Machine Learning

Academic Year: (2023 / 2024) **Review date: 09-02-2024**

Department assigned to the subject: Computer Science and Engineering Department

Coordinating teacher: FERNANDEZ REBOLLO, FERNANDO

Type: Electives ECTS Credits : 6.0

Year : 4 Semester :

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Programming (Year 1 - Semester 1)
Probability (Year 2 - Semester 2)
Aritificial Intelligence (Year 2 - Semester 2)

SKILLS AND LEARNING OUTCOMES

CB1. Students have demonstrated possession and understanding of knowledge in an area of study that builds on the foundation of general secondary education, and is usually at a level that, while relying on advanced textbooks, also includes some aspects that involve knowledge from the cutting edge of their field of study.
CB2. Students are able to apply their knowledge to their work or vocation in a professional manner and possess the competences usually demonstrated through the development and defence of arguments and problem solving within their field of study.
CB3. Students have the ability to gather and interpret relevant data (usually within their field of study) in order to make judgements which include reflection on relevant social, scientific or ethical issues.
CB4. Students should be able to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences.
CB5. Students will have developed the learning skills necessary to undertake further study with a high degree of autonomy.
CG1. Students are able to demonstrate knowledge and understanding of concepts in mathematics, statistics and computation and to apply them to solve problems in science and engineering with an ability for analysis and synthesis.
CG3. Students can solve computationally with the help of the most advanced computing tools mathematical models coming from applications in science, engineering, economy and other social sciences.
CG4. Students are able to show that they can analyze and interpret, with help of computer science, the solutions obtained from problems associated to real world mathematical models, discriminating the most relevant behaviours for each application.
CG6. Students can search and use bibliographic resources, in physical or digital support, as they are needed to state and solve mathematically and computationally applied problems arising in new or unknown environments or with insufficient information.
CE20. Students have shown that they understand the fundamentals of bayesian statistics and that they have learnt the different computational intensive techniques to implement inference and bayesian prediction, as well as techniques used in machine learning.

RA1. Students must have acquired advanced cutting-edge knowledge and demonstrated indepth understanding of the theoretical and practical aspects of working methodology in the area of applied mathematics and computing.
RA2. Through sustained and well prepared argument and procedures, students will be able to apply their knowledge, their understanding and the capabilities to resolve problems in complex specialized professional and work areas requiring the use of creative and innovative ideas.
RA3. Students must have the capacity to gather and interpret data and information on which they base their conclusions, including where relevant and necessary, reflections on matters of a social, scientific, and ethical nature in their field of study.
RA4. Students must be able to perform in complex situations that require developing novel solutions in the academic as well as in the professional realm, within their field of study.
RA5. Students must know how to communication with all types of audiences (specialized or not) their knowledge, methodology, ideas, problems and solutions in the area of their field of study in a clear and precise way.
RA6. Students must be capable of identifying their own education and training needs in their field of

study and the work or professional environment and organize their own learning with a high degree of autonomy in all types of contexts (structured or not).
RA7. Students must possess the professional maturity necessary to choose and evaluate their work objectives in a reflexive, creative, self-determined and responsible way, for the betterment of society.

OBJECTIVES

* Understand basic Machine Learning techniques
* Learn to determine when to use Machine Learning on real problems
* Learn to determine which technique is appropriate for each problem
* Learn to apply the techniques in a practical way to real problems

DESCRIPTION OF CONTENTS: PROGRAMME

1. Introduction to machine learning and inductive learning
2. Classification and prediction techniques
3. Non supervised techniques
4. Reinforcement based techniques
5. Relational learning
6. Methodological aspects

LEARNING ACTIVITIES AND METHODOLOGY

AF1.THEORETICAL-PRACTICAL CLASSES. Knowledge and concepts students must acquire. Student receive course notes and will have basic reference texts to facilitatefollowing the classes and carrying out follow up work.Students partake in exercises to resolve practical problems and participatein workshops and an evaluation tests, all geared towards acquiring the necessary capabilities.Subjects with 6 ECTS are44 hours as a general rule/ 100% classroom instruction
AF2.TUTORING SESSIONS. Individualized attendance (individual tutoring) or in-group (group tutoring) for students with a teacher.Subjects with 6 credits have 4 hours of tutoring/ 100% on- site attendance.
AF3.STUDENT INDIVIDUAL WORK OR GROUP WORK.Subjects with 6 credits have 98 hours/0% on-site.
AF8.WORKSHOPS AND LABORATORY SESSIONS. Subjects with 3 credits have 4 hours with 100% on-site instruction. Subjects with 6 credits have 8 hours/100% on-site instruction.
MD1.THEORY CLASS. Classroom presentations by the teacher with IT and audiovisual support in which the subject`s main concepts are developed, while providing material and bibliography to complement student learning.
MD2.PRACTICAL CLASS. Resolution of practical cases and problem, posed by the teacher, and carried out individually or in a group.
MD3.TUTORING SESSIONS. Individualized attendance (individual tutoring sessions) or in-group (group tutoring sessions) for students with teacher as tutor. Subjects with 6 credits have 4 hours of tutoring/100% on-site.
MD6.LABORATORY PRACTICAL SESSIONS. Applied/experimental learning/teaching in workshops and laboratories under the tutor's supervision.

ASSESSMENT SYSTEM

SE1.FINAL EXAM. Global assessment of knowledge, skills and capacities acquired throughout the course.The percentage of the evaluation varies for each subject between 60% and 0%.
SE2.CONTINUOUS EVALUATION. Assesses papers, projects, class presentations, debates, exercises, internships and workshops throughout the course.The percentage of the evaluation varies for each subject between 40% and 100% of the final grade.

Final grade will be composed of 50% of individual work and 50% of team work. 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 could be required.

Specifically, the activities to develop are:

- Partial exams (20%): exams with theoretical content, to evaluate the knowledge acquired by the students trough the use of basic and advanced bibliography. Those exams permit to evalueta the knowledge in fundamentals, paradigms and techniques in intelligent systems and machine learning.

- Final exam (30%): theoretical-practical exam to evaluate the capacity of the student to represent human knowledge in different formalisms, specifically, in a way that can be handled with machine learning methods, allowing them the analysis, design and implementation of a final solution. The development of the exam requires a global knowledge about the main concepts related to machine learning.

- Tutorials and practices (50%): tutorials will be about the use of machine learning tools and techniques; practices wiil be about practical applications that require the representation of knowledge for the analysis, design and implementation of a computing solution in intelligent systems based on machine learning.

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

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

BASIC BIBLIOGRAPHY

- 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

- 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.