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Fuzzy Clustering in Community Detection Based on Nonnegative Matrix Factorization with Two Novel Evaluation Criteria

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Abstract

Clustering or community detection is one of the most important problems in social network analysis, and because of the existence of overlapping clusters, fuzzy clustering is a suitable way to cluster these networks. In fuzzy clustering, in addition to the correctness of the clusters assigned to each node, the produced membership of one node to each cluster is also important. In this paper, we introduce a new fuzzy clustering algorithm based on the non-negative matrix factorization (NMF) method. Despite the well-known fuzzy clustering techniques like FCM, the proposed method does not depend on any parameter. Also, it can produce appropriate memberships based on the network structure and so identify the overlap nodes from non-overlap nodes, well. Also, to evaluate the validity of such fuzzy clustering algorithms, we propose two new evaluation criteria (*SFEC* and *UFEC*), which are constructed based on the neighborhood structure of nodes and can evaluate the memberships. Experimental results on some real-world networks and also many artificial networks show the effectiveness and reliability of our proposed criteria.

Keywords: Community detection, Fuzzy clustering, Nonnegative Matrix Factorization, Fuzzy C-means, Fuzzy membership matrix.

1. Introduction

Recently, analysis of large networks in biology, science, technology and social systems has become very popular [1, 2]. Community detection in networks is an important area of current research with many applications [3,