VisNetMiner: An Integration Tool for Visualization and Analysis of Networks

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Abstract. As the social network analysis has gradually been applied in many scientific fields, a tool for visualizing and analyzing large-scale networks is urgently needed. VisNetMiner is an integration tool for visualization and analysis of networks, which aims at integrating data preprocessing, modeling, analysis and visualization. This tool can analyze different kinds of data and builds a clear architecture for network analysis and visualization. Moreover, VisNetMiner has the following characteristics: 1) organizing the structural data with a uniform and flexible multi-dimensional data model; 2) providing comprehensive methods for network analysis and visualization; 3) assisting users manage the analytic processes with the workflow management. The experiments verify the effectiveness of VisNetMiner with an academic collaboration network.

1   Introduction

From the Internet to the WWW, from the author collaboration network to many relation networks for economy and society, it clearly shows that people have been living in a world which consists of various complex networks [1]. The structure of complex network is usually very complicated and difficult to understand. If we only use tables or texts to indicate networks, the implied information will not be accessed well. Undoubtedly, visualization is the best method to show complex networks intuitively [2]. For the moment, many scientific researchers need combine technologies of visualization and theories of complex network to analyze some actual phenomena. However, many experts in other fields are not familiar with information technology and thus unable to concentrate their energies on solving their problems. So it is very important to develop a visual analytic tool.

There have been several tools for complex network analysis and visualization such as ArnetMiner [3], CFinder [4]. However, these tools usually face the following problems: 1) it is difficult to define a uniform data model to analyze different kinds of data; 2) the functions of analysis and visualization for networks are not comprehensive; 3) the operations in these systems may be complicated for users with little computer experiences due to absence of necessary wizards.

In this paper, we develop a Tool for Visualizing Network and Mining (called Vis-NetMiner). This tool proposes a uniform multi-dimensional data model to support the multi-dimensional analysis of networks. It integrates powerful analytic methods and visualization technologies. In addition, the workflow management is used for providing an integrated analytic process.

2   Related Work

A number of tools have been designed for the social network analysis and visualization. For example, ArnetMiner [3], PaperLens [5], and CiteSpace [6] aim at data analysis and visualization in academic networks. These systems provide powerful statistical analysis and search services on authors, papers and conferences. However, it is very difficult to use them to analyze data in other fields.

Some tools focus on special analysis functions. For example, C-Group [7] is a visual analytic tool for pairwise analysis of dynamic group membership over time, and CFinder [4] is a fast program locating and visualizing overlapping, densely interconnected groups of nodes in undirected graphs.

Besides, some other tools can not only analyze networks in various fields, but also provide powerful capabilities of data analysis and visualization. The Network Workbench (NWB) [8] develops a large-scale network analysis, modeling, and visualization cyberinfrastructure for biomedical, social science, and physics researches. The Information Visualization CyberInfrastructure (IVC) [9] is a toolkit for information visualization, which includes many basic tools such as Prefuse [10]. Although these tools are comprehensive and powerful, the independent analytic functions cause the absence of integrated analytic process.

3   System Architecture

In this section, we will present the architecture of VisNetMiner. To make VisNet-Miner more flexible, reusable and understandable, we divide the framework into different layers based on their functions. As illustrated in Fig. 1, the system mainly consists of four layers.

1. **Data Source Layer.** This system can handle different kinds of data sources including database, text file and GraphXML. A uniform access interface shields the details of the underlying data.
2. **Data Model Layer.** Data modeling has two steps: 1) data preprocessing is executed to collect and clean data; 2) network extraction transforms different data into the multi-dimensional model. In addition, this layer includes another important module: data configuration management. It is responsible for managing the configuration information of data preprocessing and network extraction.
3. **Visual Analysis Layer.** This Layer aims at analysis and visualization of multi-dimensional data model. On the one hand, there are three analysis modules: multi-dimensional analysis, statistical analysis, and social network analysis. On the other hand, there are three visualization modules: chat visualization, network visualization, and visualization filter. The analysis and visualization are