



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

103000667 - Deep learning

DEGREE PROGRAMME

10AP - Eit Digital Master's Programme In Data Science

ACADEMIC YEAR & SEMESTER

2018/19 - Semester 2

Index

Learning guide

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

1. Description

1.1. Subject details

| | |
|---------------------------------------|--|
| Name of the subject | 103000667 - 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 | 10AP - Eit digital master's programme in data science |
| Centre | 10 - Escuela Tecnica Superior de Ingenieros Informaticos |
| Academic year | 2018-19 |

2. Faculty

2.1. Faculty members with subject teaching role

| Name and surname | Office/Room | Email | Tutoring hours * |
|---|--------------------|------------------------|-------------------------|
| Martin Molina Gonzalez (Subject coordinator) | 2111 | martin.molina@upm.es | Sin horario. |
| Luis Baumela Molina | 2204 | luis.baumela@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. Skills and learning outcomes *

3.1. Skills to be learned

CB06 - Poseer y comprender conocimientos que aporten una base u oportunidad de ser originales en el desarrollo y/o aplicación de ideas, a menudo en un contexto de investigación

CE12 - Capacidad para aplicar métodos matemáticos, estadísticos y de inteligencia artificial para modelar, diseñar y desarrollar aplicaciones, servicios, sistemas inteligentes y sistemas basados en el conocimiento.

CG08 - Comprensión amplia de las técnicas y métodos aplicables en una especialización concreta, así como de sus límites

3.2. Learning outcomes

RA83 - To know the main challenges and achievements of deep learning

RA85 - To be able to identify areas of application where the techniques of deep learning can be used

RA84 - To know the existing techniques and software tools about deep learning, understanding their scope and limitations

RA86 - To be able to 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.

4. Brief description of the subject and syllabus

4.1. 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 proved to be significantly better 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. The course presents first the foundations of artificial neural networks with both supervised and unsupervised learning. Then, the course presents different types of deep architectures (e.g., convolutional neural networks) and application domains (e.g., computer vision and natural language processing). To complement the practical view, the course also presents specialized software tools for deep learning and describes how to use them in practical problems.

4.2. Syllabus

1. Introduction to deep learning
2. Artificial neural networks
 - 2.1. Foundations
 - 2.2. Learning in artificial neural networks
 - 2.3. Tools
3. Deep learning for computer vision
 - 3.1. Foundations of computer vision
 - 3.2. Convolutional neural networks
 - 3.3. Sample projects
4. Deep learning for natural language processing

5. Schedule

5.1. Subject schedule*

| Week | Face-to-face classroom activities | Face-to-face laboratory activities | Other face-to-face activities | Assessment activities |
|------|--|------------------------------------|-------------------------------|---|
| 1 | Lecture on Unit 1 Duration: 02:00 Lecture Lecture on Unit 2 Duration: 01:00 Lecture | | | |
| 2 | Lecture on Unit 2 Duration: 03:00 Lecture | | | |
| 3 | Lecture on Unit 2 Duration: 03:00 Lecture | | | |
| 4 | Lecture on Unit 2 Duration: 03:00 Lecture | | | |
| 5 | Lecture on Unit 2 Duration: 03:00 Problem-solving class | | | |
| 6 | Lecture on Unit 2 Duration: 03:00 Problem-solving class | | | |
| 7 | Lecture on Unit 3 Duration: 02:00 Lecture | | | Practical project (Unit 2) Group work Continuous assessment Duration: 00:00 |
| 8 | Lecture on Unit 3 Duration: 02:00 Lecture | | | |
| 9 | Lecture on Unit 3 Duration: 02:00 Lecture | | | |
| 10 | Lecture on Unit 3 Duration: 02:00 Lecture | | | |
| 11 | | | | |
| 12 | Lecture on Unit 3 Duration: 02:00 Problem-solving class | | | |
| 13 | Lecture on Unit 3 Duration: 02:00 Problem-solving class | | | |

