Chapter VII

Ontology Enhancement for Including Newly Acquired Knowledge About Concept Descriptions and Answering Imprecise Queries

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Abstract

This chapter presents a text-mining-based ontology enhancement and query-processing system. The key ideas introduced here are that of learning and including imprecise concept descriptions into ontology structures. This is essential for ontology-based text information extraction since it is not necessary that text description of the concepts or user-specified descriptions will exactly match stored concept descriptions. The traditional property-value framework for concept description has been extended to a property-
value-qualifier framework for this purpose. The system also supports ontology enhancement by identifying, defining, and adding new precise and imprecise concept descriptions mined from text documents. The acquired knowledge is stored in a structured knowledge base for answering user queries. Since user queries may contain concept descriptions, which do not exactly match stored or known concepts, the query processor uses fuzzy reasoning for query processing. Each answer is accompanied by a confidence value that reflects its similarity to the original query concept.

Introduction

Ontological structures used for describing concepts and their interrelationships are gaining popularity for designing efficient Web-based information processing systems. The Semantic Web visualized by Berners-Lee (2001) aims at integrating knowledge from heterogeneous Web resources and ontology can be a key enabling technology to realize it. Ontologies have found their use in a wide range of applications like search engines, e-commerce, biomedical knowledge processing, knowledge engineering, information retrieval and extraction from unstructured texts, natural language processing, multi-agent systems, qualitative modeling of physical systems, database design, geographic information science and digital libraries (Baader et al., 2003; Bodner & Song, 1996).

An ontology can be viewed as a model of a domain that defines the concepts existing in that domain, their attributes and the relationships between them and is typically represented as a knowledge base. For example, plant ontology specifies structural organization of plants in terms of parts and subparts like stems, leaves, cells, etc.; the various categories of plants like algae, legumes, ferns, and so on. Thus an ontology can be viewed as an explicit formal specification of how to represent the objects, concepts, and other entities that are assumed to exist in some area of interest and the relationships that hold among the specified concepts.

Even as the use of ontology for domain-specific applications are fast gaining popularity, researchers are actively engaged in tackling some of the chief bottlenecks that still hinders the use of ontology for general-purpose applications. Though ontology plays a key role by defining concepts and relationships in an unambiguous way, it is unreal to expect that there exists a unique, unambiguous way of defining every concept which all authors and users will adhere to. Hence, for all large, complex applications it is imperative that facilities for learning and updating of underlying ontological structures are integrated into the system.
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