

Chapter XV

Ontology Mapping Techniques in Information Integration

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ABSTRACT

The semantic Web suggests to annotate Web resources with machine-processable metadata; and ontologies, as means to conceptualize and structure knowledge, are seen as the key to realize the vision of the semantic Web. However, ontologies themselves do not provide semantic interoperability, since a single ontology cannot be used to represent all kinds of domains and applications. Ontology mapping, therefore, is introduced to achieve knowledge sharing and semantic integration in an environment with different underlying ontologies. This chapter provides an overview of the approaches to information integration developed by researchers in the community of ontology mapping. After introducing the backgrounds and concepts of ontology mapping, a comprehensive and detailed treatment of different ontology mapping schemes is presented. Closely related aspects of ontology mapping, such as mapping result description, similarity measures, algorithm performance evaluation and so forth, have also been addressed. The emphasis is to present a snapshot of the fast-growing field in a manner suitable for both experts and non-specialists.

INTRODUCTION

Ontology mapping is an important step to achieve knowledge sharing and semantic integration in an environment where knowledge and information are represented with different underlying ontologies. Business integration (Bussler, 2002) is integration and translation through the metadata layer of information and applications to provide context. In other words, information integration is the first step to support business integration. The problem of mapping different ontologies is well known in information integration (Calvanese, 2001). Several problems central to information integration, such as ontology mapping and schema matching, can be viewed as alignment tasks with the goal to find optimal correspondences between two structured objects and to compute the associated similarity score.

This chapter provides an overview of the approaches to information integration developed by researchers in the community of ontology mapping. In particular, a comprehensive and detailed treatment of different ontology mapping schemes is given, along with other closely related aspects, such as mapping result descriptions, similarity measures and algorithm performance evaluation. Meanwhile, to avoid confusion of ontology with formal concept analysis (FCA), the differentiation between them is also described. Emphasis is given to present the topic in a manner suitable for both experts and non-specialists. A list of references is provided at the end of the chapter for further study.

The main body of the chapter is organized as follows: The background of information integration on the Web, ontologies and ontology mapping are introduced next. Then we give an overview of the popular ontology mapping techniques, especially the semi-automatic and automatic mapping discovery approaches. The representation methods of mapping results are also included in this section. Similarity measurement is introduced after that, followed by performance evaluation of

ontology mapping methods. Finally, a conclusion and future work are given in the last section.

BACKGROUND

Information integration has been a research topic for database and knowledge representation communities for many years (Wiederhold, 1993). Ontology, as an important technique to represent knowledge and information, allows incorporating semantics into data to dramatically promote information exchange. Ontologies themselves, however, do not solve any interoperability problems. Ontology mapping, therefore, is the key to exploit the semantic interoperability of information and has been drawing a great amount of attention in the research community during the past years. This section introduces the basic concepts of information integration, ontology and ontology mapping.

Information Integration

There has been spectacular growth in the quantity of information. Recent studies from IBM indicate that business-relevant information is growing at around 50% per year, with about one to two exabytes (10^{18}) of information being generated each year. At the same time, the task of managing such data has become more complex because of the vast amount of heterogeneous information and our limited ability to explicate it.

The problems of interoperability between different business services consist of the system and syntactic, structural and semantic levels of heterogeneity (Sheth, 1999). The system level includes incompatible hardware and operating systems; the syntactic level refers to different languages and data representations; the structural level includes different data models; and the semantic level refers to the meaning of terms used in the interchange. Semantic heterogeneity

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