



POLITÉCNICA

INTERNATIONAL
CAMPUS OF
EXCELLENCE

COORDINATION PROCESS OF
LEARNING ACTIVITIES
PR/CL/001



Etsi Agronómica, Aliment. y
Biosistemas

ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

203000023 - Machine Learning

DEGREE PROGRAMME

20BC - Master Universitario En Biología Computacional

ACADEMIC YEAR & SEMESTER

2025/26 - Semester 1

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1. Description

1.1. Subject details

Name of the subject	203000023 - Machine Learning
No of credits	3 ECTS
Type	Optional/elective
Academic year of the programme	First year
Semester of tuition	Semester 1
Tuition period	September-January
Tuition languages	English
Degree programme	20BC - Master Universitario en Biología 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 *
Esteban Garcia Cuesta	2201	esteban.garcia@upm.es	Sin horario. http://www.dia.fi.upm.es/es/estebangarcia
Bojan Mihaljevic (Subject coordinator)	3205	b.mihaljevic@upm.es	Sin horario. http://dia.fi.upm.es/es/node/201

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

3. Prior knowledge recommended to take the subject

3.1. Recommended (passed) subjects

The subject - recommended (passed), are not defined.

3.2. Other recommended learning outcomes

- notions of python and statistics

4. Skills and learning outcomes *

4.1. Skills to be learned

CE01 - Comprender las bases moleculares y las técnicas experimentales estándares más comunes en las investigaciones ómicas (genómica, transcriptómica, proteómica, metabolómica, interactómica, etc.).

CE04 - Utilizar diferentes bases de datos (incluidos los bigdata), conocer sus estructuras y ontologías, aplicar la estadística a su análisis, siendo capaz de utilizar herramientas de representación y visualización.

CE08 - Capacidad de integrar tecnologías y sistemas propios de la Inteligencia Artificial, con carácter generalista, y en contextos más amplios y multidisciplinares.

CE09 - Capacidad de interpretar los modelos de clasificación supervisada y no supervisada obtenidos al aplicar las técnicas de Aprendizaje Automático para un conjunto de datos.

CG02 - Familiarizarse con el trabajo y los métodos de la Biología Computacional en condiciones reales, adquiriendo la capacidad de diseñar aplicaciones/experimentos de forma independiente y describir, cuantificar, analizar y evaluar críticamente los resultados obtenidos.

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

4.2. Learning outcomes

RA6 - Ser capaz de llevar a cabo análisis de datos sofisticados por medio de software específico.

RA78 - RA67 - Ser capaz de identificar el tipo de método (supervisado, no supervisado, relación entre variables) a utilizar para modelizar un problema real de biología computacional

RA77 - RA66 - Ser capaz de interpretar el modelo obtenido

RA76 - RA64 - Ser capaz de seleccionar el modelo/ algoritmo idóneo para cada método

* 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.

5. Brief description of the subject and syllabus

5.1. Brief description of the subject

Machine Learning (ML) is the study of algorithms that allow programs to automatically improve through experience. These algorithms build a model based on "training data" to make predictions or decisions without being explicitly programmed to do so.

The combination of ML with biological data is producing some of the most cost-effective tools for building predictive models in the field of Biology. Some examples include: annotating new genomic sequences, predicting macromolecular function, identifying functionally important sites in proteins, identifying genetic markers of diseases, and discovering the networks of genetic interactions.

In this subject, students will learn several methods for the construction of these models and their application to computational biology.

5.2. Syllabus

1. Introduction to machine learning
2. Data preprocessing
3. Unsupervised learning
 - 3.1. Introduction to clustering
 - 3.2. Evaluation of learning models for clustering
 - 3.3. Partitional clustering
 - 3.4. Hierarchical clustering
 - 3.5. Other clustering methods
4. Supervised learning
 - 4.1. Introduction to classification and regression
 - 4.2. Simple classification and regression methods
 - 4.3. Evaluation of learning models for classification and regression
 - 4.4. Advanced Classification and Regression Methods

