Bachelor in Computer Science Engineering

Course information

Year 2021-22

GENERAL SPECIFICATIONS				
English name				
Machine Learning				
Spanish name				
Machine Learning				
Code		**Type**		
606010238		Mandatory		
Time distribution				
	Total	**In class**	**Out class**	
Working hours	150	60	90	
ECTS: 6				
Standard group	**Small groups**			
	Classroom	**Lab**	**Practices**	**Computer classroom**
3				3
Departments		**Knowledge areas**		
Information Technology		Computer Science and Artificial Intelligence		
Year		**Semester**		
4º		1º		

TEACHING STAFF			
Name	**E-Mail**	**Telephone**	**Office**
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SPECIFIC INFORMATION OF THE COURSE
1. Contents description
1.1. In English:
Lesson 1: Introduction Lesson 2: Knowledge acquisition Lesson 3: Supervised classifiers Lesson 4: Inductive Logic Programming Lesson 5: Parametric Learning Lesson 6: Neural Networks Lesson 7: Reinforcement Learning
1.2. In Spanish
Tema 1: Introducción Tema 2: Adquisición de conceptos Tema 3: Clasificación supervisada Tema 4: Programación lógica inductiva Tema 5: Aprendizaje por optimización paramétrica. Tema 6: Redes Neuronales Tema 7: Aprendizaje por refuerzo

2. Background

2.1.Situation within the Degree:

Mandatory subject that develops one of the most important aspects of Artificial Intelligence: the development of systems with learning capacity.

2.2. Recommendations:

Solid knowledge of programming in any general purpose language. Java and/or Python are especially recommended.

3. Objectives (as result of teaching):

Machine learning is one of the most important branches of Artificial Intelligence. It is focused on studying ability of machines (or programs) to modify their behavior to acquire new knowledge. Exist many ways in which this knowledge can be acquired automatically and are usually related to the way in which knowledge is represented.

One of the goals of this course is to present a series of approaches and algorithms that allow computers to learn.

Within the variety of existing approaches, the subject focuses on inductive symbolic learning, learning by analogy, reinforcement learning and learning based on parametric optimization. It has been chosen not to include in the syllabus of the subject to some of the paradigms of artificial intelligence related to learning automatic, such as genetic algorithms, fuzzy systems or bio-inspired systems, since these are treated in depth in other subjects.

4. Skills to be acquired

4.1. Specific Skills:

CE7-C: Ability to know and develop computational learning techniques and design and implement applications and systems that use them, including those dedicated to automatic information extraction and knowledge from volumes of data.

4.2. General Skills:

CB5. Develop the learning skills required to undertake further studies with a high degree of autonomy.

CG0: Capacity for analysis and synthesis: Finding, analyzing, criticizing (critical reasoning), relating, structuring and synthesize information from various sources, as well as integrate ideas and knowledge

G02: Capacity of oral and written communication in the academic and professional field with special emphasis in the writing of technical documentation

G03: Ability to solve problems

G04: Ability to make decisions based on objective criteria (experimental, scientific or simulation data available) as well as the ability to logically argue and justify said decisions, knowing how to accept others points of view

G05: Teamwork ability

G06: Capacity for autonomous learning as well as initiative and entrepreneurial spirit

T01: Use and mastery of a second language

CT2: Development of a critical attitude in relation to the capacity for analysis and synthesis.

CT4: Ability to use Computer and Information Competencies (CI2) in professional practice**.**

5. Training Activities and Teaching Methods

5.1. Training Activities:

- Theory sessions on the contents of the Program.
- Problem Solving sessions.
- Practical sessions in specialized laboratories or computer rooms.
- Activities Academically Directed by the Faculty: seminars, conferences, development of works, debates, collective tutorials, evaluation activities and self-evaluation.

5.2. Teaching Methods:

- Participatory Master Class.
- Development of Practices in Specialized Laboratories or Computer Classrooms in small groups.
- Problem solving and practical exercises.
- Approach, Realization, Tutoring and Presentation of Works.
- Evaluations and Exams.

5.3. Development and Justification:

Theory academic sessions

The theoretical classes will last 2 hours. They will expose and explain the theoretical content of each of the topics and the realization of some theoretical exercises. It will be available to the student, on the web with adequate time, digital content for the best understanding of the subject.

Academic problems sessions

At the end of each topic a series of selected exercises will be carried out. This set of exercises proposed for the theme. These bulletins will be available on the web of the subject with enough time.

Laboratory practices sessions

The practical sessions will be developed in classrooms equipped with computers and will have a duration of 2 hours. In these practices, aspects of implementation of the different techniques of machine learning, as well as some tools that develop these techniques.

Resolution and delivery of works

Throughout the course a list of practical works to be developed by the students individually.
Each student must choose one of these works, whose grade corresponds to the practical evaluation of the subject.
The follow-up of these works will be done in individualized tutoring.

