

Topological Data Analysis

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Abstract

Topology studies the structure of spaces and maps between them. Algebraic topology uses algebraic tools to characterize these structures. It is particularly good at assembling global properties from local information. In the last century, applications of algebraic topology were mostly to other parts of mathematics. In the present century, it is becoming apparent that the tools of algebraic topology can be of great benefit in summarizing and understanding some of the large, complex, high-dimensional data sets being generated today.

I will give an introduction to the new subject of topological data analysis (TDA). I will briefly mention some of its connections to other areas of mathematics: commutative algebra, representation theory, and category theory. It also has important connections with algorithms, computations, statistics and machine learning. I will illustrate TDA with some examples from biology: brain magnetic resonance images and protein data. I will also discuss some of the many open problems in the subject.