POLITECNICO DI MILANO

PhD in DATA ANALYTICS AND DECISION SCIENCES - 39th cycle

THEMATIC Research Field: CAUSAL INFERENCE IN ARTIFICIAL INTELLIGENCE WITH APPLICATION TO HEALTH DATA SCIENCE

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	Considerable progress has been made in predictive systems for healthcare following the advent of powerful machine learning (ML) approaches. In healthcare, clinical decision support (CDS) tools make predictions for tasks such as detection, classification and/or segmentation from electronic health record (EHR) data such as medical images, clinical text notes, blood tests and genetic data. These systems are usually trained with supervised learning techniques. However, most CDS systems powered by ML techniques learn only associations between variables in the data, without distinguishing between causal relationships and (spurious) correlations. CDS systems targeted at precision medicine need to answer complex queries about how individuals would respond to interventions.A major upstream challenge in healthcare becomes then how to acquire the necessary information to causally reason about treatments and outcomes. Modern healthcare data are multi-modal, high-dimensional and often unstructured. In addition, many diseases are progressive over time, thus necessitating that the temporal dimension is taken into account. Finally, any system must ensure that these predictions will be generalizable across deployment environments such as different hospitals, cities or countries. Causal Inference (CI) can help alleviate these challenges. ML allows causal models to process high-dimensional and unstructured data by learning complex nonlinear relations between variables. CI adds an extra layer of understanding about a

	system with expert knowledge, which improves information merging from multi-modal data, generalization and explainability of current ML systems.
Methods and techniques that will be developed and used to carry out the research	•Causal Inference •Graphical models •Structural Causal Models •Bayesian Networks
Educational objectives	To be able to critically analyse, model, ask and answer pertinent biological questions from data. To develop skills in statistical data analysis, machine learning, causal inference and their application to human genetics research and to epidemiological studies carried out over secondary databases.
Job opportunities	The profile proposed here are broadly relevant for a range of employers including (but not limited to): public and private healthcare institutions, hospitals, clinical and pharmaceutical companies, technology, and biotech companies, as well as Research institutes in healthcare domain.
Composition of the research group	1 Full Professors 3 Associated Professors 3 Assistant Professors 3 PhD Students
Name of the research directors	Prof. E. DiAngelantonio & Prof. P. Secchi

Contacts
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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	12

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
Further support is available for students who engage in activities of teaching or additional lab duties coherent with their academic mission and doctoral training.The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.