ICT PHD

Research project for a PhD curriculum in ICT – Computer Engineering and Science

**Tutor**: Rita Cucchiara

**(\*) Italian [Industrial] Co-tutor:**

**(\*\*) Foreign Co-tutor:**

**Proposed Title of the research:  
Trustworthy self-attentive models for visual-semantic understanding, matching and verification**

**Keywords: (5)  
Self-Attentive Architectures, Visual generation, Trustworthy AI**

**Research objectives: --(max 10 rows)**

Deep learning has quickly become the state-of-the-art approach for extracting knowledge from visual data and it is rapidly solving some of the most complex problems in Computer Vision, such as image classification, object detection and visual-semantic understanding with supervised learning. As Deep Learning gets better at visual and semantic tasks, and new self-attentive operators and architectures emerge to tackle visual understanding and generative problems, the need for algorithms matching the visual and semantic domain increases. This becomes particularly important in light of the emergence of better visual generative algorithms and Deep Fakes, with which fake visual data is generated to influence opinions on social networks and content sharing platform. The purpose of this research topic is the design and analysis of novel and data-intensive algorithms for visual data understanding and verification, also leveraging the integration of vision, high-level semantics and language. The research activities will also be conducted in the context of the ELSA European project.

**Proposed research activity -- (max 10 rows)**Research activity will cover the following topics.

1. Design of novel architectures with self-attentive and Transformer-like approaches
2. Design and development of novel training techniques for self-supervised and/or partially supervised training, for matching real and fake data at high semantic levels
3. Design of Transformer-like networks for visual data generation and retrieval.
4. AI learning and inference from HPC to edge.

Research will be carried on with the support of the European project ELSA, with datasets and using HPC facilities with CINECA and NVIDIA, in the context of the NVIDIA AI Technical Centre of Modena. Part of the research will be done during a period of internship in Europe in some research/industrial centres involved in the projects.

**Supporting research projects (and Department)**

Research will be carried out in the AImagelab laboratory (aimagelab.unimore.it) in the Department of Engineering “Enzo Ferrari” with the support of the NVIDIA AI Technical research centre.

**Possible connections with research groups, companies, universities.**

Connections will be (many of them are already established)

- NVIDIA (Simon See Hong Kong, Fredric Pairente, Luxembourg)

- INRIA (Natalia Díaz-Rodríguez)

- CNR (Consiglio Nazionale delle Ricerche)

- FBK (Fondazione Bruno Kessler)

(\*) optional

(\*\*) optional/to be completed on the second year