Seminars, exhibitions and debates

Each student will be able to expose (if applicable) their work in class. The final classes of the subject will be dedicated to the exhibition of these works.

Partial evaluable tests

During the course, evaluable partial tests may be carried out, whose weight in the final grade will be based on the content they cover.
As a general rule, the attendance regime for theoretical and practical classes is optional, in no case is a minimum number of hours of attendance to pass the subject. Only assistance to those who are face-to-face evaluation activities.

6. Detailed Contents:

Topic 1: Introduction
1.1 Learning concept
1.2 Natural learning
1.3 Types of machine learning
1.4 A little history
1.5 Representations of knowledge
Topic 2: Linear Regression
2.1 Theoretical introduction
2.2 Algorithms of gradient descent
2.3 Algorithms of stochastic gradient descent
2.4 Normal equations
Topic 3: Support Vector Machines
3.1 Fundamentals
3.2 Kernel
3.3 Applications
Topic 4: Neural Networks
4.1 Introduction. General characteristics
4.2 The artificial neuron
4.3 Neural networks of one or more levels
4.4 The perceptron
4.5 Types of training
4.6 The Multilayer Percepton
4.7 Backpropagation Algorithm.
Topic 5: Concepts acquisition
5.1 Introduction
5.2 First approaches
5.3 The version space
Topic 6: Supervised classification
6.1 Introduction
6.2 Decision trees
6.3 Classification rules
Topic 7: Inductive logic programming
7.1 Introduction
7.2 Terminology
7.3 Generation of rules by specialization
7.4 Generation of rules by inverse deduction
Topic 8: Unsupervised Learning
8.1 Introduction
8.2 Clustering
Topic 9: Learning by reinforcement
9.1 Introduction
9.2 Elements
9.3 Evaluative feedback (n-armed bandits)
9.4 Definition of the problem
9.5 Dynamic programming
9.6 Methods of Monte-Carlo
9.7 Temporal differences

7. Bibliography

7.1. Basic Bibliography

- Tom M. Mitchell, "Machine Learning", Editorial McGraw-Hill, 1997.
- Yaser S. Abu-Mostafa, Malik Magdon-Ismail, and Hsuan-Tien Lin. “Learning from Data.”. 2012. AMLBook.

7.2. Additional Bibliography:

- ANDREW NG. “MACHINE LEARNING YEARNING”. https://www.mlyearning.org/
- Machine Learning for Hackers
- The Hundred-Page Machine Learning Book by Andriy Burkov

8. Systems and Assessment Criteria

8.1. System for Assessment:

Theory / problems exam: 60%
Practice defense: 0%
Defense of Written Works and Reports: 40%

The activities corresponding to the evaluation systems "Examination of theory/problems" and "Examination of practices" will be carried out/presented on the dates established by the center for official calls. These activities will be:

I) Exam about theoretical questions (30% of final)
II) Exam about exercises and practical questions (30% of final)

The activity corresponding to the evaluation system "Defense of Written Works and Reports" will be carried out on the published dates, with sufficient advance, by the teaching team.

The final grade of the subject for an ordinary call will be obtained by adding the partial grades obtained in each of the assessment systems of the current call, provided that it exceeds 40% in each and every one of the parts to be evaluated.

Those students who consider it may opt for the completion of a final single evaluation. In this case, the evaluation will consist of an evaluation test with the following blocks:
Theory block (60%): Exam of questions (theoretical and / or problems), face-to-face and individual and a maximum duration of 2 hours. This block will content 2 parts: theoretical (30%) and exercises (30%). The subject matter will be treated throughout the course. Only the documentation provided by the teaching team on the day of the test (if any) may be used.
Practical block (40%): Exam in which an eminently practical statement will be presented to be developed, they have a face-to-face character and an individual duration of 2 hours. Only the documentation provided by the teaching team on the day of the test can be used.

The mention of Enrollment of Honor may be granted to students who have obtained a grade equal to or greater than 9.5. As a general rule, these mentions will be awarded in descending order to the final grade obtained and by order of calls.
In no case will the number of "Enrollments of Honor" granted be higher than the maximum established for the subject in the current academic year. In case of a tie, the regularity obtained throughout all the evaluation systems proposed will prevail.
For all the materials delivered by the students, the originality declaration is implicitly assumed, understood in the sense that they have not used sources without citing them properly. The detection of plagiarism in any of these materials, and in application of article 15 of the Regulation of evaluation for the degrees and official master's degree of the University of Huelva, will entail the numerical grade of zero (0) in the subject, independently of the rest

of grades that the student would have obtained. In addition, the professor will initiate the appropriate disciplinary procedure before the Teaching Commission of the Department.
8.2. Assessment Criteria and Marks: