ICT PHD

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

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

**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 trustworthy algorithms increases. The purpose of this topic is the design and analysis of novel and data-intensive algorithms for visual data understanding, visual generation and for the integration of vision, semantics and language - with a focus on the design of novel operators and on the trustworthiness of the results. It will also ensure that developed techniques are in line with the emerging European legal framework on AI.

**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
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 European projects (Human-E-AI-Net, PERSEO), 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 EU projects (Human-E-AI-Net, PERSEO) and 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