



PhD in INGEGNERIA DELL'INFORMAZIONE / INFORMATION TECHNOLOGY - 40th cycle

Research Area n. 1 - Computer Science and Engineering

PNRR 630 Research Field: DESIGN AND DEVELOPMENT OF COMPUTER ARCHITECTURES
FOR THE ANALYSIS OF GENOMIC AND MULTI-OMIC KNOWLEDGE GRAPHS

Monthly net income of PhDscholarship (max 36 months)

€ 1500.0

In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity

Motivation and objectives of the research in this field

Objectives:

This project aims to revolutionize the field of genomic and multi-omic analysis through the development and implementation of advanced tools and computer architectures for generative artificial intelligence. The main goal is to make the analysis of large biological datasets not only more efficient but also more accessible, promoting the widespread adoption of genomic and multi-omic techniques in biomedical and environmental research.

Motivation:

Genomic and multi-omic technologies are essential for understanding complex biological mechanisms and for developing new therapeutic and diagnostic strategies. However, the complexity and the sheer volume of data generated pose significant challenges for analysts and researchers. The use of generative artificial intelligence can provide innovative solutions for simplifying and automating the analysis of such data. In this context, novel computer architectures that make GenAI more efficient are needed to enable the broader application of omic techniques even in resource-limited environments.

Expected Impact:



	<p>The success of this project could significantly lower the technical and economic barriers that currently limit the use of genomic and multi-omic analyses. This could not only accelerate scientific research but also democratize access to omic technologies, with profound impacts both in the health and environmental sectors. Furthermore, the integration of generative AI opens new frontiers for personalized medicine and environmental conservation, with the potential to radically transform the way biological information is interpreted and used. The adoption of generative AI tools for the analysis of genomic and multi-omic knowledge graphs will not only enhance our ability to understand life at the molecular level but also provide essential tools to address some of the most urgent health and environmental challenges of our time.</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<ol style="list-style-type: none"> 1. Development and application of Generative Algorithms: The candidate will create and implement advanced machine learning algorithms that can generate new insights from vast genomic and multi-omic knowledge graphs, facilitating scientific discoveries previously unattainable. 2. Design and prototyping of Computer Architectures for generative AI: The analysis of the developed generative algorithms will highlight their computational bottlenecks. The candidate will explore different heterogeneous architectures to make the computation faster and more energy efficient. 3. AI Tools for Omic Analysis: The candidate will implement software platforms that integrate hardware-accelerated generative AI for the automatic interpretation of patterns and the prediction of phenotypes from genomic and multi-omic data. 4. Validation and Benchmarking: The candidate will validate the developed methods against standard reference datasets to ensure their effectiveness and accuracy.
<p>Educational objectives</p>	<p>Acquire all the necessary knowledge and disseminate the findings of the research</p>
<p>Job opportunities</p>	<p>Bioinformatician</p>



Composition of the research group	1 Full Professors 0 Associated Professors 0 Assistant Professors 2 PhD Students
Name of the research directors	Prof. Marco Domenico Santambrogio

Contacts	
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Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	750.0 €
By number of months	6

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	GenoGra s.r.l. (Milano)
By number of months at the company	12
Institution or company where the candidate will spend the period abroad (name and brief description)	Lawrence Berkeley National Laboratory (USA)
By number of months abroad	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<p>EDUCATIONAL ACTIVITIES (purchase of study books and material, including computers, funding for participation in courses, summer schools, workshops and conferences): financial aid per PhD student.</p> <p>TEACHING ASSISTANTSHIP: availability of funding in recognition of supporting teaching activities by the PhD student. There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.</p> <p>COMPUTER AVAILABILITY: 1st year: Yes 2nd year: Yes 3rd year: Yes</p>