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Zigzag Persistent Homology and Real-valued Functions

We study the problem of computing zigzag persistence of a sequence of homology groups and study a particular sequence derived from the levelsets of a real-valued function on a topological space. The result is a local, symmetric interval descriptor of the function. Our structural results establish a connection between the zigzag pairs in this sequence and extended persistence, and in the process resolve an open question associated with the latter. Our algorithmic results not only provide a way to compute zigzag persistence for any sequence of homology groups, but combined with our structural results give a novel algorithm for computing extended persistence. This algorithm is easily parallelizable and uses (asymptotically) less memory.