

# COMPUTER AND CONTROL ENGINEERING

## PNRR - Design of Tools for exploiting heterogeneous fog computing systems

<b>Funded By</b>	MINISTERO DELL'UNIVERSITA' E DELLA RICERCA [P.iva/CF:97429780584] Politecnico di TORINO [P.iva/CF:00518460019]
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<b>Context of the research activity</b>	<p>The process of task mapping on the HW units available on heterogeneous systems (multi-core, CPU, GPU, FPGA, Neuromorphic HW) is challenging for a SW developer.</p> <p>This project will investigate methods and techniques for designing parallel optimized tools fully exploiting the heterogeneous HW architectures of modern fog computing system for implementing bioinformatics and IoT applications.</p> <p>The candidate will be involved in the activity of the EBRAINS-Italy Project PNRR.</p> <p>Progetto finanziato nell'ambito del PNRR - PNRR M4C2, Investimento 3.1 - Avviso n. 3264 del 28/12/2021 - IR0000011 European Brain ReseArch INfrastructureS-Italy (EBRAINS-Italy) - CUP B51E22000150006</p>
<b>Objectives</b>	<p>The objectives of the PhD plan are the following:</p> <ol style="list-style-type: none"><li>1. Develop the competence to analyze available data from product documentation, experiments and scientific reports, for extracting features of complex components and systems.</li><li>2. Analyze the state-of-the-art of compiler technology for heterogeneous HW architectures in the data analysis and bioinformatics fields of applications.</li><li>3. Develop a general (machine learning-based) approach for partitioning a sequential data stream application, described in a high-level programming language, into elementary computation tiles (kernels).</li><li>4. Design a reliable methodology for placing the elementary kernels on the devices available on the target heterogeneous systems, together with the generation of the inter-task communication interfaces.</li><li>5. Design of proof-of-concept experiments for demonstrating that the developed partitioning and allocation methodology succeeds in better exploiting the resources of heterogeneous HW, by reducing the execution time and/or the power consumption of an application.</li><li>6. Provide a framework for configuring heterogeneous embedded systems in a semi-automatic way, to further facilitate the optimized porting of applications on</li></ol>

the emerging heterogeneous systems.

The activities of research mentioned above will focus on three primary areas of application:

- Medical and bioinformatics data stream analysis;
- Video surveillance and object recognition;
- Smart energy system.

The candidate will design optimized bioinformatics tools to accelerate and optimize data analytics tasks, with a particular focus on the analysis of RNA molecules and the simulation of brain neural structures.

In the project, the candidate will target several emerging HW technologies such as FPGA, GPU, Neuromorphic platforms, and parallel architectures. Neuromorphic technology will be strongly integrated into the supported use cases.

**Skills and competencies for the development of the activity**

MS degree in computer engineering and electronics engineering.

Excellent skills in computer programming.

Technical background in electronic design, modeling, simulation and optimization.