

ACADEMIC YEAR & SEMESTER

2021/22 - 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	2021-22

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
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.
Jose Francisco Morales Caballero	2101	josefrancisco.morales@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 the logic programming paradigm, i.e., 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 addresses negation by failure and meta-programming, as well as an introduction to constraint 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, 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
 - 2.2. Resolution and Unification
 - 2.3. Data structures
 - 2.4. Recursive programming
3. Prolog
 - 3.1. Syntax
 - 3.2. Execution model
 - 3.3. Arithmetic
 - 3.4. Data structures
 - 3.5. Basic programming techniques
 - 3.6. Meta-programming

3.7. Efficient Prolog programming

4. Theory of LP

4.1. Review of first-order predicate logic

4.2. Resolution

4.3. Fundamental results

4.4. Semantics of logic programs

5. Introduction to CLP

5.1. Constraint satisfaction

5.2. Basic constraint programming

5. Schedule

5.1. Subject schedule*

Week	Face-to-face classroom activities	Face-to-face laboratory activities	Distant / On-line	Assessment activities
1	1.1 y 1.2 Duration: 02:00 Lecture		1.1 y 1.2 Duration: 02:00 Lecture	In-class exercises Individual work Continuous assessment Not Presential Duration: 02:00
2	2.1 y 2.2 Duration: 02:00 Lecture		2.1 y 2.2 Duration: 02:00 Lecture	Work on the assignments Individual work Continuous assessment Not Presential Duration: 02:00
3	2.3 Duration: 02:00 Lecture Tutoría en grupo Duration: 02:00 Problem-solving class		2.3 Duration: 02:00 Lecture Tutoría en grupo Duration: 02:00 Problem-solving class	Work on the assignments Individual work Continuous assessment Not Presential Duration: 02:00
4	2.4 Duration: 02:00 Lecture		2.4 Duration: 02:00 Lecture	Work on the assignments Individual work Continuous assessment Not Presential Duration: 02:00
5	2.5 Duration: 02:00 Lecture		2.5 Duration: 02:00 Lecture	Work on the assignments Individual work Continuous assessment Not Presential Duration: 02:00
6	3.1 y 3.2 Duration: 02:00 Lecture		3.1 y 3.2 Duration: 02:00 Lecture	Work on the assignments Individual work Continuous assessment Not Presential Duration: 02:00
7	3.3 y 3.4 Duration: 02:00 Lecture		3.3 y 3.4 Duration: 02:00 Lecture	Work on the assignments Individual work Continuous assessment Not Presential Duration: 03:00
8	3.5 Duration: 02:00 Lecture		3.5 Duration: 02:00 Lecture	Assignment presentation Individual work Continuous assessment Not Presential Duration: 02:00

9	3.6 Duration: 02:00 Lecture Tutoría en grupo Duration: 02:00 Problem-solving class		3.6 Duration: 02:00 Lecture Tutoría en grupo Duration: 02:00 Problem-solving class	Work on the assignments Individual work Continuous assessment Not Presential Duration: 02:00
10	3.7 Duration: 02:00 Lecture		3.7 Duration: 02:00 Lecture	Work on the assignments Individual work Continuous assessment Not Presential Duration: 02:00
11	3.7 Duration: 02:00 Lecture		3.7 Duration: 02:00 Lecture	Work on the assignments Individual work Continuous assessment Not Presential Duration: 02:00
12	4.1 y 4.2 Duration: 02:00 Lecture		4.1 y 4.2 Duration: 02:00 Lecture	Assignment presentation Individual presentation Continuous assessment Not Presential Duration: 02:00
13	4.3 y 4.4 Duration: 02:00 Lecture		4.3 y 4.4 Duration: 02:00 Lecture	Work on the assignments Individual work Continuous assessment Not Presential Duration: 02:00
14	5.1 Duration: 02:00 Lecture		5.1 Duration: 02:00 Lecture	Work on the assignments Individual work Continuous assessment Not Presential Duration: 02:00
15	5.2 Duration: 02:00 Lecture Tutoría en grupo Duration: 02:00 Problem-solving class		5.2 Duration: 02:00 Lecture Tutoría en grupo Duration: 02:00 Problem-solving class	Assignment presentation Individual presentation Continuous assessment Not Presential Duration: 02:00
16				Practical examination (optional, depends on performance in practical assignments) Problem-solving test Continuous assessment Not Presential Duration: 01:00
17				Final exam Written test Final 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.

* The schedule is based on an a priori planning of the subject; it might be modified during the academic year, especially considering the COVID19 evolution.

