

Course title:

Introduction to Deep Learning

Duration: 24 (PILLAR)

PhD Program [MERC/MPS/SPACE]: SPACE

Name and Contact details of unit organizer(s):

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Course Description:

Aim of this introductory course is to provide fundamental concepts and theoretical tools on machine learning, artificial neural networks, deep learning. In addition, coding sessions in Python and Keras will provide practical tools to implement and use popular deep learning models. Image processing problems will be used to demonstrate concepts and tools.

Syllabus:

Theory

- Machine Learning Basics, Linear regression, Maximum Likelihood
- Artificial Neural Networks
- Optimization and Backpropagation, Scaling to large Data, Stochastic Gradient Descent
- Training Neural Networks
- Convolutional Neural Networks (CNN), Popular CNN architectures
- Other architectures, Autoencoders, Generative Adversarial Networks, Transformers

Practice:

- A gentle introduction to Python *
- Scientific computation and image processing in Python *
- Introduction to Keras, <https://keras.io/>
- Implementation of main deep learning architectures using Keras
- Overfitting and countermeasures: dataset augmentation and network fine-tuning
- Implementation of CNN-based solutions for image processing tasks
- Implementation and training of Generative Adversarial Networks

Assessment:

Oral exam

Suggested reading and online resources:

1. Nielsen, "Neural networks and deep learning", online at <http://neuralnetworksanddeeplearning.com/>
2. Zhang et al, "Dive into deep learning", online at <https://d2l.ai/>
3. Python programming language guide and exercises, online at <https://www.geeksforgeeks.org/python-programming-language/>
4. Notes provided by the Teacher.