

Efficient computations of discrete cubical homology

Nathan Kershaw

University of Western Ontario

We will present the fastest known algorithm for computing discrete cubical homology, a valuable graph invariant with a wide range of applications, including matroid theory, hyperplane arrangements, and topological data analysis. This invariant is capable of detecting certain types of "holes" within a graph, providing insight into its structure. We will begin by defining discrete cubical homology and outlining the standard approach to its computation. We will then present an algorithm designed to improve efficiency by using techniques such as faster generation of singular cubes, reducing chain complex dimensions through quotients over automorphisms, and preprocessing graphs using results from discrete homotopy theory. These advancements aim to make the invariant more accessible computationally for applications. We are now able to compute examples that were previously considered out of reach by experts. This talk is based on the paper: Kapulkin, Kershaw, Efficient computations of discrete cubical homology, arXiv:2410.09939.

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