

HIKE (HPKB Integrated Knowledge Environment) – A Query Interface and Integrated Knowledge Environment for HPKB

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Abstract

This demonstration is based upon the results of a research project sponsored by the Defense Advance Research Projects Agency (DARPA), called High Performance Knowledge Bases (HPKB). The demonstrated portion of HPKB follows a question-answering paradigm. The integrated architecture developed at Science Applications International Corporation (SAIC), called the HPKB Integrated Knowledge Environment (HIKE) is introduced. Following this, the components involved in the demonstration, which include a natural language understanding system, a first order theorem prover, and a knowledge server are briefly described. The demonstration effectively illustrates the use of both a graphical user interface and a natural language interface to query a first order theorem prover with similar results.

Introduction

This demonstration displays the integration of multiple technology components brought together to achieve the goals set out for the HPKB Crisis Management Challenge Problem. For this experiment, a participant contractor in the HPKB program provides a set of queries and knowledge sources. In order to answer these queries, knowledge bases are constructed manually from the provided sources, and semi-automatically from other non-restricted sources. First order theorem provers are then applied to these knowledge bases to generate answers to queries. This demonstration focuses on the integration of

the varying technology components required to accomplish this process.

System Architecture

Different research groups have developed the various components of the HIKE system. Because of this, these components clearly have different integration needs and application programming interfaces. An architecture diagram is provided in figure 1 below. Central to the system architecture is an Open Knowledge Base Connectivity (OKBC) bus [1].

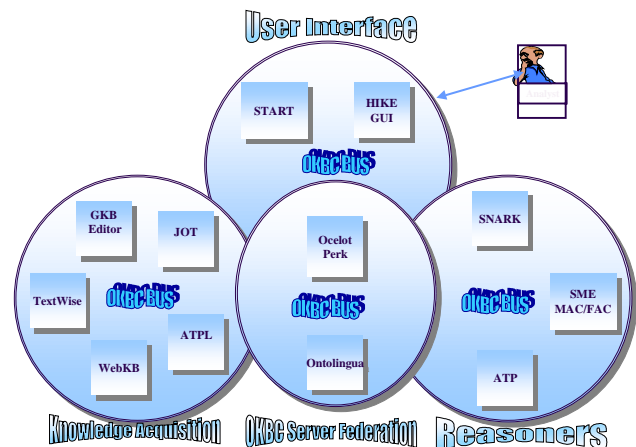


Figure 1

The system components are divided into four categories: user interface, OKBC server federation, knowledge acquisition and reasoners. It also needs to be noted that this classification is not absolute, and some of the systems overlap in the roles they perform

The user interface category contains components that allow two types of interfaces. HIKE provides a form-based GUI. Users can construct queries using pull down menus. Query construction templates are defined according to the templates defined in the Crisis Management specification. Questions can also be entered in natural language. MIT's component, Syntactic Analysis using Reversible Transformations (START) [3] accepts natural language queries and then attempts to answer the questions. For answering questions that involve more complex types of reasoning, START generates a formal representation of the query and passes it to one of the theorem provers.

The OKBC server federation category, within the SAIC Crisis Management portion of the HPKB program makes use of KSL's Ontolingua [5], as well as SRI International's Ocelot and Perk systems. Providing a federation of OKBC servers facilitates the development of a distributed heterogeneous environment.

The knowledge acquisition category includes all those components used for both manual and semi-automatic knowledge acquisition. SRI International's Generic Knowledge Base (GKB) editor [6] is a graphical tool for browsing and editing large knowledge bases, used primarily for manual knowledge acquisition. WebKB supports semi-automatic knowledge acquisition [7]. Given some training data and an ontology as input, a web spider searches in a directed manner and populates instances of classes and relations defined in the ontology. TextWise extracts data from text and newswire feeds, converting them into KIF [4] triples (concept-relation-concept), which are then loaded into the knowledge servers. JOT is a web-based editor developed by Stanford KSL that is used with Ontolingua. ATPL (Abstract Theorem Prover Listener) allows the user easy access to theorem prover usage and knowledge acquisition.

The reasoners category supports multiple reasoning methods. SRI International's SNARK (SRI's New Automated Reasoning Kit) is a first order theorem prover [8]. Stanford KSL's ATP (Abstract Theorem Prover) is also a first order theorem Prover. SME and MAC/FAC developed by NWU provide the capability for analogical reasoning.

Question Answering Protocol

Consider an example of a question being answered by the system. The system was developed to answer questions about international crises, so a sample question would be, "What risks would Kuwait face in attacking targets in Iran with chemical weapons?" [10]. The user enters a query

by either selecting parameters on HIKE or typing in natural language to START. In either situation, the query is converted to a formal representation in a standardized grammar. This formalized query is then converted into a representation unique to the theorem prover that will answer it (such as SNARK or ATP). This query is then sent to the theorem prover which, in turn, sends the answer to the query back to HIKE where it is displayed for the user. Thus, HIKE creates an integrated knowledge environment by providing connectivity between an array of complimentary technology components.

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