An Architecture for Reasoning with Terminological Systems

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Abstract. We propose a client-server architecture for terminological systems, which aims at standardization and interchangeability of its various components. This architecture primarily focuses on the aspect of reasoning with the knowledge in the terminological system. We propose the following components: Description Logics (DL) as representation formalism, KRSS for knowledge representation syntax, RACER or a comparable application as a logical reasoner, and Lexicon Query Services (LQS) as interface with the reasoner. This results in an architecture based on open standards, allowing interchangeability of terminological systems, servers and clients.

Introduction. Currently, a myriad of terminological systems exist, such as Clinical Terms V3, UMLS, SNOMED RT, and GALEN. Each of these systems has its specific philosophy, intended use, and strengths and weaknesses. They vary not only in their structure and syntax, but also in functionalities that are provided by *proprietary* terminology servers. This results in the impossibility of switching between terminological systems, which is required in order to benefit from their combined strengths. Although the systems vary in complexity, all proprietary servers provide a large body of common functions such as phrase lookup, and finding the parents of a concept. The architecture we propose provides a first step towards standardizing functions related to *reasoning* with terminological systems, such as automatic classification of concepts. Reasoning is instrumental in various tasks such as updating the knowledge base.

Knowledge Representation (KR) Formalism. Terminological systems are specified in a number of more or less formal ways. We propose specifying and classifying concepts in a system by means of Description Logics (DL's), as they provide a solid formal basis for automated reasoning while allowing practical reasoning.

KR Syntax. An obvious syntax for DL-based knowledge representation is the Knowledge Representation System Specification (KRSS)[1]. KRSS specifies syntax and semantics both for definition (of concepts, roles, attributes, individuals, and assertions) and for interrogation (querying, retrieval and validation). Hence, the first part (definition) can be the KR syntax, as used e.g. in SNOMED RT, whereas the latter (interrogation) can comprise an interface for a reasoner.

Interface with the reasoner. As terminological systems can be incorporated in a wide variety of applications, a network-based standardized protocol is necessary for client-server communication. The Lexicon Service Specification (LQS)[2] specifies a set of common, read-only methods for accessing the content of medical terminological systems. This specification goes far beyond, but includes many, methods for accessing KR Systems. The methods are specified as an IDL-description together with a reference model for the terminology services. Using IDL (Interface Definition Language) for specifying the methods ensures that all clients and servers that implement this IDL are able to intercommunicate. LQS should ideally be extended to fully implement all KRSS queries, retrievals and validations.

Reasoner. The Renamed A-Box and Concept Expression Reasoner (RACER 1.5)[3] is the first DL system for T-Box and A-Box reasoning in $\mathcal{SHIQ}$ (an expressive DL). The A-Box, containing knowledge about the instances of the domain, facilitates reasoning about individuals, in addition to reasoning about concepts. RACER provides a LISP-interface, which implements all of the retrieval and query methods of KRSS. RACER accepts KR systems in its proprietary format, which slightly extends KRSS syntax. It provides a proprietary Java-server interface that implements most of the KRSS retrieval and query methods.

Results. The proposed architecture allows for flexible interchange of terminological systems and reasoners. Transformation of existing terminological systems into a DL-based formalism, represented with KRSS, is feasible. Reasoners, such as RACER, should provide the part of the LQS interface that deals with accessing KR systems. Extension of LQS to fully implement all KRSS interrogations is desirable. We are currently implementing these ideas in a case study involving an Intensive Care terminological system.

References.

1. Patel-Schneider P, Swartout B. Description-Logic Knowledge Representation System Specification from the KRSS Group of the ARPA Knowledge Sharing Effort; 1993 1 November 1993.
2. OMG. *Lexicon Query Service*: Object Management Group; 2000 July 2000. Report No.: 00-06-31.pdf.
3. http://kogs-www.informatik.uni-hamburg.de/~race/download.html