Computational topology - group project

Cubical complexes

Introduction: Homology and persistent homology are typically computed fo filtrations arising from simplicial complexes. However, in many settings these do not provide optimal descriptions of our space. In the case of bitmap pictures, or 3D models, cubical decomposition seems more appropriate. The aim of this project is to implement homology and persistent homology algorithm for cubical complexes and test it.

A detailed description:

- Describe and implement a convenient description of 2- and 3-dimensional cubical complexes.

- Implement homology and persistent homology algorithm for cubical complexes in various coefficients.

- Test your algorithm on various datasets: images and 3D images. Try to draw the homology generators.

  See http://www.cim.mcgill.ca/~shape/benchMark/ or similar databases for examples.

- Use your algorithm to compute homology of Klein bottle, torus, and projective plane. Demonstrate how the result may depend on the coefficients.

Results: The report should include a description of cubical complexes, a pseudocode, methods of computation and their difference with respect to the classical algorithms, examples of computed homology, and division of work.

Students are encouraged to take the initiative and possibly implement their own ideas on the theme of the project.