BIOENGINEERING AND MEDICAL-SURGICAL SCIENCES

Ateneo/DET - PROMISE-AI: Predictive Model for Precision Oncology using Multimodality Data and Artificial Intelligence

Funded By	Politecnico di TORINO [P.iva/CF:00518460019] Dipartimento DET
Supervisor	MOLINARI FILIPPO - filippo.molinari@polito.it
Contact	SALVI MASSIMO - massimo.salvi@polito.it MEIBURGER KRISTEN MARIKO - kristen.meiburger@polito.it
Context of the research activity	The context of this research activity lies in developing and refining multimodality predictive approaches for precision oncology. By incorporating various modalities of data, we can capture a more complete and nuanced picture of cancer biology, tumor characteristics, and patient-specific factors. Clinical data, such as patient demographics and treatment history, can further contribute to the overall understanding of the disease.
Objectives	The field of oncology has witnessed significant advancements in recent years, particularly in the area of precision medicine. Precision oncology aims to tailor cancer treatment strategies to individual patients by considering their unique genetic, molecular, and clinical characteristics. This approach has shown great promise in improving patient outcomes and minimizing unnecessary treatments and adverse effects. However, despite these advancements, several challenges remain in accurately predicting treatment responses and outcomes. One of the key challenges in precision oncology is the complexity and heterogeneity of cancer. Cancer is a multifaceted disease that can vary greatly across individuals and even within the same patient. To address this complexity, a multimodal approach that integrates multiple sources of data is crucial. Multimodality refers to the combination of diverse data types, such as genomics, proteomics, imaging, and clinical data, to gain a comprehensive understanding of the disease and improve predictive models. The PhD project on multimodality predictive approaches for precision oncology will have the following main objectives, which the candidate will be required to accomplish: - Develop a framework to integrate diverse data types, including genomics, proteomics, imaging, and clinical data, to create a comprehensive and cohesive dataset for precision oncology. - Develop advanced algorithms for data preprocessing, normalization, and

	fusion techniques to ensure compatibility and meaningful integration of different modalities. - Design and implement AI-based predictive models that leverage the multimodality data. These models will aim to predict treatment responses, identify patients at risk for adverse events, and guide the selection of targeted therapies. - Validate the developed predictive models using independent datasets or, if feasible, in collaboration with clinical trials. With access to the extensive multimodal data collected from DIPAT3-CARE projects, the candidate will employ advanced computational techniques and AI algorithms to develop predictive models for prostate cancer and aggressive lymphomas. At the end of the PhD activity, the candidate will consolidate the findings and propose a complete framework for multimodality predictive approaches in precision oncology. This framework will encompass the entire workflow, from data acquisition and integration to model development and validation.

Skills and competencies for the development of the activity	The candidate must have a Master's Degree in Biomedical Engineering and possess previous experience in the analysis of digital pathology images. Specifically, the successful candidate should demonstrate a strong and documented expertise in the following areas: • Digital pathology: In-depth knowledge and experience in the field of digital pathology, including the acquisition, processing, and analysis of digital pathology images. • Color imaging: Proficiency in color imaging techniques and the ability to work with color images in the context of digital pathology. • Deep learning-based methods: Extensive experience and expertise in the development and application of deep learning models for image generation, segmentation, and classification tasks. This includes knowledge of convolutional neural networks (CNNs), GANs, diffusion models and semantic segmentation. • Multi-modal data fusion: Basic expertise in integrating and fusing data from multiple modalities in the context of digital pathology. Additionally, programming skills and experience in implementing deep learning models in Python are highly appreciated. While not required, hands-on experience with digital pathology systems would be beneficial for the candidate.