



POLITÉCNICA

INTERNATIONAL  
CAMPUS OF  
EXCELLENCE

COORDINATION PROCESS OF  
LEARNING ACTIVITIES  
PR/CL/001



E.T.S. de Ingeniería y Sistemas  
de Telecomunicación

# ANX-PR/CL/001-01

## LEARNING GUIDE

### SUBJECT

**595040066 - Introduction To Machine Learning**

### DEGREE PROGRAMME

59SC - Grado En Ingeniería De Sistemas De Telecomunicación

### ACADEMIC YEAR & SEMESTER

2023/24 - Semester 1

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### Learning guide

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## 1. Description

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### 1.1. Subject details

|                                       |  |
|---------------------------------------|--|
| <b>Name of the subject</b>            | 595040066 - Introduction To Machine Learning                               |
| <b>No of credits</b>                  | 3 ECTS   |
| <b>Type</b>                           | Optional   |
| <b>Academic year of the programme</b> | Fourth year  |
| <b>Semester of tuition</b>            | Semester 7   |
| <b>Tuition period</b>                 | September-January  |
| <b>Tuition languages</b>              | English  |
| <b>Degree programme</b>               | 59SC - Grado en Ingeniería de Sistemas de Telecomunicación                 |
| <b>Centre</b>                         | 59 - Escuela Técnica Superior De Ingeniería Y Sistemas De Telecomunicación |
| <b>Academic year</b>                  | 2023-24  |

## 2. Faculty

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### 2.1. Faculty members with subject teaching role

| <b>Name and surname</b>                          | <b>Office/Room</b> | <b>Email</b>          | <b>Tutoring hours *</b>   |
|--|--------------------|-----------------------|---|
| Eduardo Juarez Martinez<br>(Subject coordinator) | A4204              | eduardo.juarez@upm.es | Sin horario.<br>Schedules are subject to possible changes. Please, confirm the latest version with the lecturer |

|                             |       |                          |  |
|-----------------------------|-------|--------------------------|--|
| Miguel Chavarrias Lapastora | A4204 | miguel.chavarrias@upm.es | Sin horario.<br>Schedules are<br>subject to possible<br>changes. Please,<br>confirm the latest<br>version with the<br>lecturer |
|-----------------------------|-------|--------------------------|--|

\* 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

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#### 3.1. Recommended (passed) subjects

The subject - recommended (passed), are not defined.

#### 3.2. Other recommended learning outcomes

- Programming and debugging using C language and optionally Python

### 4. Skills and learning outcomes \*

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#### 4.1. Skills to be learned

CE B2 - Conocimientos básicos sobre el uso y programación de los ordenadores, sistemas operativos, bases de datos y programas informáticos con aplicación en ingeniería.

CG 02 - Capacidad de búsqueda y selección de información, de razonamiento crítico y de elaboración y defensa de argumentos dentro del área.

CG 03 - Capacidad para expresarse correctamente de forma oral y escrita y transmitir información mediante documentos y exposiciones en público.

CG 04 - Capacidad de abstracción, de análisis y de síntesis y de resolución de problemas.

CG 05 - Capacidad de trabajo en equipo y en entornos multidisciplinares.

CG 06 - Capacidad de adaptación, negociación, resolución de conflictos y de liderazgo.

CG 07 - Capacidad para el diseño, la gestión y la dirección de proyectos.

CG 08 - Capacidad de organización, planificación y de toma de decisiones.

CG 12 - Habilidad para las relaciones interpersonales y el trabajo en un contexto nacional e internacional, con capacidad para expresarse de forma oral y escrita en lengua inglesa.

CG 13 - Habilidades de aprendizaje con un alto grado de autonomía.

## 4.2. Learning outcomes

RA1048 - Capacidad para conocer, entender y utilizar redes neuronales en el contexto del aprendizaje máquina

RA1049 - Capacidad para utilizar aceleradores hardware para el desarrollo de redes neuronales

RA1047 - Capacidad para utilizar herramientas CAD para la construcción de redes neuronales

\* 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

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### 5.1. Brief description of the subject

The course is focused on introducing the basic concepts related to machine learning. As it is intended to provide an introduction, during the first part of the course the fundamentals related to the development of machine learning algorithms and some use-cases will be explained. The course approach is eminently practical and is based on how to program in Python machine learning and neural network models specifically designed for computer vision applications.

The methodology of the course is project-based. The course is divided in two parts: In the first part, basic machine learning concepts will be introduced. Specifically, the fundamental ideas of neural networks will be reviewed. In addition, groups of students will be established to collaborately review different parts of the project proposal. The results will be shared with the student colleagues in a presentation. The second part of the course will be focused on the project proposal. Besides a presentation, students are required to write a report of achieved results.

