

HOMOLOGICAL CLUSTERING AND SIMPLICIAL CONVOLUTIONAL NEURAL NETWORKS

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The talk has two parts. Both relate to simplicial Laplacians, which shows promise to complement traditional tools in topological data analysis.

The first part is concerned with a generalization of spectral clustering [1, 2]. In classical spectral clustering of graphs, the vertices are first embedded in Euclidean space by means of the (low-eigenvalue) eigenvectors of the graph Laplacian, then some Euclidean clustering scheme is applied, before the result is pulled back to the graph. We introduce a similar scheme for simplicial complexes that is sensitive to the homology of the complex.

In the second part of the talk, we describe how the simplicial Laplacian allows us to define simplicial convolutional networks to perform deep learning where the input and output data are cochains on a fixed underlying simplicial complex, and where the learning is sensitive to this structure. This provides a broad generalization of regular and graph-based CNNs [3].

REFERENCES

- [1] Fan Chung: *Spectral graph theory*. AMS (1997).
- [2] Andrew Y. Ng, Michael I. Jordan and Yair Weiss: *On Spectral Clustering: Analysis and an algorithm*. Advances in neural information processing systems (2002), 849–856.
- [3] Michaël Defferrard, Xavier Bresson and Pierre Vandergheynst: *Convolutional neural networks on graphs with fast localized spectral filtering*. Advances in neural information processing systems (2016), 3844–3852.

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