Last update: 06-05-2019

230706 - DLAI - Deep Learning for Artificial Intelligence

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering

Teaching unit: 739 - TSC - Department of Signal Theory and Communications

Academic year: 2019

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

ECTS credits: 5 Teaching languages: English

Teaching staff

Coordinator: Giró Nieto, Xavier

Others: Ruiz Hidalgo, Javier
Ruiz Costa-Jussa, Marta
Sayrol Clols, Elisa
Vilaplana Besler, Veronica
Morros Rubio, Josep Ramon
Casamitjana Díaz, Adrià

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

Total learning time: 125h	Hours large group:	26h	20.80%
	Hours small group:	13h	10.40%
	Self study:	86h	68.80%

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Content

1. DEEP NEURAL NETWORKS

Learning time: 18h

Theory classes: 3h 57m
Self study : 14h 03m

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.

2. TRAINING

Learning time: 35h 59m

Theory classes: 7h 53m
Self study : 28h 06m

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

3. MEMORY NETWORKS

Learning time: 18h

Theory classes: 3h 57m
Self study : 14h 03m

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

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4. BEYOND SUPERVISED LEARNING	Learning time: 18h Theory classes: 3h 57m Self study : 14h 03m

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

5. COMPUTATION	Learning time: 18h Theory classes: 3h 57m Self study : 14h 03m

Description:
5.1 Software stack
5.2 Computational requirements
5.3 Scalability

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Planning of activities

Lectures	Hours: 108h Theory classes: 23h 40m Self study: 84h 20m

Description:

1. DEEP NEURAL NETWORKS
2. TRAINING
3. MEMORY NETWORKS
4. BEYOND SUPERVISED LEARNING
5. COMPUTATION

Labs in class	Hours: 10h Laboratory classes: 5h Self study: 5h

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.

Support materials:

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

Project	Hours: 40h Theory classes: 1h Laboratory classes: 8h Self study: 31h

Description:

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

Support materials:

GPUs on a cloud service.

Descriptions of the assignments due and their relation to the assessment:

Oral presentation
Poster

Grading	Hours: 4h Theory classes: 4h

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Description:
Written exams in class.

Qualification system

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

Bibliography

Basic:

Goodfellow, Ian; Bengio, Yoshua; Courville, Aaron. Deep learning [on line]. 1. Boston: MIT Press, 2016 [Consultation: 16/06/2017]. Available on: <http://www.deeplearningbook.org/>. ISBN 978-0262035613.

Others resources:

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

Audiovisual material

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