

Academic Year/course: 2022/23

69158 - Applications of Deep Learning

Syllabus Information

Academic Year: 2022/23

Subject: 69158 - Applications of Deep Learning

Faculty / School: 110 - Escuela de Ingeniería y Arquitectura

Degree: 615 - Master's in Robotics, Graphics and Computer Vision/ Robótica, Gráficos y Visión por Computador

ECTS: 3.0

Year: 1

Semester: Second semester

Subject Type: Optional

Module:

1. General information

1.1. Aims of the course

The objective of the course is to study the main techniques and applications of deep machine learning in the context of robotics, graphics and computer vision, and to be able to apply them in real examples.

These approaches and objectives are aligned with some of the Sustainable Development Goals, SDG, of the 2030 Agenda (<https://www.un.org/sustainabledevelopment/es/>) and certain specific goals, in such a way that the acquisition of the Learning outcomes of the subject provides training and competence to the student to contribute to a certain extent to their achievement:

- Goal 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
 - Target 8.3 Promote development-oriented policies that support productive activities, the creation of decent jobs, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro, small and medium-sized enterprises, including through access to financial services
- Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation
 - Target 9.4 By 2030, modernize infrastructure and reconvert industries so that they are sustainable, using resources more efficiently and promoting the adoption of clean and environmentally sound industrial technologies and processes, and ensuring that all countries take measures in accordance with their respective capabilities
- Goal 16: Promote peaceful and inclusive societies for sustainable development, facilitate access to justice for all, and create effective, accountable and inclusive institutions at all levels
 - Target 16.7 Ensure the adoption at all levels of inclusive, participatory and representative decisions that respond to the needs

1.2. Context and importance of this course in the degree

Machine learning and deep learning systems are transversal tools in many applications, including applications in robotics, graphics and computer vision. The contents of this course extend the contents in the "Machine learning" basic course and complement and deepen the deep learning tools that are seen in other subjects of the degree.

1.3. Recommendations to take this course

Having passed the course of Machine Learning.

2. Learning goals

2.1. Competences

Basic and General Competences:

- CB7 - That students know how to apply the acquired knowledge and ability to solve problems in new or little-known settings within broader (or multidisciplinary) contexts related to their area of study.
- CB8 - That students are able to integrate knowledge and face the complexity of formulating judgments based on information that, being incomplete or limited, includes reflections on the social and ethical responsibilities linked to the application of their knowledge and judgments.
- CB9 - That students know how to communicate their conclusions and the latest knowledge and reasons that support them to specialized and non-specialized audiences in a clear and unambiguous way.
- CB10 - That students possess the learning skills that allow them to continue studying in a way that will have to be largely self-directed or autonomous.
- CG01 ? Acquisition of advanced and demonstrated knowledge, in a context of scientific and technological research or highly specialized, a detailed and well-founded understanding of the theoretical and practical aspects and of the working methodology in the fields of Robotics, Graphics and / or Computer Vision, allowing them to be innovative in a context of research, development and innovation.
- CG03 - Ability to evaluate and select the appropriate scientific theory and the precise methodology of their fields of study to formulate judgments based on incomplete or limited information, including, when necessary and pertinent, considerations on social or ethical responsibility linked to the solution that is proposed in each case.
- CG08 ? To possess the aptitudes, skills and method necessary to carry out multidisciplinary research and / or development work in the fields of Robotics, Graphics and / or Computer Vision.
- CG10 - Ability to understand, relate to the state of the art and critically evaluate scientific publications in the fields of Robotics, Graphics and / or Computer Vision.

Specific

- CE01 - Ability to apply mathematical and artificial intelligence methods to model, design and develop Robotics, Graphics and / or Computer Vision systems and applications.
- CE07 - Ability to develop and evaluate software for Robotics, Graphics and Computer Vision problems that can use general and / or specific purpose architectures.
- CE08 - Ability to conceive, design and develop Machine Learning systems, and apply them to Robotics, Graphics and / or Computer Vision problems.
- CE09 - Ability to autonomously carry out a work of initiation to research and / or development in the field of Robotics, Graphics, or Computer Vision, in which the skills acquired in the degree are synthesized and integrated.

2.2. Learning goals

The student must be able to:

- Know and apply advanced techniques of deep and reinforcement learning.
- Apply machine learning techniques to extract knowledge in environments that handle large amounts of data.
- Apply machine learning techniques to extract knowledge in environments with small amounts of data, interactive or sequential data.
- Apply the knowledge acquired to specific problems in application domains related to Robotics, Computer Vision and Computer Graphics
- Understand the different types of Machine Learning systems most appropriate for each application.
- Identify the machine learning problems under investigation for which there are no known solutions within the field of Robotics, Computer Vision and Computer Graphics.
- Synthetically present the proposed technical and / or scientific results.

- Evaluate relevant bibliographic sources.

2.3. Importance of learning goals

Deep machine learning has become a fundamental piece of artificial intelligence systems, for the most diverse applications, from engineering, business, information systems, science and even the arts. They have allowed great advances in fields such as image and audio processing, the development of virtual assistants, autonomous driving systems or the automatic creation of digital cinema effects. Knowledge of these algorithms gives companies a significant competitive advantage.

3. Assessment (1st and 2nd call)

3.1. Assessment tasks (description of tasks, marking system and assessment criteria)

P1[30%]- written test and laboratory. Open test on practical cases proposed by the teachers or the project developed by the student.

P2 [60%] - Directed work. Works, exercises, and reports of laboratory practices, in which the knowledge and skills acquired in the subject will be put into practice.

P3 [10%] - Presentations and debates orally. Oral presentations of the work, exercises and practices will be valued. Evaluation of the practice during the sessions.

The final grade will be calculated according to the following formula: $0.3 * P1 + 0.6 * P2 + 0.1 * P3$.

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The teaching-learning process will be done through: lectures, practice sessions (examples and case studies with active participation of students), laboratory sessions (in small groups, with simulation tools or real systems) and the realization of practical work and study supervised by the professors.

4.2. Learning tasks

The course consists of 3 ECTS credits that correspond with a dedication of the student estimated 75 hours distributed in the following way:

- Lectures, practice and lab sessions: 22 h
- Assignments of practical application or research work: 25 h
- Personalized tutor-student tutoring: 5 h
- Study: 20 h
- Assessment and evaluation activities: 3 h

4.3. Syllabus

1. Advanced deep learning techniques
 - a. Deep reinforcement learning
 - b. Bayesian deep learning
 - c. Generative models.
1. Applications:
 - a. Deep machine learning for robotics.
 - b. Deep machine learning for computer vision.
 - c. Deep machine learning for computer graphics.

4.4. Course planning and calendar

The calendar of the subject will be defined by the center in the academic calendar of the corresponding course. The detailed calendar of activities will be available in Moodle, and will be presented on the first day of class.

4.5. Bibliography and recommended resources

- Machine Learning: a Probabilistic Perspective, by Kevin Patrick Murphy, MIT Press, 2012
- Deep Learning, Ian Goodfellow and Yoshua Bengio and Aaron Courville, MIT Press, 2016
- Mathematics for Machine Learning. Marc Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong. Published by Cambridge University Press 2020
- Reinforcement Learning: An Introduction, Richard S. Sutton and Andrew G. Barto, Second Edition, MIT Press, 2018

Biblioteca Unizar:

http://biblos.unizar.es/br/br_citas.php?codigo=69158&year=2020