ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

103000815 - Artificial Neural Networks And Deep Learning

DEGREE PROGRAMME

10AJ - Master Universitario en Inteligencia Artificial

ACADEMIC YEAR & SEMESTER

2020/21 - Semester 1

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1. Description

1.1. Subject details

Name of the subject	103000815 - Artificial Neural Networks And Deep Learning
No of credits	5 ECTS
Type	Optional
Academic year ot the programme	First year
Semester of tuition	Semester 1
Tuition period	September-January
Tuition languages	English
Degree programme	10AJ - Master Universitario en Inteligencia Artificial
Centre	10 - Escuela Tecnica Superior de Ingenieros Informaticos
Academic year	2020-21

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.

* 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

- Basic knowledge of Linear Algebra

- Programming languages (e.g., Python)

4. Skills and learning outcomes *

4.1. Skills to be learned

CB10 - Que los estudiantes posean las habilidades de aprendizaje que les permitan continuar estudiando de un modo que habrá de ser en gran medida autodirigido o autónomo.

CB7 - 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

CEIA10 - Identificación de áreas de aplicación en las que se pueda utilizar las técnicas y métodos de la Inteligencia Artificial.

CEIA4 - Capacidad de interpretar los modelos de clasificación supervisada y no supervisada obtenidos al aplicar las técnicas de Aprendizaje Automático para un conjunto de datos.

CG13 - Apreciación de los límites del conocimiento actual y de la aplicación práctica de la tecnología más reciente.

4.2. Learning outcomes

RA98 - Manejar la formalización matemática de las redes de neuronas artificiales

RA102 - Elegir el modelo neuronal más adecuado para cada clase de problema

RA101 - Construir una red de neuronas entrenada a partir de un conjunto de datos

RA100 - Seleccionar técnicas de aprendizaje profundo (deep learning) para entrenar redes de neuronas

RA99 - Comparar las redes de neuronas artificiales con otros métodos de inteligencia artificial

* 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

This course presents a theoretical and practical view of artificial neural networks. The course presents first the foundations of artificial neural networks and different types of architectures (both shallow and deep networks). Then, the course presents learning techniques to train neural networks, with special attention to deep learning methods. The course also presents neural models for problem classes and application domains (e.g, reinforcement learning and computer vision). To complement the practical view, the student will use specialized software tools to train neural networks in practical problems.

5.2. Syllabus

1. Artificial neural networks
    1.1. Foundations of artificial neural networks
    1.2. Training artificial neural networks
    1.3. Software tools for artificial neural networks
2. Deep learning methods
    2.1. Performance evaluation
    2.2. Normalization and initialization
    2.3. Regularization
    2.4. Optimization algorithms
3. Applications
    3.1. Deep reinforcement learning
    3.2. Computer vision

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	
2			**Lecture on Unit 1** Duration: 02:00 Lecture	
3			**Lecture on Unit 1** Duration: 01:00 Lecture **Practical exercises of Unit 1** Duration: 01:00 Problem-solving class	
4			**Lecture on Unit 1** Duration: 01:00 Lecture **Practical exercises of Unit 1** Duration: 01:00 Problem-solving class	
5			**Lecture on Unit 1** Duration: 01:00 Lecture **Practical exercises of Unit 1** Duration: 01:00 Problem-solving class	
6			**Lecture on Unit 1** Duration: 01:00 Lecture **Practical exercises of Unit 1** Duration: 01:00 Problem-solving class	
7			**Lecture on Unit 2** Duration: 02:00 Lecture **Group tutoring session** Duration: 02:00 Additional activities	
8			**Lecture on Unit 2** Duration: 01:00 Lecture **Practical exercises of Unit 2** Duration: 01:00 Problem-solving class	

			Group tutoring session Duration: 02:00 Additional activities	
9			**Lecture on Unit 2** Duration: 01:00 Lecture **Practical exercises of Unit 2** Duration: 01:00 Problem-solving class **Group tutoring session** Duration: 02:00 Additional activities	
10			**Lecture on Unit 2** Duration: 01:00 Lecture **Practical exercises of Unit 2** Duration: 01:00 Problem-solving class **Group tutoring session** Duration: 02:00 Additional activities	
11			**Lecture on Unit 3** Duration: 02:00 Lecture **Group tutoring session** Duration: 02:00 Additional activities	
12			**Lecture on Unit 3** Duration: 02:00 Lecture	**Practical project "building an artificial neural network"** Group work Continuous assessment Not Presential Duration: 00:00
13			**Lecture on Unit 3** Duration: 02:00 Lecture	
14			**Lecture on Unit 3** Duration: 02:00 Lecture	
15				**Attendance and participation** Other assessment Continuous assessment Not Presential Duration: 00:00 **Written examination** Online test Continuous assessment Not Presential Duration: 02:00

16				
17				**Practical project "building an artificial neural network"** Group work Final examination Not Presential Duration: 00:00 **Written examination** Written test Final examination Not 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
12	Practical project "building an artificial neural network"	Group work	No Presential	00:00	50%	5 / 10	CB10 CEIA4 CEIA10 CB7 CG13
15	Attendance and participation	Other assessment	No Presential	00:00	10%	7 / 10	CEIA4 CEIA10 CB7 CG13
15	Written examination	Online test	No Presential	02:00	40%	5 / 10	CB7 CG13 CEIA4 CEIA10

7.1.2. Final examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
17	Practical project "building an artificial neural network"	Group work	No Presential	00:00	50%	5 / 10	CEIA4 CEIA10 CB7 CG13 CB10
17	Written examination	Written test	No Presential	02:00	50%	5 / 10	CEIA4 CEIA10 CB7 CG13

7.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Practical project "building an artificial neural network"	Group work	Face-to-face	00:00	50%	5 / 10	CB10 CEIA4 CEIA10 CB7 CG13
Written examination	Written test	Face-to-face	02:00	50%	5 / 10	CEIA4 CEIA10 CB7 CG13

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.

Students who have chosen "continuous" assessment may be affected during the course by problems related to Covid-19 or by the need to enter working life due to the socio-economic situation. In this case, students can apply for admission to the "final examination". This request must be sent to the coordinator (martin.molina@upm.es) and duly justified with the appropriate documentation.

Students who follow "final examination" or "referred (re-sit) examination" must submit to the coordinator (martin.molina@upm.es) the practical project 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 project.

8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
UPM Moodle	Web resource	Support to on-line education
Microsoft Teams	Others	Support to on-line education
Blackboard Collaborate	Others	Support to on-line education
Bibliography	Bibliography	Selected bibliography (papers and text books)

9. Other information

9.1. Other information about the subject

Online education is planned to be performed in the following way:

- UPM Moodle will be used by instructors, for example, to communicate general messages to students, to provide course material (e.g. lecture slides), to propose assignments and to communicate grades. Students will use UPM Moodle, for example, to take online exams and to submit the results of assignments.
- Microsoft Teams or Blackboard Collaborate will be used for online lectures by instructors, student presentations, support to online exams and meetings with students.

This course 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).