



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

Research Area n. 1 - Computer Science and Engineering

Number of scholarship offered	7
Department	DIPARTIMENTO DI ELETTRONICA, INFORMAZIONE E BIOINGEGNERIA

Description of the Research Area
<p>The research in the Computer Science and Engineering Area of the PhD Programme in Information Technology at the Department of Electronics, Information and Bioengineering (DEIB) is organized along these lines:</p> <ul style="list-style-type: none"> • System Architectures, which deals with digital systems architecture and design methodologies for concurrent development of hardware and software components for embedded digital systems, including multi-core, reconfigurable and adaptive platforms. • Data, web, and society: the research in this area addresses technologies, design methods, and tools for data management systems, information management and querying on the Web, and multimedia and multichannel communication. • Artificial intelligence and robotics, devoted to the integration of Machine Learning, Computational Intelligence, Intelligent Data Analysis, Robotics, and Artificial Intelligence techniques for the development of intelligent systems and autonomous agents. • Advanced software architectures and methodologies, which is focused on techniques, tools and frameworks for the development of complex software systems, characterized as distributed, pervasive, adaptive, reconfigurable, dynamic and critical. • Information Systems, which deals with service-based and adaptive information systems, IT cost evaluation, and in particular green ICT and green software, information quality and security, and Web reputation, including semantic categorization and sentiment analysis of social media. <p>Further information:</p> <ul style="list-style-type: none"> - Research at the DEIB Department: https://www.deib.polimi.it/eng/ - PhD Programme in Information Technology (IT PhD): https://dottoratoit.deib.polimi.it/ - Computer Science and Engineering Section at DEIB: https://www.deib.polimi.it/eng/computer-science-and-engineering



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THEMATIC Research Field: **LEARNING AND ADAPTATION IN DISTRIBUTED ENVIRONMENTS**

Monthly net income of PhDscholarship (max 36 months)

€ 1400.0

In case of a change of the welfare rates or of changes of the scholarship minimum amount from the Ministry of University and Research, during the three-year period, the amount could be modified.

Context of the research activity

Motivation and objectives of the research in this field

Machine Learning (ML) research has seen an increasing interest in the design of novel algorithms and techniques to:

- **Learn in a distributed** and privacy-preserving manner the backbone models to be employed/customized in individual devices at the edge.
- **Automatically detect** whether the operating conditions for a ML model depart from the nominal ones where that was originally trained. This includes detecting faults and tampering.
- **Autonomously adapt models** running on devices to track the dynamics of the data-generating process.

These research directions are of primary concern for STMicroelectronics research who develops embedded devices for industrial monitoring and for wellness/health monitoring. This grant follows a fruitful collaboration between the research teams and an example of research outcomes can be found at https://boracchi.faculty.polimi.it/Projects/ECG_Monitoring/IJCAI_2018_Demo.html

Methods and techniques that will be developed and used to carry out the research

The PhD candidate will pursue fundamental research in any of the following directions with application in scenarios of interest to STMicroelectronics:



	<ul style="list-style-type: none"> • Distributed Learning / Personalization: Centralized learning is the mainstream learning paradigm, requiring multiple devices to share the entirety of their acquired raw data. This solution has several drawbacks including communication overhead and, most importantly, raises privacy concerns since collected data might contain sensitive information. The PhD candidate will become acquainted with the federated learning literature and design algorithms to distribute the learning process among devices. • Autonomous Adaptation to Nonstationarities: A model learned from data acquired in an initial training session might no longer describe data acquired during long-term monitoring sessions. Such a mismatch typically produces a large amount of false alarms. Therefore, to avoid performance degradation, the PhD candidate will design algorithms to detect changes and adapt data-driven models to the custom operating conditions of each device.
Educational objectives	The PhD candidate will develop a strong background in machine learning and applied statistics, together with very practical engineering skills thanks to the strict collaboration with our industrial partners.
Job opportunities	The PhD candidate will address fundamental problems with a broad applicability in the field of machine learning. A PhD graduate with such a background can be very valuable in STMicroelectronics as well as many other large companies / SME.
Composition of the research group	0 Full Professors 1 Associated Professors 1 Assistant Professors 6 PhD Students
Name of the research directors	Giacomo Boracchi

Contacts

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<https://boracchi.faculty.polimi.it/>

Additional support - Financial aid per PhD student per year (gross amount)			
	1st year	2nd year	3rd year
Housing - Foreign Students	1500.0 € per student	1000.0 € per student	1000.0 € per student
	max number of financial aid available: 4, given in order of merit ..		
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

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

LIST OF UNIVERSITIES, COMPANIES, AGENCIES AND/OR NATIONAL OR INTERNATIONAL INSTITUTIONS THAT ARE COOPERATING IN THE RESEARCH: Politecnico di Milano; ST Microelectronics, SRA; Tampere University

The PhD will be co-supervised by the Applied Math team in SRA (System Research and Application) at STMicroelectronics. The Applied Math team features 3 senior researchers and a few PhD/MSs students that are hired as interns in STMicroelectronics. The PhD candidate will be asked to contribute to the MSs students' supervision, and to collaborate with STMicroelectronics.

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
5.707,13 € per student

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.

COMPUTER AVAILABILITY:
1st year: individual use
2nd year: individual use
3rd year: individual use

DESK AVAILABILITY:
1st year: individual use



2nd year: individual use
3rd year: individual use