



PhD in INGEGNERIA DELL'INFORMAZIONE / INFORMATION TECHNOLOGY - 38th cycle

Research Area n. 1 - Computer Science and Engineering

PNRR_352 Research Field: CLOUD COMPUTING, VIRTUALISATION AND MICROSERVICES

Monthly net income of PhDscholarship (max 36 months)

€ 1400.0

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

Cloud computing is becoming a major enabler for many software systems because of the computing resources, predefined components, and integration options it offers. Nowadays, besides conventional computing resources (e.g., virtual machines and containers), many cloud infrastructures also offer high-performance computing (HPC) systems that offer yet another means to address computation intensive problems (e.g., complex graph-based computations and ML tasks), but the integration between different resource types is still in the first phases, and more appropriate solutions have still to be conceived. Besides being able to orchestrate the computation on the different executors, there is also a problem of data exchange and availability, where data must be offered properly and by means of the right formats without introducing tedious bottlenecks in the resulting system.

This research starts from the aforementioned problems, and the idea of slicing the global computation through proper microservices, and containers, to identify appropriate (software) architectures, interaction means, and data exchange solutions and allow for the quality conception of these data-intensive heterogenous systems and for their efficient operation and management. The use of self-adaptiveness to manage data and resources dynamically and the inclusion of edge nodes in the infrastructure of interest could be additional dimensions



	<p>touched by the proposed research.</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>The work is in the context of complex cloud-based systems and will heavily exploit the advanced and private computing resources (private cloud, HPC, and edge infrastructures) made available by the partner company. This means that the candidate will become proficient in all the methods, techniques, and technologies available to conceive these systems and operate and manage them properly. These elements span from more theoretical enablers (based, for example, on control theory or queuing networks) to concrete and well-known technologies available as either proprietary products (e.g., the well-known solutions proposed by the main cloud vendors) or open-source projects (e.g., the many Apache-supported projects).</p> <p>The candidate will then start from these enablers and will conceive her/his proposal by extending and composing them, but also by developing new methods, solutions, and tools aimed to address the problems of interest.</p> <p>The availability of a real cloud/HPC/edge infrastructure, contributed by the partner company will offer a unique opportunity to validate produced ideas and artifacts on real problems, on a wide-enough infrastructure, and in a real context.</p>
<p>Educational objectives</p>	<p>Besides offering the opportunity of starting a PhD program at the Politecnico di Milano, along with all its "standard" educational objectives, this proposal will offer the candidate the unique opportunity of becoming an expert in a very modern and trendy class of complex, distributed computing systems. The theoretical foundations will be complemented by deep knowledge of all the main technologies and by concrete experiences on real problems and systems (given the active role of the partner company). All PhD candidates are offered: general-purpose educational opportunities, e.g., on soft skills and other foundational aspects, through courses and seminars, and high-quality training on topics the related to the problems and solutions touched while carrying out the assigned research. In addition, this joint academia-industry proposal will also offer training on state-of-the-art</p>



	cloud/HPC/edge infrastructures and on the specific domains and problems addressed by the partner company.
Job opportunities	The concepts and technologies touched by this research proposal offer different job opportunities. The candidate will become an expert in: (a) modern software engineering, (b) cloud computing systems, (c) cloud-based system operation and management, (d) HPC systems, and (e) edge computing. All these elements are highly requested by the current ICT market both in the Italian context and worldwide.
Composition of the research group	1 Full Professors 0 Associated Professors 2 Assistant Professors 2 PhD Students
Name of the research directors	Prof. Luciano Baresi / Luigi Capone (Leonardo spa)

Contacts	
luciano.baresi@polimi.it	
+39 02 2399 3638	
https://baresi.faculty.polimi.it	

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	700.0 €
By number of months	6

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	Leonardo S.p.A (https://www.leonardo.com/it/home)
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	TU Vienna (https://www.tuwien.at)
By number of months abroad	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information



Attinenza alle tematiche, alle missioni/componenti prescelte del bando PNRR v. D.M. 352, art.6

La ricerca si propone di sviluppare strumenti di base per realizzare sistemi cloud-based più complessi, più velocemente e con maggior qualità. La proposta si inquadra nella Missione 4, componente 2 "Dalla Ricerca all'Impresa" - Investimento 3.3 "Introduzione di dottorati innovativi che rispondono ai fabbisogni di innovazione delle imprese e promuovono l'assunzione dei ricercatori dalle imprese".

Pur trattando una tematica ortogonale a molti domini applicativi specifici, considerando anche l'azienda cofinanziatrice, la ricerca si adatta anche alle richieste della missione 1: digitalizzazione, innovazione, competitività, cultura e turismo, dove si parla di "M1C2 - Digitalizzazione, innovazione e competitività nel sistema produttivo" e di "sostegno alle filiere e all'internazionalizzazione e investimenti nel settore aerospaziale" (Leonardo è società leader mondiale nel settore aerospaziale)

Impresa, presso cui si svolgerà l'attività esterna

Leonardo S.p.A, aerospazio, difesa e sicurezza, <https://www.leonardo.com/it/home>, 6 mesi, l'idea è di continuare lo sviluppo delle idee e delle soluzioni concordate, consentendo al candidato di toccare con mano i problemi dell'azienda e di lavorare con i ricercatori dedicati al progetto. Il periodo in azienda sarà anche l'occasione, principale, per usare gli strumenti di calcolo HPC e edge, messi a disposizione dall'azienda.

Ente, università, azienda, centro di ricerca presso cui si svolgerà il periodo di studio e ricerca all'estero

Tu Vienna, <https://www.tuwien.at>, 6 mesi, come sopra, le attività previste saranno la continuazione della ricerca in un contesto e con punti di vista diversi da quelli nazionali. Il proponente ha una collaborazione in essere da diversi anni con il gruppo del professor Schahram Dustdar.

All information regarding educational activities, personal funding, regulations and obligations of Ph.D. candidates are available on the web site <https://dottoratoit.deib.polimi.it/>