



## Course guide

# 820055 - IAAE - Artificial Intelligence for Engineering

Last modified: 02/10/2025

**Unit in charge:** Barcelona East School of Engineering  
**Teaching unit:** 723 - CS - Department of Computer Science.

**Degree:** BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Optional subject).  
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Optional subject).  
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Optional subject).  
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Optional subject).  
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Optional subject).  
BACHELOR'S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Optional subject).

**Academic year:** 2025    **ECTS Credits:** 6.0    **Languages:** Catalan, Spanish

## LECTURER

**Coordinating lecturer:**

**Others:**

## PRIOR SKILLS

Computer Science course (Python) or equivalent.

## REQUIREMENTS

There are no previous requirements.

## DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

**Transversal:**

1. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.

## TEACHING METHODOLOGY

The course consists of four classroom hours per week in lab: two correspond to theoretical expositions combined with guided exercises performed with a computer and two of laboratory practice.

Should carry out a non-contact techniques are applied to a problem studied for the degree.

The course uses the narrative approach (theory) by 10%, a problem-based by 10%, attendance group work (laboratory) by 20%, non-contact individual work by 27% and non-contact work group by 33%.

## LEARNING OBJECTIVES OF THE SUBJECT

The course aims:

- To familiarize students with basic concepts in the fields of Machine Learning and Pattern Analysis
- To provide tools of Artificial Intelligence that will be useful to apply them to engineering problems



## STUDY LOAD

Type	Hours	Percentage
Hours small group	60,0	40.00
Self study	90,0	60.00

**Total learning time:** 150 h

## CONTENTS

### Introduction

**Description:**

Patterns analysis from the standpoint of artificial intelligence  
Applications in the fields of engineering and technology

**Related activities:**

Lecture  
Practices 1 and 2: introduction to python

**Full-or-part-time:** 16h

Theory classes: 2h  
Laboratory classes: 6h  
Self study : 8h

### Characterization data using attributes

**Description:**

Data representation  
Treatment of missing values and normalization  
Distance measures  
Feature extraction: principal component analysis (PCA), independent component analysis (ICA)

**Related activities:**

lectures  
Practice 3: representation, normalization, nul values, covariances, correlations, binarization, distance matrices, similarities, etc.  
Practice 4: PCA + ICA

**Full-or-part-time:** 16h

Theory classes: 4h  
Laboratory classes: 4h  
Self study : 8h



## Clustering

**Description:**

k-means, PAM  
Dendograms  
Introduction to Spectral Clustering

**Related activities:**

Lectures  
Practice 5: kmeans and PAM  
Practice 6: dendrogram

**Full-or-part-time:** 30h

Theory classes: 14h  
Laboratory classes: 6h  
Self study : 10h

## Optimization

**Description:**

Simulated annealing and gradient descent  
Genetic Algorithms

**Related activities:**

Lectures  
Practice 7: simulated annealing and gradient descent  
Practice 8: genetic algorithms

**Full-or-part-time:** 26h

Theory classes: 4h  
Laboratory classes: 4h  
Other activities: 10h  
Self study : 8h

## Classification

**Description:**

Based on distances: k Nearest Neighbours, linear classifier and supervised k-means  
Based on probabilities: Naïve Bayes and introduction to Maximum Entropy  
Based on rules: Decision Trees (splitting and entropy) and an introduction to AdaBoost  
Linear classifier with kernels and Support Vector Machines (SVMs)

**Related activities:**

Lectures  
Practice 9: classifiers based on distances  
Practice 10: classifiers based on probabilities  
Practice 11: rule-based classifiers  
Practice 12: SVMs

**Full-or-part-time:** 46h

Theory classes: 18h  
Laboratory classes: 10h  
Self study : 18h



### Theory of statistical estimation

**Description:**

Bias and variance  
Test Protocols: single and cross-validation  
Statistical tests  
Measures of evaluation

**Related activities:**

Lecture

**Full-or-part-time:** 8h

Theory classes: 4h  
Self study : 4h

### Other problems in the pattern analysis

**Description:**

Regression, anomaly detection, projections...

**Related activities:**

Lecture

**Full-or-part-time:** 8h

Theory classes: 4h  
Self study : 4h

## GRADING SYSTEM

The evaluation will be conducted through the assessment by teachers of different laboratory practice (which will mean 50%) and class work (which will represent the other 50%).

This subject has neither exams nor reevaluation.

## BIBLIOGRAPHY

**Basic:**

- Benítez, Raúl ... [et al.]. Inteligencia artificial avanzada. Barcelona: UOC, 2012. ISBN 9788490298879.
- Géron, Aurélien. Hands-on machine learning with Scikit-Learn and TensorFlow : concepts, tools, and techniques to build intelligent systems [on line]. Sebastopol: O'Reilly, 2017 [Consultation: 29/05/2020]. Available on: <https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=4822582>. ISBN 9781491962299.

**Complementary:**

- Duda, Richard O.; Hart, Peter E.; Stork, David G. Pattern classification. 2nd. New York [etc.]: John Wiley & Sons, cop. 2001. ISBN 0471056693.
- Shawe-Taylor, J.; Cristianini, Nello. Kernel methods for pattern analysis. Cambridge: Cambridge University Press, 2004.

## RESOURCES

**Other resources:**

Documentation uploaded to Athena by teachers.