Community Detection for Multi-relational Sparse Networks with Dependent Adjacency Matrix

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Abstract

: Multilayer and multiplex networks are increasingly prevalent in network data. We tackle the challenge of identifying common community structures in multi-relational networks by developing a spectral clustering algorithm specifically designed to handle dependent adjacency matrices. Our approach establishes the theoretical conditions for consistent community detection across layers, even when there is dependence between them. Additionally, we demonstrate the algorithm's effectiveness through examples and simulations, showing its ability to detect both assortative and disassortative community structures, even when individual layers fall below the detectability threshold. These theoretical results are further validated by simulation studies.

Keywords— Multilayer network, Community detaction, Dependent adjacency matrices, Assortative and Disassortative network layers