Einladung
Würzburger Mathematisches Kolloquium

Julius-Maximilians-Universität Würzburg • Institut für Mathematik

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Where are all of these Cutting Edges Going? Graph-based Learning as a Statistical Problem in Geometry and Analysis

Dienstag, 18. Juni 2024 • 14:15 Uhr

Seminarraum SE41 • Humboldt-Bau (Emil-Fischer-Straße 41, 97074 Würzburg)

Der Vortrag wird auch als Zoom-Meeting übertragen: go.uniwue.de/ifmcolloquium-zoom

Abstract. The field of graph-based learning is one that is closely connected to manifold learning. It explores the following question: given a collection of data points $x_1, \ldots, x_n$ and a similarity graph over it, how can we use this graph to learn important features from the dataset and also learn about the distribution that generated it? The question becomes a geometric or analytical problem when one assumes that the sampling distribution is supported on an unknown low dimensional manifold, as it is postulated by the manifold hypothesis.

In the first part of the talk, I will give a rough overview of this field and discuss some of its literature developed in the last decade: from the analysis of variational geometric problems on large geometric graphs to the analysis of Laplacians and other differential operators for supervised and unsupervised learning tasks in the large data limit. Then I will discuss that, despite the multiple questions and answers that have been explored in this area, there are several fundamental questions in statistical theory that have been largely unexplored, all of which are essential for manifold learning. Examples of these questions include: 1) What is the best possible estimator (potentially not graph-based), from a sample efficiency perspective, for learning features of unknown manifolds from observed data? 2) What is the asymptotic efficiency of popular graph-based estimators used in unsupervised learning? I will focus on the first type of question in the context of spectral embeddings (or the learning of eigenfunctions of elliptic differential operators from data) and will present new results that can be interpreted as a first step in bridging the gap between the mathematical analysis of graph-based learning and the analysis of fundamental statistical questions like the ones mentioned above.

This talk is based on several works developed in the past decade, but its core is based on very recent work with my PhD student Chenghui Li (UW-Madison) and with Raghavendra Venkataraman (NYU).

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Alle sind herzlich eingeladen.

Die Dozentinnen und Dozenten der Mathematik