Mathematics and CS Seminar

GeomTop seminar: Non-Topological Persistence for Computer Vision

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Persistent Homology (PH) provides a mathematical description of a data set that captures its internal structure (relations) at multiple scales in a robust manner [3]. These properties made of PH a widely used tool in applications [4] However, PH requires the dataset to be represented as a topological space, usually as a simplicial complex whose homology group can be computed via efficient algorithms. In this talk, we will build on the non-topological persistence framework introduced in [1,2], which allows us to define persistence diagrams (PDs) in other categories than FinSimp (e.g., weighted graphs, quivers, metric spaces) and arbitrary functors (e.g., edge-block and clique communities). We will discuss two general ways for producing persistence functions, and some examples coming from graph theory and image processing. We will introduce a non-topological persistence construction that allows for the detection of the boundary of objects in images, and that is robust to noise, e.g. salt and pepper, and Gaussian noise. We will use this construction, that we named persistence pooling, to define a new pooling layer for Convolutional Neural Networks. The persistence pooling layer associates a PD to each patch. The pixels will be consequently sorted in a list following their lifetime. The final output will be obtained averaging this list with a list of learnable weights. Preliminary results will be presented showing the performances of this layer on the Fashion-MNIST dataset [5].[1] Bergomi, M.G., Ferri, M., Vertechi, P., Zuffi, L. (2019), Beyond topological persistence: Starting from networks, arXiv.[2] Bergomi, M.G., Vertechi, P. (2019), Rank-based persistence, arXiv.[3] Cohen-Steiner, D., Edelsbrunner, H., & Harer, J. (2007). Stability of persistence diagrams. Discrete & Computational Geometry, 37(1), 103-120.[4] Ferri, M. (2017). Persistent topology for natural data analysisA survey. In Towards Integrative Machine Learning and Knowledge Extraction (pp. 117-133). Springer, Cham.[5] Xiao, H., Rasul, K., Vollgraf R. (2017), Fashion-MNIST: a Novel Image Dataset for Benchmarking Machine Learning Algorithms, arXiv

Wednesday, November 20, 2019 04:30pm - 05:30pm
Mondi Seminar Room 3, Central Building

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