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The Reeb Graph Interleaving Distance and its Application to Data Analysis

Abstract for the Combinatorics Seminar 2016 March 15

Topological Data Analysis (TDA) is a recently emerging field which seeks to use the shape and structure of data to improve its analysis. This is often done using so-called “topological signatures” to represent the shape of the data in a simplified form. One commonly used such signature is called the Reeb graph, which represents the structure of the connected components of level sets of a real-valued function defined on a topological space. This construction deserves its name since, for nice enough pairs of topological spaces and real-valued functions, the Reeb graph is, in fact, a graph. In the data setting, the Reeb graph gives a method for simplifying a data set with a chosen filter function into a graph representing its overall structure.

I will discuss the recently defined “Reeb graph interleaving distance”, which allows us to inject an understanding of noise and similarity into these signatures. The inspiration for this distance comes from understanding the category-theoretical representations of Reeb graphs, and using this structure to translate the interleaving distance for persistence diagrams, another topological signature commonly used in TDA. This distance also provides theoretical justification for the Mapper algorithm, a frequently used tool in TDA and intuitively an approximation of the Reeb graph, by showing that it converges to the Reeb graph in this distance.

This work is joint with Vin de Silva, Amit Patel, and Bei Wang.

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Last update: **2020/01/29 19:03**

