Random walks and vertex ranking in directed graphs

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Random walks on undirected graphs have been extensively studied in the literature. In contrast, random walks and spectral approaches for directed graphs have not been as well developed. For example, one of the key invariants for undirected graphs is the Cheeger constant, which is one of the main tools for bounding the mixing time for random walks on undirected graphs. We will introduce the Laplacian for a directed graph and derive the Cheeger inequalities which relate the eigenvalues of the Laplacian to other invariants for directed graphs. These techniques can be used to deal with various problems arising in the study of non-reversible Markov chains with applications to vertex and edge ranking in graphs.