Chapter 8.13
Soft Statistical Decision Fusion for Distributed Medical Data on Grids

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ABSTRACT

This chapter introduces the decision fusion as a means of exploring information from distributed medical data. It proposes a new method of applying soft data fusion algorithm on the grid to analyze massive data and discover meaningful and valuable information. It could potentially help to better understand and process medical data and provide high-quality services in patient diagnosis and treatment. It allows incorporation of multiple physicians into one single case to recover and resolve problems, and integration of distributed data sources overcome some limitations of geographical locations to share knowledge and experience based on the soft data and decision fusion approach.

INTRODUCTION

Healthcare service is a complex industry nowadays. It is one of the most critical components of the modern human-oriented service. Informatics is an essential technology to health care (Dick & Steen, 1991) and has been applied to this field as long as computers have existed. Information technology can be one of the major drivers of e-health activity, both directly and indirectly. E-health offers new opportunities to further improve the quality and safety of services because technology makes possible the high level of information management. However, it raises an important issue of how to utilize and integrate an impressive amount of medical data efficiently to provide high-quality and safe services.

Grid computing has emerged to address this issue. It was first developed in the scientific community and can be used as effective infrastructures

for distributed high-performance computing and data processing (Foster, Kesselman, & Tuecke, 2001). The features of grid computing make the designation of an advance decision support system possible.

How to apply data fusion in a distributed medical decision system on the grid is still an open problem. In our previous research on this subject, the following observations were made that should guide our further work:

1. Massive data are collected in different organizations. With an explosion in size of database, discovering meaningful and valuable information from different datasets on grids is still a critical issue that affects decision-making in this area. There is an urgent need for a new computation technique to help service providers to process, analyze, and extract meaningful information from the rapid growing data.
2. The need for efficient, effective, and secure communication between multiple service providers for sharing clinical knowledge and experience is increasing. Traditional techniques are infeasible for analyzing large datasets that may maintain over geographically distributed sites.
3. The need for finding an efficient way to integrate data, knowledge, and decision from different parties is increasing.

These first two observations suggest an answer: build a grid-based system that enables the sharing of application and data in an open, heterogeneous environment. The last observation suggests an answer to build a soft fusion mechanism to do summarization, and it may result in higher accuracy of diagnosis and better treatment.

RELATED WORK

There are several research groups whose work can contribute to grid-based data fusion on e-health.

We first discuss decision support on the grid in the grid community, then we will introduce some related works about the medical decision support from the health community, and finally we will present some related works about soft data fusion and our proposal for solving this problem.

Decision Support on the Grid

A decision support system is defined as any computer program that assists decision-makers to utilize data and models to solve problems (Gorry & Morton, 1971; Keen & Morton, 1978; Sprague & Calson, 1980). Usually, it requires access to vast computation resources and processes a very large amount of data to make a decision. Grid computing is one approach to solving this problem. It has emerged as a paradigm with the ability to provide secure, reliable, and scaleable high-speed access to a distributed data resource. Compared to traditional distributed techniques, it has many advantages like resource sharing, high-performance services. The grid offers significant capability for designation and operation of complex decision support system by linking together a number of geographically distributed computers (Ong et al., 2004).

A grid-based decision support system can be used in a broad range of problems, from business to utilities, industry, earth science, health care, education and so on. Most researchers focus on simulation and visualization for specific processes such as air pollution (Mourino, Martin, Gonzalez, & Doallo, 2004), flooding crisis (Hluchy et al., 2004; Benkner, et al., 2003), and surgical procedures (Narayan, Corcoran-Perry, Drew, Hoyman, & Lewis, 2003; CrossGrid project) and then support decision-makers to make decisions on the basis of simulation results.

Medical Decision Support

The term medical decision support system describes a set of computer applications that are

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