COURSE DATA

DATA SUBJECT

Code: 46577
Name: Deep learning
Cycle: Master's Degree
ECTS Credits: 6
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
2262 - Master's Degree in Data Science	Escola Tècnica Superior d'Enginyeria	1	Second quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
2262 - Master's Degree in Data Science	Deep learning	COMPULSORY

COORDINATION

LAPARRA PEREZ-MUELAS VALERO

SUMMARY

In this course, the most advanced machine learning models are taught; it is therefore a continuation of the machine learning modules (I) and (II). The course focuses on models that currently have a large number of parameters such as deep convolutional models, recurrent models and MLPs used as autoencoders. Finally, the paradigm of reinforcement learning using these models is discussed.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

OTHER REQUIREMENTS

No enrolment restrictions with other subjects in the curriculum have been specified

COMPETENCES / LEARNING OUTCOMES

2262 - Master's Degree in Data Science

Ability to access and manage information in different formats for subsequent analysis in order to obtain knowledge from data.

Ability to solve classification, modelling, segmentation and prediction problems from a set of data.

Capacidad para trabajar en equipo para llegar a soluciones de problemas interdisciplinarios usando técnicas de análisis de datos.

Entender la utilidad de la ciencia de datos y sus elementos asociados, así como su aplicación en la resolución de problemas, eligiendo las técnicas más adecuadas a cada problema, aplicando de forma correcta las técnicas de evaluación y, finalmente,
interpretando los modelos y resultados.

Extraer conocimiento de conjuntos de datos en diferentes formatos.

Modelar la dependencia entre una variable respuesta y varias variables explicativas, en conjuntos de datos complejos, mediante técnicas de aprendizaje máquina, interpretando los resultados obtenidos.

Ser capaces de acceder a herramientas de información (bibliográficas y de empleo) y utilizarlas apropiadamente.

Ser capaces de asumir la responsabilidad de su propio desarrollo profesional y de su especialización en uno o más campos de estudio, aplicando los conocimientos adquiridos en la identificación de salidas profesionales y yacimientos de empleo.

Students should communicate conclusions and underlying knowledge clearly and unambiguously to both specialized and non-specialized audiences.

Students should demonstrate self-directed learning skills for continued academic growth.

Students should possess and understand foundational knowledge that enables original thinking and research in the field.

DESCRIPTION OF CONTENTS

1. Convolutional Neural Networks (CNN)

MLP problems with images. Architecture of a CNN. Learning algorithm. Classical structures. Transfer learning.

2. Autoencoders. Variational models

Basic autoencoders: relationship with PCA. Deep autoencoders. Variational versions.

3. Generative Adversarial Networks

GAN: basic architecture. Cost function. Learning algorithm. Variations.

4. Recurrent neural networks

Recurrent networks: early architectures (Elman / Jordan / IIR networks). Current models: LSTM and GRU. Attention Models.

5. Reinforcement learning. Deep models

Reinforcement learning. Elements. Bellman's equation. Q-Learning. Deep models

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theoretical and practical classes	60,00
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	20,00
Independent study and work	15,00
Preparation of lessons	33,00
Preparation for assessment activities	12,00
Resolution of case studies	10,00
Total hours	**90,00**

TEACHING METHODOLOGY

Theoretical activities. Expository development of the subject with the participation of the student in the resolution of specific questions. Individual evaluation questionnaires.

Practical activities. Learning by solving problems, exercises and case studies through which competences on the different aspects of the subject are acquired.

Laboratory and/or computer classroom work. Learning through activities carried out individually or in small groups and carried out in computer classrooms.

EVALUATION

The assessment of the learning of the knowledge and skills acquired by students will be carried out continuously throughout the course, and will consist of the following evaluation components:
Exercises and assignments submitted during the course and/or midterm exams: 60% of the final grade in the first call, 40% in the second call.
Final exam: 40% of the final grade in the first call, 60% in the second call. A minimum grade of 4 in the final exam will be required to pass the subject.
The grades obtained in section 1 will be retained for both calls of the academic year in which they were completed, as this evaluation is only possible during the teaching period.

REFERENCES

- Francois Chollet (2021). Deep Learning with Python. Manning Publications. Segunda edición.
- Ian GoodFellow, Yoshua Bengio (2016). Deep Learning. MIT Press, 2016.
- Nikhil Buduma, Nicholas Locascio (2017). Fundamentals of Deep Learning: Designing NextGeneration Machine Intelligence Algorithms 1st Edition. OReilly.
- Maxim Lapan (2020). Deep Reinforcement Learning Hands-On: Apply modern RL methods to practical problems of chatbots, robotics, discrete optimization, web automation, and more, 2nd Edition. Packt.
- Kevin Murphy (2021). Probabilistic Machine Learning: a Probabilistic Perspective. MIT Press. Disponible en https://probml.github.io/pml-book/book1.html
- Mohamed Elgendy (2020) Deep Learning for Vision Systems, Manning.
- Edward Raff (2022) Inside Deep Learning: Math, Algorithms, Models, Manning.