

PhD in Physics

Research Title:

Inference and control of dynamic processes on large-scale networks: from data to models

Funded by	Politecnico di Torino through the "SmartData@PoliTo" Center
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Context of the research activity	<p>The research activity will focus on a class of inference problems defined starting from data that are the output of dynamical processes occurring on networks. An example, already object of study in the framework of SmartData@PoliTo and within a national research project (PRIN) obtained by the supervisors, is the inference of contagion channels between farms starting from the partial knowledge of cattle movements and epidemiological data provided by the Italian National Bovine Registry. In such a context, successful approximate inference methods require to include in the probabilistic modeling some partial information of the underlying dynamical process. This can be done by means of advanced mean-field methods developed in the statistical mechanics of disordered systems. In the same framework, it is also possible to develop computational methods for the control of dynamical processes (e.g. containment of epidemic spread). In addition to the supervisors, the PhD student will be directly supported by a team of researchers (Prof. A. Braunstein, Dr. I. Biazio) with years of experience in the field, and will have the opportunity to interact with others, belonging to the SmartData@PoliTo Center, with interests in similar topics (big data analysis, inference and machine learning techniques, control methods) .</p> <p>In this respect, the research activity fits in the SmartData@PoliTo interdepartmental centre, that brings together competences from different fields, ranging from modelling to computer</p>
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	programming, from communications to statistics. The candidate will join this interdisciplinary team of experts and collaborate with them.
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Objectives	The main objective of this thesis is the development and improvement of approximate inference methods for dynamical processes on network. The PhD student will become familiar with the most advanced techniques in the field, both from statistical mechanics and machine learning community, and will learn how to deal with large datasets and perform data analysis. Such cutting-edge theoretical notions and computational techniques will be possibly very useful for his/her future career, both in academic research and in the industrial applications of the ICT sector.
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Skills and competencies for the development of the activity	<p>The candidate should have a good knowledge of:</p> <ul style="list-style-type: none"> - basic theoretical and algorithmic methods in approximate inference (e.g. mean-field variational methods); - statistical physics of disordered systems and stochastic processes; - basic machine learning techniques (desirable but not mandatory); - Python, C++ or Julia languages. <p>A strong, genuine interest in data analysis is welcome.</p>
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