6. Activities and assessment criteria

6.1. Assessment activities

6.1.1. Continuous assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
1	In-class exercises	Individual work	No Presential	02:00	%	5 / 10	
2	Work on the assignments	Individual work	No Presential	02:00	%	5 / 10	
3	Work on the assignments	Individual work	No Presential	02:00	%	5 / 10	
4	Work on the assignments	Individual work	No Presential	02:00	%	5 / 10	
5	Work on the assignments	Individual work	No Presential	02:00	%	5 / 10	
6	Work on the assignments	Individual work	No Presential	02:00	%	5 / 10	
7	Work on the assignments	Individual work	No Presential	03:00	%	5 / 10	
8	Assignment presentation	Individual work	No Presential	02:00	30%	5 / 10	CGI1 CG7 CG18 CEIA6
9	Work on the assignments	Individual work	No Presential	02:00	%	5 / 10	
10	Work on the assignments	Individual work	No Presential	02:00	%	5 / 10	
11	Work on the assignments	Individual work	No Presential	02:00	%	5 / 10	
12	Assignment presentation	Individual presentation	No Presential	02:00	30%	5 / 10	CG7 CG18 CEIA6 CGI1
13	Work on the assignments	Individual work	No Presential	02:00	%	5 / 10	
14	Work on the assignments	Individual work	No Presential	02:00	%	5 / 10	

15	Assignment presentation	Individual presentation	No Presential	02:00	30%	5 / 10	CG11 CG7 CEIA6
16	Practical examination (optional, depends on performance in practical assignments)	Problem-solving test	No Presential	01:00	10%	5 / 10	CG11 CG7 CG18 CEIA6

6.1.2. Final examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
17	Final exam	Written test	Face-to-face	02:00	100%	5 / 10	CG11 CG18 CG7 CEIA6

6.1.3. Referred (re-sit) examination

No se ha definido la evaluación extraordinaria.

6.2. Assessment criteria

Students are assumed by default to follow the 'continuous evaluation' path. This modality is highly recommended, since this is a highly practical course. Those students who do not wish to follow the practical part of the course (the assignments) must apply to the course coordinator for this status within the first 4 weeks. These students will have to take the (ordinary) final exam.

Continuous evaluation:

- Several practical programming tasks will be assigned during the course.
- These assignments have to be completed individually.
- The descriptions of the assignments, instructions, information on systems to use, etc. will be sent by email and Moodle.
- Assignments will be checked on Deliverit and turned in via Moodle.
- The final grade for the assignments will be the average of the grades for each assignment. No minimum is required for each assignment.
- If the practical part has been passed (average ≥ 5.0) with "guarantees of authenticity" as well as a possible individual (short) practical exam, this will be the final grade.

Evaluation by final exam:

- Those students that chose to be evaluated by final exam should take this exam. There are no practical assignments associated with this exam and the final grade is that of the exam.

Todos los estudiantes se entiende por defecto que cursan la asignatura por evaluación continua. Esta modalidad es altamente recomendada ya que se trata de una asignatura eminentemente práctica. Los estudiantes que quieran ir por el contrario a evaluación por prueba final deben comunicarlo al coordinador durante las 4 primeras semanas del curso. Estos estudiantes deberán presentarse al examen final (ordinario).

Evaluación continúa:

- Se realizarán varias prácticas 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.
- Las prácticas se comprobarán en Deliverit y la entrega se hará utilizando Moodle.
- La nota final de prácticas será la media de todas las prácticas. No hay nota mínima para cada práctica.
- Si se han aprobado las prácticas (media ≥ 5.0) con garantía de autenticidad y el posible examen de prácticas individual (corto), la nota final será la de prácticas.

Evaluación por examen final:

- Aquellos estudiantes que eligieron ser evaluados por prueba final deben presentarse a este examen. En este caso no hay prácticas y la nota final será la del examen.

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	
Course web site	Web resource	http://www.clip.dia.fi.upm.es/prode
Ciao Prolog	Web resource	Lenguaje de programación http://ciao-lang.org
Sitio Moodle de la asignatura	Web resource	
Aula	Equipment	
Sala de trabajo en grupo	Equipment	
Laboratorio: Centro de Cálculo	Equipment	

8. Other information

8.1. Other information about the subject

- The sanitary situation caused by the COVID-19 pandemic makes it necessary to limit occupancy in the classrooms and it has thus been decided that this semester will be conducted in principle in mixed-presence mode. In this mode each group is divided into subgroups so that each week one subgroup will be present in the classroom (the "activity in the classroom" column in the chronogram) while the remaining ones will connect to the class remotely (tele-presence column). Each week a different subgroup attends in the classroom. Students that for health reasons cannot attend in person are allowed to follow remotely.
- If the sanitary conditions worsen, or other circumstances do not allow conducting the class in person, students and faculty will connect remotely following the tele-presence column. In this situation any in-person evaluation activities will be conducted remotely, without any changes needed in this guide.
- If, on the contrary, the sanitary conditions improve and it is possible to teach normally in-class, all students will attend following the "activity in the classroom" column.
- 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.