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Online seminar

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Hosted on: Zoom

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A Framework to Differentiate Persistent Homology with Applications in Machine Learning and Statistics

Prof. Vaccarino introduces the seminar.

Abstract

Understanding the differentiable structure of persistent homology and solving optimization tasks based on functions and losses with a topological flavor is a very active, growing field of research in data science and Topological Data Analysis, with applications in non-convex optimization, statistics and machine learning. However, the approaches proposed in the literature are usually anchored to a specific application and/or topological construction, and do not come with theoretical guarantees. In this talk, we will study the differentiability of a general map associated with the most common topological construction, that is, the persistence map. Building on real analytic geometry arguments, we propose a general framework that allows to define and compute gradients for persistence-based functions in a very simple way. As an application, we also provide a simple, explicit and sufficient condition for convergence of stochastic subgradient methods for such functions. If time permits, as another application, we will also show how this framework combined with standard geometric measure theory arguments leads to results on the statistical behavior of persistence diagrams of filtrations built on top of random point clouds.

Biography

Frédéric Chazal is a Directeur de Recherche (senior researcher) at INRIA Saclay Île-de-France since 2007. After a PhD in pure mathematics, he oriented his research to computational geometry and topology. He is now leading the DataShape team at INRIA, a group working on Topological Data Analysis (TDA), a recent fast growing field at the crossing of mathematics, statistics, machine learning and computer science. He is also the head of the DATAIA Institute at Université Paris-Saclay. Frederic's contributions to the field go from fundamental mathematical aspects to algorithmic and applied problems. He published more than 90 papers in major computer sciences conferences and mathematics journals, he co-authored 2 reference books and 3 patents. He is the Editor-in-Chief of the Journal of Applied and Computational Topology (Springer), and he is or has been, also an associate editor of 3 other international journals: Discrete and Computational Geometry (Springer), SIAM Journal on Imaging Science, Graphical Models (Elsevier). During the last few years Frederic has been heading several national and international research projects on geometric and topological methods in statistics and machine learning. He is also the scientific head of joint industrial research projects between Inria and several companies such as Fujitsu (TDA, Machine Learning and explainable AI) or the French SME Sysnav.