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Nonlinear Label Spreading on Hypergraphs

Semi-supervised learning is the problem of finding clusters in a graph or a point-clould dataset where we are given “few” initial input labels. Label Spreading (LS) is a standard technique for this problem, which can be interpreted as a random walk diffusion process of the labels on the graph \[1\].

Recent work in network science has shown that in many graph algorithms a great advantage can be obtained when accounting directly for higher-order interactions modeled as hypergraphs, where, for example, a hyperedge directly connects all the authors of a paper in a co-authorship network \[2\].
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In this work we propose a variation of LS for hypergraphs where the standard random walk Laplacian matrix is replaced by a nonlinear Laplacian-inspired map which is defined in terms of the hypergraph incidence matrix \[3\].
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We show the convergence of the new nonlinear diffusion process to the global minimum of a regularized objective function that aims at reducing the variance across the hyperedge nodes and we demonstrate the efficiency of our approach on a variety of point cloud and network datasets.

Primary authors: PROKOPCHIK, Konstantin (GSSI); TUDISCO, Francesco (GSSI)

Presenter: PROKOPCHIK, Konstantin (GSSI)

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