Chapter XIV

Semantic Visualization to Support Knowledge Discovery in Multi–Relational Service Communities

Nadeem Bhatti
Fraunhofer IGD, Germany

Stefan Hagen Weber
Siemens AG, Germany

ABSTRACT

Services provided through the Internet serve a dual purpose. They are used by consumers and by technical systems to access business functionality, which is provided remotely by business partners. The semantics of services, multi-relational networked data and knowledge discovery in multi-relational service communities (e.g., service providers, service consumers, and service brokers, etc.) become an area of increasing interest. The complex multi-dimensional semantic relationship between services demands innovative and intuitive visualization techniques to present knowledge in a personalized manner, where community members can interact with knowledge assets and navigate through the network of Semantic Web services. In this chapter, the authors introduce Semantic Visualization approach (SemaVis) to support knowledge discovery by using hybrid recommender system (HYRES). It makes use of the semantic descriptions of the Web services, and also exploits the dynamic evolving relationships between services, service providers and service consumers. The authors introduce a sample scenario from a research project TEXO, within the THESEUS research program initiated by the German Federal Ministry of Economy and Technology (BMWi). It aims to supply a service-oriented architecture for the integration of Web-based services in the next generation of Business Value Networks. The authors present as well the application of their approaches SemaVis and HYRES to support knowledge discovery in multi-relational service communities of future Business Value Networks.
INTRODUCTION

In recent years there has been an enormous increase in interest in novel collaborative web sites on the one hand and semantically annotated content on the other hand. The fusion of collaborative and semantic data leads to complex scenarios with multi-relational data that contain several entity classes and multiple interactions. As an example consider some of the recent developments in the Web 2.0 that have resulted in novel types of social network communities represented as multi-relational data. Similarly, it is expected that the emergent Semantic Web will produce an enormous amount of structured relational data. Another example is B2B and B2C transaction data that is collected and analyzed to better serve the customers. Yet another example is enterprise applications based on service oriented architectures (SOA), containing a network of semantic Web services. Multi-relational networked data are now easily accessible and knowledge discovery in multi-relational domains has become an area of increasing interest. As a sample scenario, a platform for dealing with semantic Web services will be described. Providers as well as consumers are part of a service community realizing future business value networks.

The success of Web applications and platforms increases proportional with the amount of high quality content provided and collected from all customers. Supporting customers as most valuable assets therefore is a crucial aspect of a flourishing web business. Additionally, exploiting all existing data with leading technology to the customer's benefit is one of the most important tasks to address. The main driving force for a satisfied customer in his community is uniqueness. The customer has to be given the feeling of being perceived as an individual rather than let him drown in the pool of anonymity. This can only be achieved by understanding dynamic social network structures, the customers themselves as well as their relations. Existing approaches from social network analysis or machine learning concentrate on one single relation type that exists between two entity types. In practice, however, entity types are arranged in multi-relational networks and the involved relation types are usually highly correlated. Using all correlated relation types simultaneously will improve the performance of the relation prediction. Siemens AG developed HYRES (HYbrid REcommender System), an easy to apply, scalable and multi-relational matrix factorization model able to deal with any number of entity types and relation types.

Knowledge discovery in multi-relational service communities is a great challenge. However, the best technological background processes will be in vain if the knowledge presentation cannot be accomplished in an intuitive and user-friendly way. The complex multi-dimensional semantic relationship between knowledge assets (e.g. services and related recommended services) demands innovative visualization techniques to present knowledge in a personalized manner, where community members can interact with knowledge assets and navigate through the network of semantic Web services. The semantic visualization techniques offer a very promising solution to support knowledge discovery in service communities.

Fraunhofer IGD and Siemens AG have developed an approach of how semantic visualization can support knowledge discovery in multi-relational service communities. According to this approach, when a knowledge worker searches for a service he starts a query. As a result, the knowledge discovery system delivers a list of services which then are presented within knowledge spaces or clusters, e.g. services for automotive industry or services for the entertainment industry. In order to distinguish services and related recommended services, different graphical metaphors within knowledge spaces or clusters will be applied. These recommendations are based on HYRES that predicts a collaborative ranking of services according to the user's profile and favoured ser-