Course guide
230706 - DLAI - Deep Learning for Artificial Intelligence

Last modified: 25/05/2023

Unit in charge: Barcelona School of Telecommunications Engineering
Teaching unit: 739 - TSC - Department of Signal Theory and Communications.

Degree: MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Optional subject).
MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Optional subject).

Academic year: 2023 **ECTS Credits:** 5.0 **Languages:** English

LECTURER

Coordinating lecturer: Consultar aquí / See here: https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/responsables-assignatura

Others: Consultar aquí / See here: https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/professorat-assignat-idioma

PRIOR SKILLS

A previous knowledge on basic machine learning is advisable. In terms of programming, it is recommended that students are familiar with Python programming language beforehand.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CE1. Ability to apply information theory methods, adaptive modulation and channel coding, as well as advanced techniques of digital signal processing to communication and audiovisual systems.

TEACHING METHODOLOGY

Lectures, in class labs and assignments.

LEARNING OBJECTIVES OF THE SUBJECT

At the end of this course students will be able to design, implement, train and evaluate a machine learning system based on deep neural networks.

STUDY LOAD

Type	Hours	Percentage
Hours small group	13,0	10.40
Self study	86,0	68.80
Hours large group	26,0	20.80

Total learning time: 125 h

CONTENTS

1. DEEP NEURAL NETWORKS

Description:
1.1 The Perceptron. Regression vs classification. The Softmax classifier.
1.2 Multi-layer perceptron (MLP).
1.3 Basic layers: Fully connected. Convolutions/Deconvolutions, Non-linearities (ReLU, tanh, sigmoid). Downsampling/Upsampling.
1.4 Interpretability: t-SNE, visualizations, highest activations.

Full-or-part-time: 18h
Theory classes: 3h 57m
Self study : 14h 03m

2. TRAINING

Description:
2.1 Backpropagation
2.2 Optimizers
2.3 Loss functions
2.4 Methodology
2.5 Efficient computation

Full-or-part-time: 35h 59m
Theory classes: 7h 53m
Self study : 28h 06m

3. MEMORY NETWORKS

Description:
3.1 Recurrent Neural Networks
3.2 Gated models: LSTM, GRU, ...
3.3 Advanced models: QRNN, pLSTM, ...

Full-or-part-time: 18h
Theory classes: 3h 57m
Self study : 14h 03m

4. BEYOND SUPERVISED LEARNING

Description:
4.1 Unsupervised and semi-supervised learning.
4.2 Adversarial training and generative models
4.3 Incremental learning
4.4 Active learning
4.5 Reinforcement learning
4.6 Meta-learning

Full-or-part-time: 18h
Theory classes: 3h 57m
Self study : 14h 03m

5. COMPUTATION

Description:
5.1 Software stack
5.2 Computational requirements
5.3 Scalability

Full-or-part-time: 18h
Theory classes: 3h 57m
Self study : 14h 03m

ACTIVITIES

Lectures

Description:
1. DEEP NEURAL NETWORKS

2. TRAINING

3. MEMORY NETWORKS

4. BEYOND SUPERVISED LEARNING
5. COMPUTATION

Full-or-part-time: 108h
Theory classes: 23h 40m
Self study: 84h 20m

Labs in class

Description:
1. Classification vs Regression
2. Convolutional neural networks for image classification.
3. Data pipelines between CPUs and GPUs.
4. Interpretability of a convolutional neural network.
5. Generative adversarial networks.

Material:
Deep learning frameworks used during the labs: Caffe, Tensorflow and Keras.

Full-or-part-time: 10h
Laboratory classes: 5h
Self study: 5h

Project

Description:
Hands on project where students must design, train and test their own deep learning model.

Material:
GPUs on a cloud service.

Delivery:
Oral presentation
Poster

Full-or-part-time: 40h
Theory classes: 1h
Laboratory classes: 8h
Self study: 31h

Grading

Description:
Written exams in class.

Full-or-part-time: 4h
Theory classes: 4h

GRADING SYSTEM

Labs: 15%
Midterm: 15%
Project: 40%
Final exam: 30%

BIBLIOGRAPHY

Basic:
- Goodfellow, Ian; Bengio, Yoshua; Courville, Aaron. Deep learning [on line]. Boston: MIT Press, 2016 [Consultation: 16/06/2017]. Available on: http://www.deeplearningbook.org/. ISBN 978-0262035613.

RESOURCES

Audiovisual material:
- https://telecombcn-dl.github.io/2017-dlsl/. Resource

Hyperlink:
- https://telecombcn-dl.github.io/2017-dlcv/. Deep Learning for Computer Vision Summer School at UPC ETSETB TelecomBCN 2017
- https://telecombcn-dl.github.io/2017-dlai/. Web page of the course