ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

203000033 - Knowledge Representation And Acquisition

DEGREE PROGRAMME

20BC - Master Universitario En Biologia Computacional

ACADEMIC YEAR & SEMESTER

2025/26 - Semester 1

Index

Learning guide

1. Description

1.1. Subject details

Name of the subject	203000033 - Knowledge Representation And Acquisition
No of credits	3 ECTS
Type	Optional/elective
Academic year ot the programme	First year
Semester of tuition	Semester 1
Tuition period	September-January
Tuition languages	English
Degree programme	20BC - Master Universitario en Biologia Computacional
Centre	20 - Etsi Agronómica, Aliment. Y Biosistemas
Academic year	2025-26

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Emilio Serrano Fernandez (Subject coordinator)	2201	emilio.serrano@upm.es	Sin horario. http://dia.fi.upm.es/es/emilioserra
Javier Bajo Perez	2105	javier.bajo@upm.es	Sin horario. http://dia.fi.upm.es/es/jbajo

* 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

CE02 - Utilizar sistemas operativos, programas y herramientas de uso común en biología computacional, así como, manejar plataformas de cómputo de altas prestaciones, lenguajes de programación y análisis bioinformáticos

CE03 - Analizar e interpretar bioinformáticamente los datos que se derivan de las tecnologías ómicas, y proponer soluciones bioinformáticas en relación a dichos datos.

CE05 - Utilizar herramientas de biología computacional para el análisis genómico, incluida la genómica comparativa y biología evolutiva.

CE10 - Conocimiento de las técnicas de representación del conocimiento reutilizables y modelos de razonamiento en entornos centralizados y distribuidos a utilizar en la resolución de problemas que impliquen conducta inteligente.

CG03 - Que los estudiantes sepan aplicar los conocimientos adquiridos y su capacidad de resolución de problemas en entornos nuevos o poco conocidos dentro de contextos más amplios (o multidisciplinares) relacionados con el area de la Biología Computacional.

CG05 - Que los estudiantes sean capaces de integrar conocimientos en el area de la Biología Computacional, de formular conclusiones, hipótesis o líneas de trabajo a partir de la información disponible, y de formarse una opinion fundamentada sobre las responsabilidades sociales y éticas vinculadas a la aplicación de sus conocimientos.

CT07 - Ser capaz de manejar las tecnologías de la información y comunicación en un contexto profesional.

CT08 - Tener capacidad de análisis y síntesis para interpretar datos relevantes y abordar los problemas desde diferentes perspectivas.

3.2. Learning outcomes

RA46 - Saber aplicar diferentes técnicas de adquisición de conocimientos (con enfoques simbólicos o enfoques evolutivos) para extraer conocimiento de datos en forma de representaciones simbólicas (por ejemplo, reglas)

RA45 - Ser capaz de conocer las características de la representación del conocimiento y su utilidad práctica para la construcción de sistemas inteligentes

RA47 - Saber cómo adquirir y utilizar el conocimiento memorizando casos representativos utilizando el razonamiento basado en casos.

* 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

In the rapidly evolving field of computational biology, the ability to effectively represent and acquire knowledge is crucial to advance research and innovation. The "Knowledge Representation and Acquisition" course is designed to equip students with the foundational and advanced concepts necessary to navigate and contribute to this interdisciplinary domain. Throughout the course, students will receive an introduction to key artificial intelligence technologies that are widely used in computational biology. Although the course will not allow for in-depth exploration of each technology due to time constraints, it aims to stimulate students to explore further and apply innovative techniques such as Explainable Artificial Intelligence (XAI), Graph Mining, Generative Artificial Intelligence, Automated Reasoning, Case-Based Reasoning, and Multi-agent Systems.

4.2. Syllabus

1. Introduction to Knowledge Representation and Acquisition (KR&A) and Explainable Artificial Intelligence (XAI)

2. Graph Representation and Graph Mining in Biological and Social Networks

3. Knowledge Representation and Acquisition in Generative Artificial Intelligence and Prompt Engineering

4. Symbolic Knowledge Representation and Automated Reasoning

5. Case-Based Reasoning for Knowledge Representation and Acquisition

6. Multi-agent Systems and Decentralized Knowledge Representation and Acquisition

5. Schedule

5.1. Subject schedule*

Week	Type 1 activities	Type 2 activities	Distant / On-line	Assessment activities
1	**Lecture on Unit 1** Duration: 02:00 Lecture			
2	**Lecture on Unit 1** Duration: 02:00 Laboratory assignments			
3	**Lecture on Unit 2** Duration: 02:00 Lecture			
4	**Lecture on Unit 2** Duration: 02:00 Laboratory assignments			
5	**Lecture on Unit 3** Duration: 02:00 Lecture			
6	**Lecture on Unit 3** Duration: 01:00 Laboratory assignments **Written Theoretical and Practical Exam** Duration: 01:00 Additional activities			**Written Theoretical and Practical Exam** Written test Progressive assessment Presential Duration: 01:00
7	**Lecture on Unit 4** Duration: 02:00 Lecture			
8	**Lecture on Unit 4** Duration: 02:00 Laboratory assignments			
9	**Lecture Unit 5** Duration: 02:00 Lecture			
10	**Lecture Unit 5** Duration: 02:00 Laboratory assignments			
11	**Lecture Unit 6** Duration: 02:00 Lecture			
12	**Lecture Unit 6** Duration: 02:00 Additional activities			

