Course guide
340659 - APAU - Machine Learning

Last modified: 03/07/2026

Unit in charge: Vilanova i la Geltrú School of Engineering
Teaching unit: 707 - ESAII - Department of Automatic Control.

Degree: MASTER'S DEGREE IN AUTOMATIC SYSTEMS AND INDUSTRIAL ELECTRONICS (Syllabus 2012). (Optional subject).

Academic year: 2026 **ECTS Credits:** 5.0 **Languages:** Spanish

LECTURER

Coordinating lecturer: Ruiz Vegas, Francisco Javier

Others: Ruiz Vegas, Francisco Javier

PRIOR SKILLS

Basic multivariable calculus, optimization of multivariable functions, vector and matrix calculus.
Basic Statistics and probability.
Basic programming (Python).
Basic concepts of machine learning (decision trees, KNN, perceptron,...)

REQUIREMENTS

Artificial Intelligence

TEACHING METHODOLOGY

Explanatory classes in which the different concepts will be presented will alternate with practical classes in which these concepts will be practiced with the help of different Python, C++ libraries and on a microcontroller. During the course, some projects will also be proposed that allow the knowledge acquired to be put into practice.

LEARNING OBJECTIVES OF THE SUBJECT

The main objective of this subject is to provide the necessary tools to apply Machine Learning techniques, especially Deep Learning, to model dynamic systems, process real-world signals, and implement these models in small microcontrollers.

STUDY LOAD

Type	Hours	Percentage
Hours large group	30,0	24.00
Self study	80,0	64.00
Hours small group	15,0	12.00

Total learning time: 125 h

CONTENTS

Signal preprocessing

Description:
The objective of this topic is to provide the tools to convert physical signals, primarily obtained through sensors, into databases suitable for machine learning models.

* Sampling frequency, noise, and filtering.
* Feature engineering in the time and frequency domains.
* Normalization and scaling.

Full-or-part-time: 8h
Theory classes: 2h
Laboratory classes: 2h
Self study : 4h

Multilayer neural networks

Description:
Introduction to the TensorFlow and Keras environment for defining, training and evaluating multilayer neural networks.

Full-or-part-time: 7h
Theory classes: 2h
Laboratory classes: 1h
Self study : 4h

Convolutional neural networks

Description:
Introduce, train and evaluate convolutional neural networks for processing images and other data with multidimensional structure

Full-or-part-time: 7h
Theory classes: 2h
Laboratory classes: 1h
Self study : 4h

Recurrent neural networks

Description:
Introduce, train and evaluate recurrent neural networks for temporal data

Full-or-part-time: 7h
Theory classes: 2h
Laboratory classes: 1h
Self study : 4h

Edge AI and Deployment on Microcontrollers (TinyML)

Description:
The key point of this section is that the model does not run in the cloud, but "on the machine" in a microcontroller.

Full-or-part-time: 10h
Theory classes: 4h
Laboratory classes: 2h
Self study : 4h

Reinforcement learning

Description:
Fundamentals of RL: Agent, Environment, State, Action and Reward function.

Full-or-part-time: 8h
Theory classes: 2h
Laboratory classes: 2h
Self study : 4h

GRADING SYSTEM

The assessment will be mainly done with a project (Pro), a collection of exercises solved with a computer (C) and a final questionnaire on the subjects of the subject (Q)
The weight of each part will be 0.4·Pro+0.3·C+0.3·Q
If the total score is less than 5, a reassessment exam with a practical part and a theoretical part (R) may be taken. In this case, the final grade will be calculated as min(7, 0.4·Pro+0.6·R)

EXAMINATION RULES.

Paper notes may be used for the questionnaire. The project will be evaluated based on the report and the oral presentation. An authorship check will be conducted to ensure the final grade for each problem.

BIBLIOGRAPHY

Basic:
- Warden, Pete and Situnayake, Daniel. Tiny ML: Machine Learning with Tensorflow Lite on Arduino and Ultra-Low-Power Microcontrollers. 1a. O'Reilly Media, 2020. ISBN 1492052043.
- Torres, Jordi. Python Deep Learning: Introducción práctica con Keras y TensorFlow 2. 1. Barcelona: Marcombo, 2020. ISBN 8426728286.