Heather Harrington, Max Planck Institute of Molecular Cell Biology and Genetics

Application driven topological data analysis

Persistent homology (PH) is a central tool in topological data analysis. PH provides a multiscale geometric descriptor of data that is functorial, stable to perturbations and interpretable, leading to many applications in mathematics and real-world data. Frequently one starts with point cloud data, a finite subset of a metric space (eg Euclidean space) and studies the topology arising from a filtration of simplicial complexes built on the data. While this process yields an interesting nontrivial descriptor of the "shape of data", some theoretical questions remain. In this talk, we will present two directions in application-driven point cloud persistence. First, we will focus on the spaces of point clouds with the same persistence. This inverse problem asks the following: What is the shape of the fiber of the persistent homology map? We use rigidity theory to study this problem. The second problem is motivated by spatial data arising in biology, which includes outliers (eg histology) or dynamic metric spaces (eg collective dynamics). We present statistics for multiparameter persistence and then apply it to complex biological data.