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Self-adaptive Louvain algorithm: fast and stable community detection algorithm based on the principle of small probability event

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Abstract

Community structure is an important structure feature of complex networks. Due to its speed, effectiveness and simplicity, the Louvain algorithm is widely used to detect community structure planted in the network topology. Speeding up the Louvain algorithm, enabling the analysis of larger graphs in a shorter time and maintaining the accuracy of result, can benefit the research of networks in many fields. We here propose the Random Self-adaptive Neighbors Louvain algorithm as a new improved Louvain algorithm. The principle of small probability event is used to infer the number of neighbors to pick up randomly. The accuracy, speed and fluctuation of our method are compared with those of the original Louvain algorithm and the Random Neighbor Louvain algorithm. The results show that the RSNL can obtain as good partition as that of the original Louvain in a faster speed. On the networks without distinct community structures, the RSNL is faster and more accurate than the RNL. A new measure, equivalent computing time, is proposed to show the expectation runtime of the algorithm to obtain a relatively good partition. The comparison of this measure shows that the RSNL algorithm can make the best performance among the three algorithms in most cases.

Keywords:
Community structure, Modularity, Louvain algorithm, Small probability event

1. Introduction

Complex networks have gained increasing attention in the past decade[1], as this description mode can compactly represent internal structures of a wide range of complex systems [2, 3, 4] from biology [5] to social media [6] or web analysis [7, 8]. Individuals in those complex systems and their interactions can be abstracted as nodes and links of networks. By analyzing the complex networks, a structural property feature called community structure was found to be ubiquitous in

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