

## 820055 - IAAE - Artificial Intelligence for Engineering

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering

Teaching unit: 723 - CS - Department of Computer Science

Academic year: 2018

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

ECTS credits: 6 Teaching languages: Catalan, Spanish

### Teaching staff

Coordinator: Gerard Escudero  
Samir Kanaan

Others: Gerard Escudero  
Samir Kanaan

### Opening hours

Timetable: Check the bulletin board information departments.

### 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.

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### 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

Total learning time: 150h	Hours large group:	0h	0.00%
	Hours medium group:	0h	0.00%
	Hours small group:	60h	40.00%
	Guided activities:	0h	0.00%
	Self study:	90h	60.00%

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### Content

<p>Introduction</p>	<p>Learning time: 16h Theory classes: 2h Laboratory classes: 6h Self study : 8h</p>
<p>Description: Patterns analysis from the standpoint of artificial intelligence Applications in the fields of engineering and technology</p> <p>Related activities: Lecture Practices 1 and 2: introduction to python</p>	
<p>Characterization data using attributes</p>	<p>Learning time: 16h Theory classes: 4h Laboratory classes: 4h Self study : 8h</p>
<p>Description: Data representation Treatment of missing values and normalization Distance measures Feature extraction: principal component analysis (PCA), independent component analysis (ICA)</p> <p>Related activities: lectures Practice 3: representation, normalization, nul values, covariances, correlations, binarization, distance matrices, similarities, etc. Practice 4: PCA + ICA</p>	

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<p>Clustering</p>	<p>Learning time: 30h Theory classes: 14h Laboratory classes: 6h Self study : 10h</p>
<p>Description: k-means, PAM Dendrograms Introduction to Spectral Clustering</p> <p>Related activities: Lectures Practice 5: kmeans and PAM Practice 6: dendrogram</p>	
<p>Optimization</p>	<p>Learning time: 26h Theory classes: 4h Laboratory classes: 4h Other activities: 10h Self study : 8h</p>
<p>Description: Simulated annealing and gradient descent Genetic Algorithms</p> <p>Related activities: Lectures Practice 7: simulated annealing and gradient descent Practice 8: genetic algorithms</p>	

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<p>Classification</p>	<p>Learning time: 46h Theory classes: 18h Laboratory classes: 10h Self study : 18h</p>
<p>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)</p> <p>Related activities: Lectures Practice 9: classifiers based on distances Practice 10: classifiers based on probabilities Practice 11: rule-based classifiers Practice 12: SVMs</p>	
<p>Theory of statistical estimation</p>	<p>Learning time: 8h Theory classes: 4h Self study : 4h</p>
<p>Description: Bias and variance Test Protocols: single and cross-validation Statistical tests Measures of evaluation</p> <p>Related activities: Lecture</p>	
<p>Other problems in the pattern analysis</p>	<p>Learning time: 8h Theory classes: 4h Self study : 4h</p>
<p>Description: Regression, anomaly detection, projections...</p> <p>Related activities: Lecture</p>	

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### Qualification 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%).

### 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 Available on:

<<http://proquest.safaribooksonline.com/recursos.biblioteca.upc.edu/9781491962282?uicode=politicat>>. 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. *Kernels methods for pattern analysis*. Cambridge: Cambridge University Press, 2004.

#### Others resources:

Documentation uploaded to Athena by teachers.