Hypergraphs with Edge-Dependent Weights

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It has been shown in veldt2020hypergraph that all hypergraphs with submodular cardinality-based splitting functions are graph reducible. Our earlier work zhu2022ans has generalized the conclusion to hypergraphs with submodular EDVW-based splitting functions. In the following section, we propose a 1-spectral clustering algorithm for all submodular hypergraphs that are graph reducible including those EDVW-based ones, which are the focus of this paper.

The pipeline for the 1-spectral clustering algorithm is summarized in Algorithm 2.

Algorithm 1 1-spectral clustering for hypergraphs with EDVW

1: **Input:** hypergraph with EDVW $\mathcal{H} = (\mathcal{V}, \mathcal{E}, \mu, \kappa, \{\gamma_e\})$
2: Convert $\mathcal{H}$ to a submodular hypergraph by constructing submodular splitting functions based on 1
3: Compute the second eigenvector of the hypergraph 1-Laplacian via the minimization of $R_1()$ in 1

Algorithm 2 IPM-based minimization of $R_1()$ (**??**)

1: **Input:** submodular hypergraph $\mathcal{H} = (\mathcal{V}, \mathcal{E}, \mu, \{w_e\})$ with N vertices, accuracy ϵ
2: **repeat**
3: $\lambda' \leftarrow \lambda, \lambda \leftarrow R_1()$
4: **until** $\frac{|\lambda - \lambda'|}{\lambda'} < \epsilon$
5: **Output:**