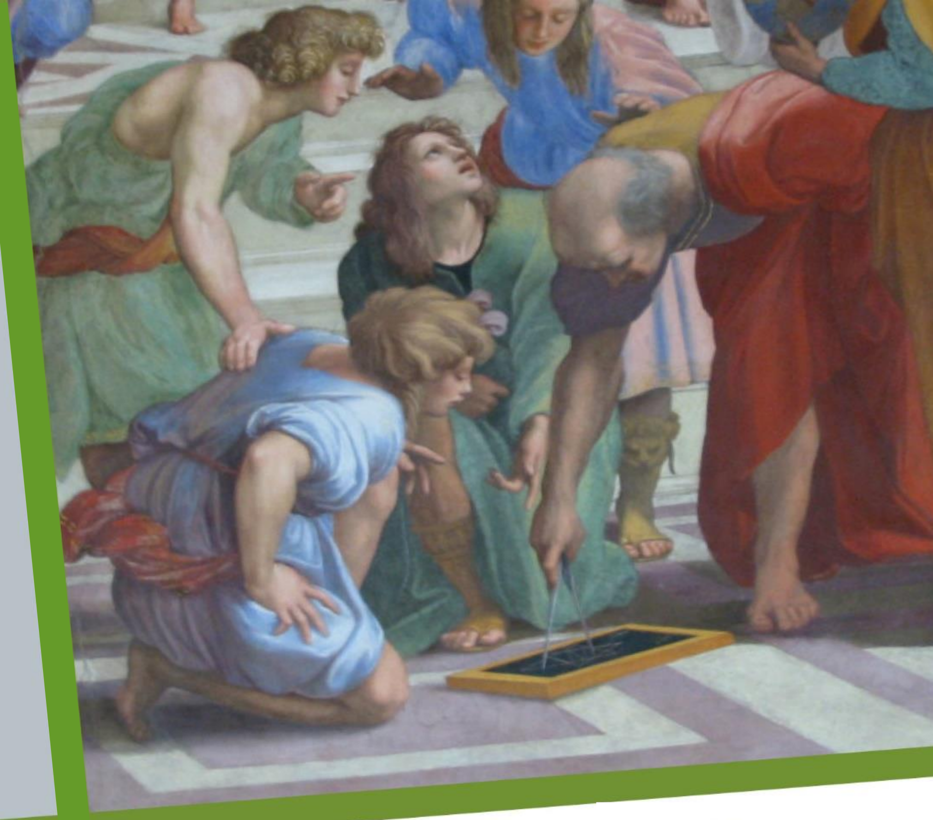
UNIVERSITÀ DI TRENTO
Dipartimento di Matematica



DOTTORATO

CYCLE 34th
ORAL DEFENCE OF THE PHD THESIS

Monday 13 June 2022 – at 11:00 am
Seminar room "-1"

The event will take place in presence and online through the ZOOM platform.
To get the access codes please contact the secretary office

Giulia Bertagnolli

PhD Student in Mathematics

Modelling the process-driven geometry of complex networks

Abstract:
Graphs are a great tool for representing complex physical and social systems, where the interactions among many units, from tens of animal species in a food-web, to millions of users in a social network, give rise to emergent, complex system behaviours. In the field of network science this representation, which is usually called a complex network, can be complicated at will to better represent the real system under study. For instance, interactions may be directed or may differ in their strength or cost, leading to directed weighted networks, but they may also depend on time, like in temporal networks, or nodes (i.e. the units of the system) may interact in different ways, in which case edge-coloured multi-graphs and multi-layer networks represent better the system. Besides this rich repertoire of network structures, we cannot forgot that edges represent interactions and that this interactions are not static, but are, instead, purposely established to reach some function of the system, as for instance, routing people and goods through a transportation network or cognition, through the exchange of neuro-physiological signals in the brain. Building on the foundations of spectral graph theory, of non-linear dimensionality reduction and diffusion maps, and of the recently introduced diffusion distance [Phys. Rev. Lett. 118, 168301 (2017)] we use the simple yet powerful tool of continuous-time Markov chains on networks to model their process-driven geometry and characterise their functional shape. The main results are: (i) the generalisation of the diffusion geometry framework to different types of interconnected systems (from edge-coloured multigraphs to multi-layer networks) and of random walk dynamics [Phys. Rev. E 103, 042301 (2021)] and (ii) the introduction of new descriptors based on the diffusion geometry to quantify and describe the micro- (through the network depth [J. Complex Netw. 8, 4 (2020)]), meso- (functional rich-club) and macro-scale (using statistics of the pairwise distances between the network's nodes [Comm. Phys. 4, 125 (2021)]) of complex networks.

Supervisor: Prof. Manlio De Domenico
Co-supervisor: Prof. Claudio Agostinelli

CONTATTI
Staff di Dipartimento - Matematica
tel. 0461 281508-1625-1701-3786
phd.maths@unitn.it
www.maths.unitn.it