



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

103000898 - Deep Learning

DEGREE PROGRAMME

10BA - Master Universitario En Ciencia De Datos

ACADEMIC YEAR & SEMESTER

2022/23 - Semester 2

Index

Learning guide

| | |
|---|---|
| 1. Description..... | 1 |
| 2. Faculty..... | 1 |
| 3. Prior knowledge recommended to take the subject..... | 2 |
| 4. Skills and learning outcomes | 2 |
| 5. Brief description of the subject and syllabus..... | 3 |
| 6. Schedule..... | 5 |
| 7. Activities and assessment criteria..... | 7 |
| 8. Teaching resources..... | 8 |
| 9. Other information..... | 8 |

1. Description

1.1. Subject details

| | |
|---------------------------------------|--|
| Name of the subject | 103000898 - Deep Learning |
| No of credits | 3 ECTS |
| Type | Compulsory |
| Academic year of 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 | 2022-23 |

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. |

* 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

- Intelligent Systems

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 shown 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 (e.g., optimization algorithms, regularization methods, normalization methods, etc.) and presents neural models for specific domains (e.g., computer vision and other application domains) 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. Other application domains

6. Schedule

6.1. Subject schedule*

| Week | Classroom activities | 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 2 Duration: 02:00 | | | Assessment activity for Unit 1 Continuous assessment Presential Duration: 02:00 |
| 5 | Lecture on Unit 2 Duration: 02:00 Lecture on Unit 2 Duration: 02:00 | | | |
| 6 | Lecture on Unit 2 Duration: 02:00 Lecture on Unit 3 Duration: 02:00 | | | |
| 7 | Lecture on Unit 3 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 | | | Assessment activity for Unit 3 Continuous assessment Presential Duration: 00:00 |
| 9 | | | | |
| 10 | | | | |
| 11 | | | | Assessment activity for Unit 1 Final examination Presential Duration: 02:00 Assessment activity for Unit 2 Final examination Presential Duration: 02:00 Assessment activity for Unit 3 Final examination Presential Duration: 02:00 |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |
| 16 | | | | |
| 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.

* 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. Assessment

| Week | Description | Modality | Type | Duration | Weight | Minimum grade | Evaluated skills |
|------|--------------------------------|----------|--------------|----------|--------|---------------|--------------------------|
| 4 | Assessment activity for Unit 1 | | Face-to-face | 02:00 | 45% | 3 / 10 | CECD06 CECD07 CB07 |
| 8 | Assessment activity for Unit 3 | | Face-to-face | 00:00 | 10% | / 10 | CECD07 CECD06 CB07 |

7.1.2. Global examination

| Week | Description | Modality | Type | Duration | Weight | Minimum grade | Evaluated skills |
|------|--------------------------------|----------|--------------|----------|--------|---------------|--------------------------|
| 11 | Assessment activity for Unit 1 | | Face-to-face | 02:00 | 45% | 3 / 10 | CB07 CECD07 CECD06 |
| 11 | Assessment activity for Unit 2 | | Face-to-face | 02:00 | 45% | 3 / 10 | CB07 CECD07 CECD06 |
| 11 | Assessment activity for Unit 3 | | Face-to-face | 02:00 | 10% | / 10 | CB07 CECD07 CECD06 |

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 | 45% | 3 / 10 | CECD07 CB07 CECD06 |
| Assessment activity for Unit 2 | | Face-to-face | 02:00 | 45% | 3 / 10 | CECD07 CB07 CECD06 |

| | | | | | | |
|--------------------------------|--|--------------|-------|-----|------|--------------------------|
| Assessment activity for Unit 3 | | Face-to-face | 02:00 | 10% | / 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 $G \geq 5$.

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

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.