Computational topology - group project

Mapper

The goal of this project is to use the Mapper algorithm to analyze the shape of the 3D object given as a cloud of points in a 3D Euclidean space.
Use the Mapper algorithm on different datasets, then compute homology for the resulting complex and compare them. You can use libraries for computing homology, but you have to implement the Mapper algorithm yourself.

The datasets can be obtained from the internet (for instance from source 1, source 2, source 3...) or you can draw your own shape in a 3D program. Make sure the end result is a 3D point-cloud that can be analyzed by your Mapper implementation (if dataset is too large, take a subsample).

Detailed description

Run a 3D version of the Mapper algorithm on each point cloud X using measurement function $f : X \to I$ and a partition U of I. Experiment with different measurement functions (z-coordinate, distance from a certain point...), partitions, clustering schemes (you can use existing clustering implementation) and make sure to make nice pictures.

For every run the output of the Mapper algorithm is a simplicial complex. Compute its persistent homology (you can implement your own algorithm or use existing ones on the internet) and compare the resulting persistent diagrams. How are the diagrams connected to the original shapes?