

# Hierarchical Community Detection with Fiedler Vectors

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**Abstract:** Hierarchical clustering of entities based on observations of their connections has already been widely studied and implemented in the practice of network analysis. However, the statistical properties of diverse hierarchical community detection are still majorly unclear. We here study the binary tree stochastic block model in the literature to accommodate general compositions of edge probabilities. It can be shown that the eigen-structures of the graph Laplacian of the population binary tree stochastic block model reveals the latent structure of the network at all levels. This fact inspires us to retrieve the hidden hierarchical structure of communities by using a recursive bi-partitioning algorithm with Fiedler vector, dividing a network into two communities repeatedly until a stopping rule indicates that there are no further communities. The method is further theoretically justified in sparse networks with the help of the newly developed theory about entrywise bound for eigenvector perturbations. This is based on an ongoing project with my student Xingmei Lou.