Machine Learning

Academic Year: (2020 / 2021) **Review date: 10-07-2020**

Department assigned to the subject: Department of Computer Science and Engineering

Coordinating teacher: FUENTETAJA PIZAN, RAQUEL

Type: Electives ECTS Credits : 6.0

Year : 3 Semester : 2

STUDENTS ARE EXPECTED TO HAVE COMPLETED

Programming
Statistics
Automata and Formal Language Theory
Artificial Intelligence

COMPETENCES AND SKILLS THAT WILL BE ACQUIRED AND LEARNING RESULTS.

¿ Ability to solve problems, both individually and in a team (PO a,b,c,d,e,k)
¿ Work in teams to analyze and design computer solutions (PO a,b,c,d)
¿ Ability to analyze and synthesize (PO a,b,c)
¿ Ability of organization and planning (PO b,c,d)
¿ Ability of information management (information acquisition and analysis) (PO a,b,k)
¿ Ability to make decisions (PO a,b,c,d,e)
¿ Motivation for quality and continuous improvement (PO b)
¿ Oral and written communication (PO g)
¿ Critical reasoning (PO a,b,d)
¿ Basic knowledge on machine learning (PO a)
¿ Ability to interpret functional specifications towards the development of machine learning based applications (PO a,b,c,e)
¿ Perform detailed analysis and design of computer applications based on machine learning techniques (PO a,b,c,e,k)

Learning results:
1. Problem solving, both individually and in group
2. Analysis and design of machine learning systems
3. Oral exposition of lectures works
4. Work to collect and analysis information

DESCRIPTION OF CONTENTS: PROGRAMME

1. Introduction to machine learning
2. Classification and regression techniques
   2.1. Decision trees and rules
   2.2. Regression trees and rules
   2.3. Instance based learning
   2.4. Classifier ensembles
3. Unsupervised techniques
   3.1 Clustering
   3.2. Associative Learning
4. Reinforcement Learning
   4.1. Markov Decision Processes
   4.2. Q-Learning
5. Relational learning
   5.1. Introduction to Inductive Logic Programmimg
6. Methodological Issues
   6.1. Machine Learning Methodology
   6.2. Evaluation and Hypothesis testing

LEARNING ACTIVITIES AND METHODOLOGY

- Lectures (1 ECTS)

Oriented, among others, towards the competences related to knowledge of concepts, relations among

them, techniques to be used, or ways to analyze and synthesize knowledge (PO a)

- Practice (3 ECTS)

Oriented, among others, towards the competences related to work in teams, problem solving, work organization, or oral (presentation in public of projects or homeworks) and written communication (written reports on their homeworks and projects) (PO b,c,d,e,g,k)

- Individual work (2 ECTS)

Oriented, among others, towards the competences related to planning, analysis, synthesis, critic reasoning, or concept acquisition (PO a,c,e,g)

ASSESSMENT SYSTEM

- Combined assessment of diverse activities performed by the students either individually or in groups. The individual work of each student is also analyzed when working in groups.
- Formative assessment will be done through continuous feedback that would allow the student to assess what s/he knows and is expected from her/him
- Final grade will be composed of 50% of individual work (PO a,c,e,g) and 50% of team work (PO b,c,d,e,g,k). Among the individual activities, assessment of activities performed during the course will be a 70% of each student grade, and a final exam will be a 30% of the grade, although mechanisms to pass the course only with the final exam will be provided. A minimum qualification in each part will be required.

Specifically, the activities to develop are:

- Partial exams: exams with theoretical content, to evaluate the knowledge acquired by the students trough the use of basic and advanced bibliography, including also research papers (CB1). Those exams permit to evalueta the knowledge in fundamentals, paradigms and techniques in intelligent systems (CECC4) and in machine learning (CECC7)

- Final Exam: theoric-practice exam that permits to evaluate the capacity of the student to represent human knowledge in different formalism (CECC5), specifically, in a way that can be handled with machine learning methods, allowing them the analysis, design and implementation of a final software solution (CECC7). The development of the exam requires a globla knowledge about the main concepts related to machine learning (CB1)

- Tutorials about the use of machine learning tools. Exercises about the use of tools and techniques in the machine learning area(CECC4)

- Practices in machine learning systems: practical applications that require the representation of human knowledge(CECC5) for the analysis, design and implementation of a computing solution in intelligent systems (like games) (CECC4) based on the automated extraction of knowledge from large sources of data (CECC7)

- Final project in development and appication of machine learning methods: development of a final project that requires the representation of human knowledge(CECC5) for the analysis, design and implementation of a computing solution in intelligent systems (like games) (CECC4) based on the automated extraction of knowledge from large sources of data (CECC7). This project may require the development of new machine learning approaches (CECC7)

% end-of-term-examination:	30
% of continuous assessment (assigments, laboratory, practicals…):	70

BASIC BIBLIOGRAPHY

- D. Borrajo, J. González y P. Isasi Aprendizaje automático, Sanz y Torres.
- E. Rich y K. Knight Artificial Intelligence, McGraw-Hill.
- S. Russel y P. Norving Artificial Intelligence: a modern approach, Prentice Hall, 2003
- T. M. Mitchell Machine Learning, Mc Graw Hill.

ADDITIONAL BIBLIOGRAPHY

- Basilio Sierra Araujo (Ed.) Aprendizaje automático: conceptos básicos y avanzados. Aspectos prácticos utilizando el software WEKA, Pearson Education.
- J. W. Shavlik y T. G. Dietterich (eds.) Readings in Machine Learning, Morgan Kaufmann.
- P. W. Langley Elements of Machine Learning, Morgan Kaufmann.
- R. Sutton and A Barto Reinforcement Learning: an Introduction, Kluwer Academic Publishers.
- Saso Dzeroski y Nada Lavrac Relational Data Mining, Springer Verlag.