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BridgeRank: A novel fast centrality measure based on local structure of the network

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Abstract:

Ranking nodes in complex networks have become an important task in many application domains. In a complex network, influential nodes are those that have the most spreading ability. Thus, identifying influential nodes based on their spreading ability is a fundamental task in different applications such as viral marketing. One of the most important centrality measures to ranking nodes is closeness centrality which is efficient but suffers from high computational complexity $O(n^3)$. This paper tries to improve closeness centrality by utilizing the local structure of nodes and presents a new ranking algorithm, called *BridgeRank* centrality. The proposed method computes local centrality value for each node. For this purpose, at first, communities are detected and the relationship between communities is completely ignored. Then, by applying a centrality in each community, only one best critical node from each community is extracted. Finally, the nodes are ranked based on computing the sum of the shortest path length of nodes to obtained critical nodes. We have also modified the proposed method by weighting the original BridgeRank and selecting several nodes from each community based on the density of that community. Our method can find the best nodes with high spread ability and low time complexity, which make it applicable to large-scale networks. To evaluate the performance of the proposed method, we use the SIR diffusion model. Finally, experiments on real and artificial networks show that our method is able to identify influential nodes so efficiently, and achieves better performance compared to other recent methods.

Keywords: Complex network; Influential nodes; Centrality measures; SIR model; Community detection; Viral marketing.

1 Introduction

Due to the rapid growth of social networks, many applications such as marketing, entertainment, education, and management utilize it, recently. The interaction and communication among people in these applications have globally relevant and coherent pattern. Extracting these patterns is usually a complicated task because of quantity and variety of information and entities (websites, organizations, persons, etc.). Therefore, different researchers tried to extract information including the relative importance of nodes and edges from corresponding graphs of the networks [1-3].