13	**Evaluation preparation workshop** Duration: 02:00 Laboratory assignments			
14	**Practical project (evaluación progresiva)** Duration: 02:00 Additional activities			**Practical project (evaluación progresiva)** Individual work Progressive assessment Presential Duration: 02:00
15				
16				**Written Theoretical and Practical Exam** Written test Global examination Presential Duration: 01:00 **Practical project (evaluación global)** Individual work Global examination Presential Duration: 01:00
17				

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
6	Written Theoretical and Practical Exam	Written test	Face-to-face	01:00	50%	5 / 10	CG03 CG05 CT07 CT08 CE02 CE03 CE05 CE10
14	Practical project (evaluación progresiva)	Individual work	Face-to-face	02:00	50%	5 / 10	CG03 CT07 CT08 CE10

6.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
16	Written Theoretical and Practical Exam	Written test	Face-to-face	01:00	50%	5 / 10	CG05 CT07 CT08 CE02 CE03 CE05 CE10
16	Practical project (evaluación global)	Individual work	Face-to-face	01:00	50%	5 / 10	CG03 CT07 CT08 CE10

6.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Practical project (evaluación extraordinaria)	Individual work	Face-to-face	02:00	50%	5 / 10	CG03 CT07 CT08 CE10
Test extraordinario	Written test	Face-to-face	01:00	50%	5 / 10	CG03 CG05 CT07 CT08 CE02 CE03 CE05 CE10

6.2. Assessment criteria

- Qualifications of 5 or higher in partial exams and practical projects are kept for the global and extraordinary evaluation.

- You can only opt for a second or third evaluation of partial exams and practical projects if they have received grades lower than 5 or have not been submitted.

- If the minimum passing grade is not achieved in one of the evaluated parts, the grade for the entire course will be the grade of the part that was not passed.

- The instructions for practical projects, as well as the type of written exam (multiple choice, short answer, essay) may vary in different assessments (progressive, final, and extraordinary).

- In the event that a written exam is evaluated through quizzes on the Moodle platform with random questions from a question bank, the solutions to the questions will not be published since it is not allowed by this type of exam. Besides, in this exam modality and to enhance anti-cheating measures, access to the quiz will be sequential (only one question can be viewed per screen, and it will not be possible to go back once a question is answered).

- The rights and duties of university students are developed in the Statutes of the Polytechnic University of Madrid (BOCM of November 15, 2010) and in the University Student Statute (RD 1791/2010 of December 30). Article 124 (a) of the statutes of the UPM establishes as the student's duty..."to follow responsibly and profitably the process of

training, knowledge acquisition, and learning corresponding to their condition as a university student"... and article 13 of the Statute of the University Student, in point (d) it also specifies as the duty of the university student "to refrain from the use or cooperation in fraudulent procedures in the evaluation tests, in the work that is carried out, or in official documents of the university". In the event that in the development of the evaluation tests the breach of the duties as a university student is appreciated, the coordinator of the subject may notify the Director if the Center, who in accordance with the provisions of article 74 (n) of the UPM Statutes has powers to "Propose the initiation of disciplinary proceedings against any member of the School or Faculty".

7. Teaching resources

7.1. Teaching resources for the subject

Name	Type	Notes
UPM Moodle	Web resource	
[Russell & Norvig, 2020]	Bibliography	Stuart Russell, Peter Norvig: Artificial Intelligence: A Modern Approach (4th Edition). Pearson 2020, ISBN 9780134610993
[Molnar, 2024]	Web resource	Ebook. A Guide for Making Black Box Models Explainable by Christoph Molnar. https://christophm.github.io/interpretable-ml-book/
[Scott, 2017]	Bibliography	Social Network Analysis. Edition: Fourth. By: John Scott. Publisher: SAGE Publications Ltd. Publication year: 2017.
[Ng 2023]	Web resource	Online course. Generative AI for Everyone, https://www.deeplearning.ai/courses/generative-ai-for-everyone/

[Richter & Weber, 2013]	Bibliography	Michael M. Richter , Rosina O. Weber. 2013). Case-Based Reasoning: A Textbook. Springer Berlin Heidelberg.
[Shoham & Leyton-Brown, 2008]	Bibliography	Yoav Shoham and Kevin Leyton-Brown. 2008. Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations. Cambridge University Press, USA.
Biblography	Bibliography	Selected bibliography (papers and text books)

8. Other information

8.1. Other information about the subject

- The subject is supported by the Moodle tool to provide information and documentation to students, as well as for the assignment of statements and deliveries of practices and the communication of student grades.