POLITECNICO DI MILANO

PhD in BIOINGEGNERIA / BIOENGINEERING - 39th cycle

THEMATIC Research Field: EXPLAINABLE ARTIFICIAL INTELLIGENCE TO PREDICT TREATMENT RESPONSE AND SURVIVAL IN NSCLC USING MULTIMODAL DATA

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	Lung cancer is a major health concern and the leading cause of cancer-related deaths globally. Non-Small Cell Lung Cancer (NSCLC) accounts for approximately 85% of all lung cancers. Despite recent advances in treatment, such as immunotherapy, the survival rate for NSCLC patients remains low, and identifying the most effective treatment for individual patients remains challenging. This PhD program aims to exploit an eXplainable Artificial Intelligence (XAI) approach to predict immunotherapy treatment response and survival in Non-Small Cell Lung Cancer (NSCLC) patients using multimodal data. This research project aims to combine different types of data - clinical and demographic information, imaging data from radiology and pathology, and molecular data such as genomics, transcriptomics, and epigenomics - to develop machine learning and deep learning models that can predict the response to immunotherapy treatment and survival rates in NSCLC patients. However, these models can often be complex and difficult to understand, which is why different XAI (eXplainable Artificial Intelligence) methodologies to improve their transparency will be used. The ultimate goal is to create models that can be easily understood by clinicians and patients, rather than just being seen as "black-boxes" due to their complexity. The proposed research activity will contribute to developing explainable, accurate and personalized approaches for immunotherapy treatment response prediction and survival estimation, which could improve patient

	outcomes. In addition, the developed XAI-based approaches could be externally validated using the data from different institutions and applied to other types of cancers and treatments. The PhD student will have the opportunity to work on a cutting-edge research topic, collaborate with clinicians and researchers from different disciplines.
Methods and techniques that will be developed and used to carry out the research	To achieve the research objectives, the PhD student will be trained in various techniques and methods, including, deep learning, explainable AI (XAI), data and statistical analysis. The candidate will be involved in standardization of the data for analysis.The PhD candidate will build on already-developed pipelines for unimodal data, such as radiomics and real-world data, and will work on advancing these pipelines by adapting them to integrate multimodal data (including digital pathological slide images and mulitomics data, such as genomics, transcriptomics, epigenomics, proteomics and metabolomics). Finally the candidate will develop different XAI approaches to make the reasoning behind the model's decision making understandable to end-users, medical oncologists and patients. The candidate will collaborate closely with medical oncologists from the Istituto Nazionale dei Tumori through the I3LUNG project (https://i3lung.eu/). During this collaboration the candidate will develop a better understanding of the clinical needs and data requirements for predicting treatment response and survival in NSCLC patients. The candidate will have access to advanced computing resources, including high-performance computing and cloud-based services. Overall, the candidate will gain a unique blend of technical and clinical expertise in the field of AI and medical oncology.
Educational objectives	Our PhD program in Bioengineering offers advanced scientific training that enhances the research and problem-solving skills of doctoral candidates. The program focuses on both theoretical and experimental skills to foster high-level scientific competence. Upon completion, graduates will possess the ability to independently develop and execute original research,

	either by leading a research group or working collaboratively within a team.
Job opportunities	After finishing the PhD, the candidate can pursue a career in academia or the industry, as the research program involves interdisciplinary knowledge in AI, medicine, and data analysis. Potential job opportunities include positions as a data scientist, AI engineer, medical researcher, or consultant. The candidate may also consider pursuing a postdoctoral fellowship to continue research in the field or start their own research program. Additionally, the candidate may have opportunities to collaborate with medical institutions and hospitals to implement the developed AI models into clinical practice.
Composition of the research group	3 Full Professors 1 Associated Professors 3 Assistant Professors 16 PhD Students
Name of the research directors	PROF ALESSNDRA PEDROCCHI

Contacts
Alessandra Laura Giulia Pedrocchi alessandra.pedrocchi@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
Two research units will be involved in this project: the Neuroengineering section of the NEARLAB, within the Department of Electronics, Information and Bioengineering of Politecnico di Milano https://nearlab.polimi.it/ and research partner, coordinator or I3LUNG project, Fondazione IRCCS Istituto Nazionale Tumori di Milano (Thoracic Unit) The PhD student will be involved in educational activities along with teaching assistantship.A

shared desk and computer will be given to the student for the time needed to carry out the research.