ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

103000898 - Deep Learning

DEGREE PROGRAMME

10BA - Master Universitario En Ciencia De Datos

ACADEMIC YEAR & SEMESTER

2021/22 - Semester 2

Index

Learning guide

1. Description

1.1. Subject details

Name of the subject	103000898 - Deep Learning
No of credits	3 ECTS
Type	Compulsory
Academic year ot the programme	First year
Semester of tuition	Semester 2
Tuition period	February-June
Tuition languages	English
Degree programme	10BA - Master Universitario en Ciencia de Datos
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 *
Luis Baumela Molina	2204	luis.baumela@upm.es	Sin horario.
Martin Molina Gonzalez (Subject coordinator)	2111	martin.molina@upm.es	Sin horario.
Daniel Manrique Gamo	2109	daniel.manrique@upm.es	Sin horario.
Emilio Serrano Fernandez	2201	emilio.serrano@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. Prior knowledge recommended to take the subject

3.1. Recommended (passed) subjects

- Sistemas Inteligentes

3.2. Other recommended learning outcomes

- Computer languages (e.g., Python)

- Basic foundations of artificial neural networks (e.g., shallow neural networks and backpropagation algorithm). For this purpose, it is recommended to attend the course "Intelligent Systems" during the first semester.

4. Skills and learning outcomes *

4.1. Skills to be learned

CB07 - 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 su área de estudio

CECD06 - Conocer y tener capacidad para aplicar métodos de minería de datos para clasificación, modelado, segmentación y predicción a partir de un conjunto de datos

CECD07 - Capacidad para desarrollar de modelos inteligentes basados en datos

4.2. Learning outcomes

RA35 - Identify areas of application where deep learning techniques can be used

RA36 - Apply machine learning software tools for practical problems related to deep learning

* 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

Deep learning has emerged from the connectionist branch of machine learning, aided by the arrival of big data and increased computational power (e. g., parallelization using graphics processing units - GPUs). Deep learning has showed better performance than other approaches to solve problems that cope with large amounts of data as it is required, for example, in computer vision (image or video processing) or speech understanding.

This course presents a theoretical and practical view of deep learning. It is assumed that students are familiar with the basic foundations of neural networks (e.g., shallow artificial neural networks and backpropagation algorithm). The course describes general methods to train deep neural networks and presents neural models for application domains (e.g., computer vision and natural language processing) together with software tools to train neural networks.

5.2. Syllabus

1. Training methods for deep neural networks
   1.1. Deep neural networks
   1.2. Training methods
2. Deep learning for computer vision
   2.1. Foundations of computer vision
   2.2. Convolutional neural networks
3. Deep learning for natural language processing

6. Schedule

6.1. Subject schedule*

Week	Face-to-face classroom activities	Face-to-face laboratory activities	Distant / On-line	Assessment activities
1	**Course introduction** Duration: 02:00 **Lecture on Unit 1** Duration: 02:00			
2	**Lecture on Unit 1** Duration: 02:00 **Lecture on Unit 1** Duration: 02:00			
3	**Lecture on Unit 1** Duration: 02:00 **Lecture on Unit 1** Duration: 02:00			
4	**Lecture on Unit 1** Duration: 02:00 **Lecture on Unit 2** Duration: 02:00			
5	**Lecture on Unit 2** Duration: 02:00			**Assessment activity for Unit 1** Continuous assessment Not Presential Duration: 02:00
6	**Lecture on Unit 2** Duration: 02:00 **Lecture on Unit 2** Duration: 02:00			
7	**Lecture on Unit 2** Duration: 02:00 **Lecture on Unit 3** Duration: 02:00			

8	**Lecture on Unit 3** Duration: 02:00 **Lecture on Unit 3** Duration: 02:00			
9				
10				
11				
12				
13				
14				
15				
16				
17				**Assessment activity for Unit 1** Final examination Presential Duration: 02:00 **Assessment activity for Unit 2** Continuous assessment and final examination Presential Duration: 02:00 **Assessment activity for Unit 3** Continuous assessment and 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.

7. Activities and assessment criteria

7.1. Assessment activities

7.1.1. Continuous assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
5	Assessment activity for Unit 1		No Presential	02:00	40%	2 / 10	CECD07 CB07 CECD06
17	Assessment activity for Unit 2		Face-to-face	02:00	40%	2 / 10	CB07 CECD07 CECD06
17	Assessment activity for Unit 3		Face-to-face	02:00	20%	/ 10	CECD07 CECD06 CB07

7.1.2. Final examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
17	Assessment activity for Unit 1		Face-to-face	02:00	40%	2 / 10	CB07 CECD07 CECD06
17	Assessment activity for Unit 2		Face-to-face	02:00	40%	2 / 10	CB07 CECD07 CECD06
17	Assessment activity for Unit 3		Face-to-face	02:00	20%	/ 10	CECD07 CECD06 CB07

7.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Assessment activity for Unit 1		Face-to-face	02:00	40%	2 / 10	CECD07 CB07 CECD06

Assessment acitivity for Unit 2		Face-to-face	02:00	40%	2 / 10	CECD07 CB07 CECD06
Assessment activity for Unit 3		Face-to-face	02:00	20%	/ 10	CECD07 CB07 CECD06

7.2. Assessment criteria

Partial and final grades are on the scale of 0 to 10. To pass the course it is required that the final grade G must be G >= 5.

"Continuous assessment" and "final examination" are mutually exclusive. Students who want to follow "final examination" must inform the coordinator (martin.molina@upm.es) at the beginning of the course (in the first two weeks of the course). Otherwise, continuous assessment is followed.

8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
UPM Moodle	Web resource	
Bibliography	Bibliography	Selected bibliography (papers and text books)

9. Other information

9.1. Other information about the subject

Students who are not familiar with basic foundations of artificial neural networks (e.g., shallow neural networks and backpropagation algorithm) may attend the course "Intelligent Systems" during the first semester.

The health situation caused by the COVID-19 pandemic is expected to have improved sufficiently to allow the full capacity of the classrooms to be utilized. Therefore, this semester's teaching has been planned in face-to-face mode.

If the health conditions do not allow the use of the full capacity of the classrooms, a mixed face-to-face mode by shifts will be used, as the one used in first semester courses, without the need to modify this guide.

The course "Deep Learning" is related to the "Sustainable Development Goal 9" (Build resilient infrastructure, promote sustainable industrialization and foster innovation), defined by the United Nations Development Programme (www.undp.org) in terms of innovation and scientific research in information technologies.

10. Adendas

- 5.2 Sylabus 1. Training methods for deep neural networks 1.1. Deep neural networks 1.2. Training methods 2. Deep learning for computer vision 2.1. Foundations of computer vision 2.2. Convolutional neural networks 3. Other deep learning applications 7.1.1. Continuous assessment Assessment activity for Unit 1: weight 45%, type face-to-face Assessment activity for Unit 2: weight 45%, week 8 Assessment activity for Unit 3: weight 10%, week 7 7.1.2. Final examination Assessment activity for Unit 1: weight 45% Assessment activity for Unit 2: weight 45% Assessment activity for Unit 3: weight 10% 7.1.3. Referred (re-sit) examination Assessment activity for Unit 1: weight 45% Assessment activity for Unit 2: weight 45% Assessment activity for Unit 3: weight 10%