A Fast Community Detection Algorithm

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Abstract : Community detection represents an important data-mining tool for analyzing and understanding real-world complex network structures and functions. We believe that at least four criteria determine the appropriateness of a community detection algorithm: (a) it produces useable normalized mutual information (NMI) and modularity results for social networks, (b) it overcomes resolution limitation problems associated with synthetic networks, (c) it produces good NMI results and performance efficiency for Lancichinetti-Fortunato-Radicchi (LFR) benchmark networks, and (d) it produces good modularity and performance efficiency for large-scale real-world complex networks. To our knowledge, no existing community detection algorithm meets all four criteria. In this paper, we describe a simple hierarchical arc-merging (HAM) algorithm that uses network topologies and rule-based arc-merging strategies to identify community structures that satisfy the criteria. We used five well-studied social network datasets and eight sets of LFR benchmark networks to validate the ground-truth community correctness of HAM, eight large-scale real-world complex networks to measure its performance efficiency, and two synthetic networks to determine its susceptibility to resolution limitation problems. Our results indicate that the proposed HAM algorithm is capable of providing satisfactory performance efficiency and that HAM-identified communities were close to ground-truth communities in social and LFR benchmark networks while overcoming resolution limitation problems.

Keywords : complex network, social network, community detection, network hierarchy