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SINGULAR PERSISTENT HOMOLOGY WITH GEOMETRICALLY PARALLELIZABLE COMPUTATION

BORIS GOLDFARB

Abstract. Persistent homology is a popular tool in Topological Data Analysis. It provides numerical characteristics of data sets which reflect global geometric properties. In order to be useful in practice, for example for feature generation in machine learning, it needs to be effectively computable. Classical homology is a computable topological invariant because of the Mayer-Vietoris exact and spectral sequences associated to coverings of a space. We state and prove versions of the Mayer-Vietoris theorem for persistent homology under mild and commonplace assumptions. This is done through the use of a new theory, the singular persistent homology, better suited for handling coverings of data sets. As an application, we create a distributed computational workflow where the advantage is not only or even primarily in speed improvement but in sheer feasibility for large data sets.

1. Motivation and Statement of Results

In order to describe the problem addressed in this paper, we start by recalling the standard treatment of persistent homology. This construction is designed to leverage computations in algebraic topology in order to quantify geometric properties of finite data sets. It provides a multi-scale representation of geometric features of the data, including the relations between the scales. On a more sophisticated level, one can use filtrations

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