## 5.2. Syllabus

1. Introduction to Machine Learning: basic concepts
2. Neural networks and hands-on labs
3. Neural network project

## 6. Schedule

### 6.1. Subject schedule\*

| Week | Classroom activities   | Laboratory activities   | Distant / On-line | Assessment activities  |
|------|--|---|-------------------|--|
| 1    | <b>Introduction to Machine Learning basic concepts</b><br>Duration: 02:00<br>Lecture               |   |                   |  |
| 2    | <b>Introduction to Machine Learning basic concepts</b><br>Duration: 02:00<br>Lecture               |   |                   |  |
| 3    | <b>Introduction to Neural networks: perceptron</b><br>Duration: 02:00<br>Lecture                   |   |                   |  |
| 4    | <b>Introduction to Neural networks: networks and backpropagation</b><br>Duration: 02:00<br>Lecture |   |                   |  |
| 5    | <b>Introduction to Neural networks: convolutional networks</b><br>Duration: 02:00<br>Lecture       |   |                   |  |
| 6    |  | <b>Hands-on lab 1.</b><br>Duration: 02:00<br>Laboratory assignments |                   |  |
| 7    |  | <b>Hands-on lab 2.</b><br>Duration: 02:00<br>Laboratory assignments |                   |  |
| 8    |  |   |                   | <b>Presentation: initial approach of the project.</b><br>Group work<br>Continuous assessment<br>Presential<br>Duration: 02:00<br><br><b>Initial report of the project.</b><br>Group work<br>Continuous assessment<br>Not Presential<br>Duration: 01:00 |
| 9    |  | <b>Hands-on lab 3.</b><br>Duration: 02:00<br>Laboratory assignments |                   |  |

|    |  |   |  |   |
|----|--|---|--|---|
| 10 |  | <b>Final project development</b><br>Duration: 02:00<br>Laboratory assignments |  |   |
| 11 |  | <b>Final project development</b><br>Duration: 02:00<br>Laboratory assignments |  |   |
| 12 |  | <b>Final project development</b><br>Duration: 02:00<br>Laboratory assignments |  |   |
| 13 |  |   |  | <b>Final project presentation</b><br>Group presentation<br>Continuous assessment<br>Presential<br>Duration: 02:00<br><br><b>Final report of the project</b><br>Group presentation<br>Continuous assessment<br>Not Presential<br>Duration: 01:00 |
| 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   |
|------|--|--------------------|---------------|----------|--------|---------------|--|
| 8    | Presentation: initial approach of the project. | Group work         | Face-to-face  | 02:00    | 15%    | 0 / 10        | CE B2<br>CG 02<br>CG 03<br>CG 04<br>CG 05<br>CG 06<br>CG 07<br>CG 08<br>CG 12<br>CG 13 |
| 8    | Initial report of the project.                 | Group work         | No Presential | 01:00    | 15%    | 0 / 10        | CE B2<br>CG 02<br>CG 03<br>CG 04<br>CG 05<br>CG 06<br>CG 07<br>CG 08<br>CG 12<br>CG 13 |
| 13   | Final project presentation                     | Group presentation | Face-to-face  | 02:00    | 30%    | 0 / 10        | CG 02<br>CG 03<br>CG 04<br>CG 05<br>CG 06<br>CG 07<br>CG 08<br>CG 12<br>CG 13          |
| 13   | Final report of the project                    | Group presentation | No Presential | 01:00    | 40%    | 0 / 10        | CE B2<br>CG 02<br>CG 03<br>CG 04<br>CG 05<br>CG 06<br>CG 07<br>CG 08<br>CG 12<br>CG 13 |

### 7.1.2. Global examination

No se ha definido la evaluación sólo por prueba final.

### 7.1.3. Referred (re-sit) examination

| Description  | Modality             | Type         | Duration | Weight | Minimum grade | Evaluated skills   |
|--|----------------------|--------------|----------|--------|---------------|--|
| Written exam. Machine Learning and neural networks fundamentals. | Written test         | Face-to-face | 01:00    | 30%    | 0 / 10        | CE B2<br>CG 02<br>CG 03<br>CG 04<br>CG 07<br>CG 08<br>CG 12<br>CG 13 |
| Evaluation of the project  | Problem-solving test | Face-to-face | 01:00    | 70%    | 0 / 10        | CE B2<br>CG 02<br>CG 03<br>CG 04<br>CG 07<br>CG 08<br>CG 12<br>CG 13 |

## 7.2. Assessment criteria

Continuous assessment will be based on the work done in class during the team sessions, the initial and final project presentations and the initial and final project reports.

In case there is a need for a referred examination, a written exam on machine learning and neural network fundamentals will be conducted and the final project will be reassessed. The project reassessment will be compulsory for those students who get a grade less than five points (5.0) in the continuous assessment. For the rest of students, this activity will be optional.

## 8. Teaching resources

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### 8.1. Teaching resources for the subject

| Name   | Type         | Notes   |
|--|--------------|---|
| Introduction to Machine Learning with Python | Bibliography | A guide for data scientists. A.C. Müller, Sarah Guido |
| Grokking Machine Learning                    | Bibliography | L.G. Serrano  |

## 9. Other information

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### 9.1. Other information about the subject

This course will be taught in English language. All the materials will be exclusively provided in English language.