Distributed algorithms for Euler characteristic curves

Davide Gurnari (IMPAN / University of Warsaw)

Monday, 6 September 2021, 15:00–15:30

The Euler Characteristic of a simplicial complex is the alternate sum of its Betti number, or equivalently alternating sum of the number of simplices of following dimension. For a filtered complex the Euler Characteristic Curve is a function that assigns an Euler number for each filtration level. ECCs are closely related to Persistence Diagrams via the Fundamental Theorem of Persistent Homology and stability with respect to the 1-Wasserstein distance can be proven under certain conditions. In this talk, I will present new techniques to compute the ECC of filtered complexes. We follow a distributed approach in which the contributions to the ECC are computed locally without having to explicitly build up the whole complex. This allows us to significatively reduce both time and memory requirements, giving us the opportunity to tackle much larger datasets compared to, for instance, persistent homology. We provide algorithms for both Vietoris-Rips complexes arising from pointclouds and cubical complexes from bitmaps of arbitrary dimension. In the former case, we also introduce a data structure to optimize the spatial search. An implementation of such algorithms is available as a scikit-learn-compatible Python package.