



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

Research Area n. 1 - Computer Science and Engineering

**THEMATIC Research Field: DESIGN, OPTIMIZATION, AND VALIDATION OF INTEGRATED
GENERATIVE AI, EXPLAINABILITY, AND NEURO-SYMBOLIC METHODS FOR
RECOMMENDATIONS AND DECISION SUPPORT IN ENERGY MANAGEMENT AND OTHER
VERTICAL DOMAINS**

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**

The European Green Deal emphasizes the development of new services and business models based on artificial intelligence for the Energy Sector, targeting different industries and a broad set of application domains. In an Energy Sector that requires a clean energy transition thanks to the decarbonization and to the switch to renewable energy sources, achieving energy efficiency goals is mandatory. In the current scenario, modern industries have a large amount of IoT data streams that needs to be analyzed and interpreted effectively to ensure this transition. In the environment of Electrical and Software Engineering for Energy Sector services, the key challenges for the future will be focused on the use of data-driven approaches based on Artificial Intelligence (AI) to prioritise energy efficiency, also improving the energy performance of the buildings and enhancing the benefits of the smart grids. Another key aspect is the need of transparency behind the proposed data-driven approach. For this purpose, all of the AI-powered data analysis phases need to be completely explainable and transparent, to be compliant with the EU Artificial Intelligence Act. This can be assured thanks to the development of inherently explainable AI models or



	<p>thanks to a fairly new research field called eXplainable Artificial Intelligence (XAI). The ultimate goal is to boost energy efficiency by empowering consumers and promoting efficient energy standards. This can be done thanks to the use of a AI-powered recommender system, that will be able to provide users with recommendations on energy consumption and efficiency and easily consultable insights, also by relying on the use of a Large Language Model (LLM).</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>The main objective of this Ph.D. program is to develop and validate models, methods, and implementations that usedata-driven approaches based on Artificial Intelligence (AI) and eXplainable AI to maximize energy efficiency by empowering consumers thanks to an LLM-powered recommender system. This Ph.D. program will cover the following phases towards its final the research objectives:</p> <ul style="list-style-type: none"> - To review the literature on Data Analysis both from a historical and a streaming perspective, IoT, Artificial Intelligence (AI) and eXplainable AI, Recommender Systems, and Large Language Models. - To design and develop a recommender system and AI-powered data-driven methodology specifically targeting a diverse set of energy sources, spanning streaming data, historic data, IoT data. - To evaluate the effectiveness and efficiency of the proposed methods through experiments, case studies, and user feedback - To propose guidelines for implementing industrial deployments of the proposed approaches. - To feed the process with data available in the consortium database.
<p>Educational objectives</p>	<p>The main educational objectives are:</p> <ul style="list-style-type: none"> - Consolidate background on Electrical and Software Engineering topics, such as energy management and efficiency, Data and Data Streams Analysis, Artificial Intelligence, eXplainable AI, Recommender Systems, Large Language Models - Develop theoretical frameworks for the scenario described in the objectives - Develop experimental know-how in the field and



	<p>integrate multidisciplinary skills aiming at supporting and implementing the solution in the Energy Sector application scenario.</p> <ul style="list-style-type: none"> - Achieve soft skills particularly related to technology transfer and entrepreneurship
Job opportunities	<p>After completing this Ph.D. program, the candidate can pursue various job opportunities spanning multiple industries and roles.</p> <ul style="list-style-type: none"> - Artificial Intelligence Expert who is responsible for designing and maintaining an organization's AI system. - eXplainable Artificial Intelligence Expert who is responsible for the transparency of the developed AI system, to assure its robustness and to be compliant with the regulation laws. - Data Analyst who focuses on analyzing data from different sources and ensuring that the data is accurate and consistent. - Data Management Consultant who advises organizations on how to manage and integrate data effectively to support their business objectives. - Recommender System Management Expert who is specialized in developing, maintaining and integrating Recommender Systems in broader data-centric projects in organizations. - Business Intelligence Analyst who is responsible for gathering and analyzing data from various sources to provide insights and support decision-making. - Research Scientist who develops new data analysis technologies and applies them to solve complex problems in the Energy Sector
Composition of the research group	<p>3 Full Professors 2 Associated Professors 4 Assistant Professors 5 PhD Students</p>
Name of the research directors	Prof. Marco Brambilla, Prof. Piero Fraternali

Contacts
marco.brambilla@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

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 (5.707,20 Euro per 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:</p> <p>1st year: Yes</p> <p>2nd year: Yes</p> <p>3rd year: Yes</p>