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Tools for spectral near-bipartite community detection

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Near-bipartite communities (NBPCs) are an example of dense graph structure with interesting internal structure. NBPCs are common in networks involving competition amongst subsets of entities (e.g. a dating network). We discuss uses of spectral embedding for NBPC detection. Typical spectral algorithms for detecting traditional community structure involve the eigenvectors of the graph Laplacian associated with the smallest non-zero eigenvalues (smoothest eigenmodes). For NBPCs, we study algorithms based on embeddings using eigenvectors associated with the largest eigenvalues of the normalized graph Laplacian (most oscillatory eigenmodes). We present important preprocessing steps, how the eigenvectors indicate the presence of NBPCs, and post-processing steps for robust detection. Additionally, we present preliminary convergence criteria and analysis of iterative eigensolvers for calculating oscillatory Laplacian eigenmodes. We use several graph models to illustrate concepts and demonstrate performance of our algorithms. We include some tests on real-world complex networks.