# Course guide
# 320115 - GDSA - Audiovisual Signal Management and Distribution

**Last modified:** 19/04/2023

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| **Unit in charge:** | Terrassa School of Industrial, Aerospace and Audiovisual Engineering |
| **Teaching unit:** | 739 - TSC - Department of Signal Theory and Communications. |
| **Degree:** | BACHELOR'S DEGREE IN AUDIOVISUAL SYSTEMS ENGINEERING (Syllabus 2009). (Compulsory subject). |

**Academic year:** 2023    **ECTS Credits:** 6.0    **Languages:** Catalan

## LECTURER

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| **Coordinating lecturer:** | XAVIER GIRÓ I NIETO |
| **Others:** | |

## PRIOR SKILLS

Students will be expected to have passed the various subjects related to programming. Programming in Python.

## DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

**Specific:**
CE21-ESAUD. Ability to build, operate, and manage telecommunications services and applications, understood as systems for capturing, analog and digital processing, encoding, transportation, representation, processing, storage, reproduction, management, and presentation of audiovisual services and multimedia information. (Specific Technology Module: Sound and Image)
CE25-ESAUD. Ability to create, encode, manage, disseminate, and distribute multimedia content, taking into account criteria of usability and accessibility of audiovisual, broadcasting, and interactive services. (Specific Technology Module: Sound and Image)

**Transversal:**
CT03 N3. Efficient oral and written communication - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.

## TEACHING METHODOLOGY

- Face-to-face sessions of presentation of the contents.
- Face-to-face sessions of practical team work.
- Autonomous study and programming work
- Preparation and realization of evaluable activities in group

Theory classes introduce all the knowledge, techniques, concepts, and outcomes needed to reach a well-founded level. These concepts are put into practice in laboratory classes, in which the student learns to develop deep learning solutions to real problems of some complexity.
In the problem classes we deepen in understanding the theory by solving problems in groups.
Python code is provided in the laboratory classes using a deep learning library that allows you to solve a problem related to the contents presented in the theoretical sessions.

## LEARNING OBJECTIVES OF THE SUBJECT

The aim of the course is to develop deep neural networks that can solve artificial intelligence problems. These machine learning tools estimate their parameters based on training data and optimization criteria. The course presents the types of layers most used in these networks, as well as the most popular algorithms and optimization methodologies. Students will be able to implement them in software, as well as monitor their training and diagnose what actions can improve their operation. The course focuses on deep neural network applications related to the management and distribution of audiovisual signals.

## STUDY LOAD

| Type | Hours | Percentage |
|------|-------|------------|
| Self study | 90,0 | 60.00 |
| Hours small group | 15,0 | 10.00 |
| Hours large group | 45,0 | 30.00 |

**Total learning time:** 150 h

## CONTENTS

### NEURALS LAYERS

**Description:**
- Perceptron and multilayer perceptron.
- Convolutional layers.
- Recurrent layers.
- Residual layers
- Mechanisms of attentio

**Specific objectives:**
Understand the mechanisms implemented of the different neural layers that make up a deep neural network.
Design deep neural networks.

**Related activities:**
- Linear and logistic regressors.
- Classification of images with a Multilayer Perceptron
- Classification of images with Convolutional Neural Network.
- Interpretability of a Convolutional Neural Network.
- Text generation with a Recurrent Neural Network.

**Full-or-part-time:** 58h
Theory classes: 22h
Laboratory classes: 9h
Self study : 27h

## TRAINING OF DEEP NEURAL NETWORKS

**Description:**
- Machine learning.
- Supervised vs. unsupervised learning.
- Backpropagation.
- Loss functions.
- Optimizers.
- Methodology.
- Data augmentation.
- Batch normalization

**Specific objectives:**
Train a deep neural network by selecting the right optimization algorithms and hyper-parameters.
Interpret training curves.

**Related activities:**
PyTorch Labs on:
- Tensors.
- Backpropagation.
- Fighting overfitting.
- Optimizers
- Adversarial training.

**Full-or-part-time:** 47h
Theory classes: 14h
Laboratory classes: 5h
Self study : 28h

## APPLICATIONS TO THE MANAGEMENT AND DELIVERY OF AUDIOVISUAL SIGNALS

**Description:**
- Image search.
- Text translation.
- Sound labeling.

**Specific objectives:**
Identify which audiovisual applications can benefit from of deep neural networks.

**Related activities:**
Development and evaluation of a deep neural network with PyTorch.

**Full-or-part-time:** 49h
Theory classes: 10h
Laboratory classes: 4h
Self study : 35h

## GRADING SYSTEM

- First exam: 30%
- Second exam: 30%
- Project: 20%
- Laboratory practices: 20%
- Laboratories: 20%

For those students who meet the requirements and take the re-assessment exam, the grade of the re-assessment exam will replace the grades of all assessment acts that are face-to-face written tests (controls, partial exams and final) and the qualifications of practices, works, projects and presentations obtained during the course will be maintained.

If the final grade after the re-assessment is lower than 5.0 it will replace the initial one only if it is higher. If the final grade after the re-assessment is greater than or equal to 5.0, the final grade of the subject will be passed 5.0.

## BIBLIOGRAPHY

**Basic:**
- Goodfellow, Ian; Bengio, Yoshua; Courville, Aaron. Deep learning [on line]. Cambridge, Massachusetts: The MIT Press, [2016] [Consultation: 28/10/2020]. Available on: http://www.deeplearningbook.org/. ISBN 9780262035613.

**Complementary:**
- Torres, Jordi. Python deep learning : introducción práctica con Keras y TensorFlow 2 [on line]. Barcelona: Marcombo, 2020 [Consultation: 03/05/2022]. Available on: https://web-p-ebscohost-com.recursos.biblioteca.upc.edu/ehost/ebookviewer/ebook?sid=13d3db2e-a268-437d-9aad-e6400127c3e6%40redis&vid=0&format=EK. ISBN 9788426728289.

## RESOURCES

**Other resources:**
Slides i vídeos de la UPC TelecomBCN:
https://github.com/telecombcn-dl/lectures-all