Introduction to Topological Data Analysis

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In this mini-course we will explore both theoretical and practical foundations of *Topological Data Analysis* (TDA) - a field with a number of applications in physical, natural and social sciences in the intersection between algebraic topology, computational geometry and computational methods.

We will cover the basic tools of TDA including discretization of spaces (in the form of various point cloud-based simplicial, cubical and general CW-complexes), algorithms to compute homology and persistent homology and applications of those. We will also explore TDA tools of visualization, like mapper and ball mapper algorithms. Moreover we will present new tools of Euler Characteristic curves and profiles and show how they can be applied to standard statistics. All the concepts will be illustrated with real examples. You will also be required to perform computations on a number of toy and real-world datasets.

Literatura

[1] Edelsbrunner, Harrer (2011), *Computational Topology: An Introduction.*,

[2] P. Dłotko, *Computational and applied topology, tutorial* $https://arxiv.org/abs/1807.08607$,