6. Schedule

6.1. Subject schedule*

Week	Type 1 activities	Type 2 activities	Distant / On-line	Assessment activities
1	Clases teóricas del tema 1 Duration: 02:00 Lecture			
2	Clases teóricas del tema 2 Duration: 02:00 Lecture			
3	Clases prácticas del tema 2 Duration: 02:00 Laboratory assignments			
4	Clases teóricas del tema 3 Duration: 02:00 Lecture			
5	Clases prácticas del tema 3 Duration: 02:00 Laboratory assignments			
6	Clases teóricas del tema 3 Duration: 02:00 Lecture			
7	Clases teóricas del tema 4 Duration: 02:00 Lecture			Proyecto práctico evaluación progresiva tema 3 Individual work Progressive assessment Presential Duration: 02:00
8	Clases prácticas del tema 4 Duration: 02:00 Laboratory assignments			
9	Clases teóricas del tema 4 Duration: 01:00 Lecture			
10	Clases prácticas del tema 4 Duration: 01:00 Laboratory assignments			
11	Clases teóricas del tema 4 Duration: 01:00 Lecture			
12	Clases prácticas del tema 4 Duration: 01:00 Laboratory assignments			
13	Ejercicios Duration: 02:00 Problem-solving class			Proyecto práctico evaluación progresiva tema 4 Individual work Progressive assessment Presential Duration: 02:00 Examen escrito evaluación progresiva temas 1-4

				Written test Progressive assessment Presential Duration: 00:50
14	Ejercicios Duration: 02:00 Problem-solving class			
15	Ejercicios Duration: 02:00 Problem-solving class			
16	Ejercicios Duration: 02:00 Problem-solving class			
17				Proyecto práctico evaluación global temas 3 y 4 Individual work Global examination Presential Duration: 02:00 Examen escrito evaluación global temas 1-4 Written test Global examination Presential Duration: 00:50

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.

7. Activities and assessment criteria

7.1. Assessment activities

7.1.1. Assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
7	Proyecto práctico evaluación progresiva tema 3	Individual work	Face-to-face	02:00	35%	5 / 10	CG02 CG05 CE01 CE04 CE08 CE09
13	Proyecto práctico evaluación progresiva tema 4	Individual work	Face-to-face	02:00	45%	5 / 10	CG02 CG05 CE01 CE04 CE08 CE09
13	Examen escrito evaluación progresiva temas 1-4	Written test	Face-to-face	00:50	20%	4 / 10	CG02 CE04 CE08 CE09

7.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
17	Proyecto práctico evaluación global temas 3 y 4	Individual work	Face-to-face	02:00	80%	5 / 10	CG02 CG05 CE01 CE04 CE08 CE09
17	Examen escrito evaluación global temas 1-4	Written test	Face-to-face	00:50	20%	4 / 10	CG02 CE04 CE08 CE09

7.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Proyecto práctico evaluación extraordinaria temas 3 y 4	Individual work	Face-to-face	02:00	80%	5 / 10	CG02 CG05 CE01 CE04 CE08 CE09
Examen escrito evaluación extraordinaria temas 1-4	Written test	Face-to-face	01:00	20%	4 / 10	CG02 CE04 CE08 CE09

7.2. 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.

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 EUPM 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 or Dean of 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, on its own initiative or at the request of the Governing Commission" to the Rector, under the terms provided in the statutes and application rules.

8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
Libro 2020	Bibliography	Alpaydin, E. (2020). Introduction to Machine Learning, fourth edition (Adaptive Computation and Machine Learning series). MIT press.
Libro 2019	Bibliography	Géron, A. (2019). Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow: Concepts, tools, and techniques to build intelligent systems. O'Reilly Media, Inc.
Libro 2019-2	Bibliography	Raschka, S., & Mirjalili, V. (2019). Python machine learning: Machine learning and deep learning with Python, scikit-learn, and TensorFlow 2. Packt Publishing Ltd.
Libro 2018	Bibliography	Machine Learning with Python Cookbook: Practical Solutions from Preprocessing to Deep Learning. 1st Edición - 2018. Author: Chris Albon
Libro 2017	Bibliography	E. Vicente, A. Mateos (2017), Datas Science y Redes Complejas. Métodos y Aplicaciones, Editorial Universitaria Ramón Areces.
Libro 2016	Bibliography	Müller, A. C., & Guido, S. (2016). Introduction to machine learning with Python: a guide for data scientists. " O'Reilly Media, Inc.".
Libro 2016-2	Bibliography	Data Mining: Practical Machine Learning Tools and Techniques. 4th Edition - October 1, 2016. Authors: Ian Witten, Eibe Frank, Mark Hall, Christopher Pal

Libro 2015	Bibliography	Data Preprocessing in Data Mining. Salvador García, Julián Luengo, Francisco Herrera. Springer-Verlag, 2015. ISBN: 978-3319102467
Libro 2009	Bibliography	The Fourth Paradigm: Data-intensive Scientific Discovery. Tony Hey, Stewart Tansley and Kristin Tolle. Microsoft Research, 2009. ISBN: 978-0982544204
Libro 2001	Bibliography	R. Duda, P.E. Hart, D.G. Stork. Pattern Classification. Wiley. 2001.

9. Other information

9.1. 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.