Ph.D. in Information and Communication Technologies – ICT

Ph.D. Course:

"PhD Course: "TensorFlow for ICT applications"

Edition 2019 (20 hours, 4 credits)

Class Objectives

Over the last years, neural networks have asserted themselves as a fundamental tool for a broad spectrum of ICT applications and fields, ranging from image processing (e.g., automatic SAR segmentation) to audio analysis and telecommunication networks. This evolution has been simplified and matched by a concurrent development of very sophisticated tools for the design and the optimization of these neural networks, that are today supporting many research and industrial projects. Among these frameworks, TensorFlow, open-sourced by Google in 2015, is today the most used one worldwide, with the version 2.0 released in March 2019.

This course will introduce the fundamentals of working with TensorFlow, with a focus on three selected ICT applications. The course will alternate small theory lectures, introducing key concepts of learning with neural networks and the evolution of deep learning frameworks, to practical coding sessions in Python using interactive Jupyter notebooks. At the end of every coding session we will implement a specific use case, ranging from channel estimation with feedforward models, to image analysis for autonomous driving and SAR segmentation.

Syllabus

1- Introduction to Python, the Anaconda environment, and working with Jupyter notebooks.
2- Brief overview of supervised learning and the evolution of deep learning frameworks over the last years.
3- TensorFlow basic operations: tensors, operations on tensors, and auto-differencing.
4- Application 1: channel estimation with linear regression.
5- Working with advanced and convolutional neural networks in TensorFlow.
6- Application 2: toy example of autonomous driving in TensorFlow.
7- Application 3: image segmentation and applications (e.g., medical images and SAR).

Class Schedule

The course will be held **from May, 20 to June, 14 2019** in the DIET department, Via Eudossiana 18, 00184 Rome, Italy, with the following schedule:

Friday May 24th   10:00-12:00   **Reading room** at the second floor of DIET Dpt.

Thursday May 30th   10:00-13:00   **Reading room** at the second floor of DIET Dpt.

Friday May 31st	10:00-13:00	**Reading room** at the second floor of DIET Dpt.
Thursday June 6th	10:00-13:00	**Reading room** at the second floor of DIET Dpt.
Friday June 7th	10:00-13:00	**Reading room** at the second floor of DIET Dpt.
Thursday June 13th	10:00-13:00	**Reading room** at the second floor of DIET Dpt.
Friday June 14th	10:00-13:00	**Reading room** at the second floor of DIET Dpt.

Final Examination

Each student will be assigned a hands-on project and will be evaluated on the correct implementation of the project itself.

Learning and teaching support materials

- Slides and notebooks from the instructor.
- Goodfellow, I., Bengio, Y. and Courville, A., 2016. Deep learning. MIT Press.
- Selected articles for further reading.

Teacher

Dr. Simone Scardapane is an Assistant Professor at the DIET department in Sapienza University of Rome. His research interest is focused on the design and optimization of deep neural networks. He has a strong interest in the promotion of machine learning in Italy. He is the co-founder of the Italian Association for Machine Learning, a not-for-profit association, and a Google Developer Expert for Machine Learning since 2017.