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

<table>
<thead>
<tr>
<th>Total learning time: 125h</th>
<th>Hours large group: 26h</th>
<th>20.80%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours small group: 13h</td>
<td>10.40%</td>
</tr>
<tr>
<td></td>
<td>Self study: 86h</td>
<td>68.80%</td>
</tr>
</tbody>
</table>
# 230706 - DLAI - Deep Learning for Artificial Intelligence

## Content

<table>
<thead>
<tr>
<th>1. DEEP NEURAL NETWORKS</th>
<th>Learning time: 18h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 3h 57m</td>
</tr>
<tr>
<td></td>
<td>Self study: 14h 03m</td>
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</tbody>
</table>

**Description:**
1.1 The Perceptron. Regression vs classification. The Softmax classifier.
1.2 Multi-layer perceptron (MLP).
1.4 Interpretability: t-SNE, visualizations, highest activations.

<table>
<thead>
<tr>
<th>2. TRAINING</th>
<th>Learning time: 35h 59m</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 7h 53m</td>
</tr>
<tr>
<td></td>
<td>Self study: 28h 06m</td>
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</tbody>
</table>

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

<table>
<thead>
<tr>
<th>3. MEMORY NETWORKS</th>
<th>Learning time: 18h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 3h 57m</td>
</tr>
<tr>
<td></td>
<td>Self study: 14h 03m</td>
</tr>
</tbody>
</table>

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

**Learning time:** 18h
- Theory classes: 3h 57m
- Self study: 14h 03m

### 5. COMPUTATION

**Description:**
- 5.1 Software stack
- 5.2 Computational requirements
- 5.3 Scalability

**Learning time:** 18h
- Theory classes: 3h 57m
- Self study: 14h 03m
## Planning of activities

### Lectures

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

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

### Labs in class

**Description:**
1. Classification vs Regression
3. Data pipelines between CPUs and GPUs.
5. Generative adversarial networks.

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

**Hours:** 10h
- Laboratory classes: 5h
- Self study: 5h

### Project

**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

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

### 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:**

**Others resources:**

- [Hyperlink](https://telecombcn-dl.github.io/2017-dlcv/)
  Deep Learning for Computer Vision Summer School at UPC ETSETB TelecomBCN 2017

- [Hyperlink](https://telecombcn-dl.github.io/2017-dlaic)
  Web page of the course

- [Audiovisual material](https://telecombcn-dl.github.io/2017-dsl/)
  Resource