Last update: 15-01-2018

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: 2017

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

Introduction

Learning time: 16h

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

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

Characterization data using attributes

Learning time: 16h

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

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

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Clustering

Learning time: 30h

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

Description:
k-means, PAM
Dendrograms
Introduction to Spectral Clustering

Related activities:
Lectures
Practice 5: kmeans and PAM
Practice 6: dendrogram

Optimization

Learning time: 26h

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

Description:
Simulated annealing and gradient descent
Genetic Algorithms

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

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Classification

Learning time: 46h

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

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

Theory of statistical estimation

Learning time: 8h

Theory classes: 4h
Self study : 4h

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

Related activities:
Lecture

Other problems in the pattern analysis

Learning time: 8h

Theory classes: 4h
Self study : 4h

Description:
Regression, anomaly detection, projections...

Related activities:
Lecture

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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, 2017Available 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.