Dynamic Non-negative Matrix Factorization for Role Analytics in Temporal Social Networks

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Abstract

Roles of nodes in a social network (SN) represent their functions, responsibilities or behavior within the network. Role discovery can be defined as the process that takes a graph and picks out sets of nodes with similar structural patterns and the problem of role discovery has attracted an increasing amount of attention recently.

However, roles can change over time making role analytics a challenging problem. Previous studies on dynamic role discovery either neglect role transition analysis or perform it separately, i.e., after discovering roles of nodes on individual snapshots of a SN. In this work we investigate how to discover roles and to analyze role transitions in networks at the same time, addressing the limitations of current approaches. We propose a novel dynamic non-negative matrix factorization (DyNMF) approach to discover role and role transition simultaneously in temporal SNs. DyNMF combines the current and the past SN snapshots to factorize the node-feature matrices. DyNMF obtains structural information from the current SN snapshot, and node role transitions by looking at past SN snapshots.

To validate the performance of the proposed DyNMF for role analytics in SNs, we conduct comprehensive experiments on four data sets from different domains. The obtained results demonstrate the effectiveness of DyNMF for role analytics in SNs, including the tasks of role discovery, role identification and transition analysis as well as role prediction.