Identifying the Presence of Communities in Complex Networks Through Topological Decomposition and Component Densities

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Abstract. The exponential growth of data in various fields such as Social Networks and Internet has stimulated lots of activity in the field of network analysis and data mining. Identifying Communities remains a fundamental technique to explore and organize these networks. Few metrics are widely used to discover the presence of communities in a network. We argue that these metrics do not truly reflect the presence of communities by presenting counter examples. This is because these metrics concentrate on local cohesiveness among nodes where the goal is to judge whether two nodes belong to the same community or vise versa. Thus loosing the overall perspective of the presence of communities in the entire network. In this paper, we propose a new metric to identify the presence of communities in real world networks. This metric is based on the topological decomposition of networks taking into account two important ingredients of real world networks, the degree distribution and the density of nodes. We show the effectiveness of the proposed metric by testing it on various real world data sets.

1 Introduction

Most real world systems take the form of networks where a set of nodes and edges might be used to represent these networks. Examples include social networks, metabolic networks, world wide web, food web, transport networks. Community detection remains an important technique to organize and understand these complex networks (Girvan and Newman (2002)). Roughly speaking, we like to define a community as a decomposition of a set of entities into 'Natural Groups'. Detection of communities has a wide range of applications in various fields. For example, in social networks, community detection could lead us towards a better understanding of how people collaborate with each other or in a transport network, a community might represent cities or countries well connected through transportation means.

Broadly speaking, research in the field of network analysis can be divided into two categories. First, by developing some metrics that can help us to analyze and detect community structures and second, developing algorithmic procedures to find and group the communities present in the networks. In this paper, we focus on different metrics proposed for community