| | | | | |
|----|--|--|--|--|
| 14 | Lecture on Unit 4 Duration: 02:00 Lecture | | | Practical project (Unit 3) Group work Continuous assessment Duration: 00:00 Assessment activity of Unit 3 Other assessment Continuous assessment Duration: 00:00 |
| 15 | Lecture on Unit 4 Duration: 02:00 Lecture | | | |
| 16 | Lecture on Unit 4 Duration: 01:00 Problem-solving class | | | Assessment activity of Unit 4 Other assessment Continuous assessment Duration: 01:00 |
| 17 | | | | Practical project (Unit 2) Group work Final examination Duration: 00:00 Practical project (Unit 3) Group work Final examination Duration: 00:00 Written examination Written test Final examination Duration: 00:00 |

The independent study hours are training activities during which students should spend time on individual study or individual assignments.

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 subject schedule is based on a previous theoretical planning of the subject plan and might go through experience some unexpected changes along throughout the academic year.

6. Activities and assessment criteria

6.1. Assessment activities

6.1.1. Continuous assessment

| Week | Description | Modality | Type | Duration | Weight | Minimum grade | Evaluated skills |
|------|-------------------------------|------------------|---------------|----------|--------|---------------|----------------------|
| 7 | Practical project (Unit 2) | Group work | No Presential | 00:00 | 40% | 2 / 10 | CG08 CE12 CB06 |
| 14 | Practical project (Unit 3) | Group work | No Presential | 00:00 | 40% | 2 / 10 | CB06 CE12 CG08 |
| 14 | Assessment activity of Unit 3 | Other assessment | Face-to-face | 00:00 | 10% | / 10 | CE12 CG08 CB06 |
| 16 | Assessment activity of Unit 4 | Other assessment | Face-to-face | 01:00 | 10% | / 10 | CE12 CG08 CB06 |

6.1.2. Final examination

| Week | Description | Modality | Type | Duration | Weight | Minimum grade | Evaluated skills |
|------|----------------------------|--------------|---------------|----------|--------|---------------|----------------------|
| 17 | Practical project (Unit 2) | Group work | No Presential | 00:00 | 40% | 2 / 10 | CE12 CG08 CB06 |
| 17 | Practical project (Unit 3) | Group work | No Presential | 00:00 | 40% | 2 / 10 | CB06 CE12 CG08 |
| 17 | Written examination | Written test | Face-to-face | 00:00 | 20% | / 10 | CB06 CE12 CG08 |

6.1.3. Referred (re-sit) examination

| Description | Modality | Type | Duration | Weight | Minimum grade | Evaluated skills |
|-------------|----------|------|----------|--------|---------------|------------------|
|-------------|----------|------|----------|--------|---------------|------------------|

| | | | | | | |
|----------------------------|--------------|--------------|-------|-----|--------|----------------------|
| Practical project (Unit 3) | Group work | Face-to-face | 00:00 | 40% | 2 / 10 | CE12 CG08 CB06 |
| Written examination | Written test | Face-to-face | 02:00 | 20% | / 10 | CE12 CG08 CB06 |
| Practical project (Unit 2) | Group work | Face-to-face | 00:00 | 40% | 2 / 10 | CG08 CE12 CB06 |

6.2. Assessment criteria

Partial and global grades are in the scale of 0 to 10. To pass the course it is required that the final grade G must be $G \geq 5$.

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

"Only final" assessment is suggested for students that are not able to do in-class assessment activities. In this case, students may take a written examination at the end of the semester.

Students who want to take the written examination (in "only final" assessment or "extraordinary" assessment) must submit to the coordinator the practical projects by email (address: martin.molina@upm.es) at least one week before the day established for the written examination. The student will be allowed to take the written examination if the student has submitted in advance the practical projects.

7. Teaching resources

7.1. Teaching resources for the subject

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

8. Other information

8.1. Other information about the subject