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Functional Blue Prints for the Development of a KMapper Prototype

SOFTWARE DESIGN DOCUMENT
KMAPPER KNOWLEDGE INFERRING SERVICES

And prepared by Martin Froment and Ludovic Tobin

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Contract No.: W7701-5-4996, RFQ 72614
Scientific Authority: Ms. Régine Lecocq (418) 844-4000 x4124

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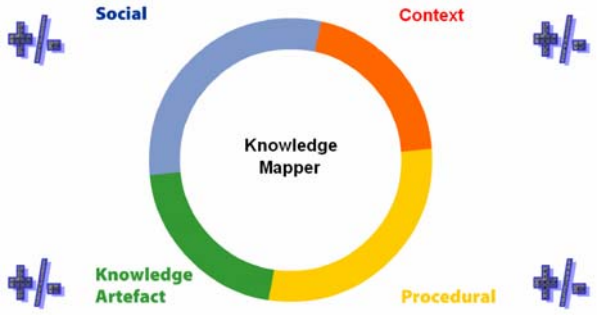

SOFTWARE DESIGN DOCUMENT

KMAPPER KNOWLEDGE INFERRING SERVICES

Version 0.3

This work was performed under contract for

DEFENSE R&D CANADA-VALCARTIER
Information and Knowledge Management Section

Contract Number: W7701-5-4996, RFQ 72614

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History

Version	Description	Author	Date
0.1	Initial version	Ludovic Tobin	September 7, 2007
0.3	SA Comments Inclusion First-draft Deposit	Ludovic Tobin	October 30th, 2007

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Résumé

Dans un premier temps, le KMapper est un outil permettant d'analyser différentes sources d'information afin d'en extraire la connaissance (et, par le fait même, les sources de connaissance analysées elles mêmes) et la structurer en fonction d'une ontologie particulière. Ces éléments de connaissance sont regroupés en quatre dimensions : *Social* (organisations, groupes, individus), *KnowledgeArtifact* (documents, sites Web, courriers électronique, bases de données, etc.), *Process* (produits et résultats de connaissance liés aux processus spécifiques utilisés) et *Concept* (regroupe tous les sujets reliés au domaine d'application du KMapper).

Dans un deuxième temps, le KMapper se veut un outil sophistiqué d'exploitation de la connaissance. Notamment, il permet d'afficher ces éléments de connaissances ainsi que de visualiser les différents liens qui existent entre ceux-ci. Le KMapper permet également l'exploitation des éléments de connaissances grâce à différentes fonctions de recherche.

Le présent document contient les spécifications fonctionnelles du *KMapper Knowledge Inferring Services*. De plus, on y retrouve des spécifications techniques qui seront utiles au développement du prototype KMapper.

Abstract

Firstly, the KMapper is a tool permitting the analysis of different information sources from which to extract knowledge (and, in so doing, the analysed knowledge sources themselves) and to structure it according to a particular ontology. These knowledge assets are grouped in four dimensions: *Social* (organisations, groups, and individuals), *KnowledgeArtifact* (documents, websites, emails, databases, etc.), *Process* (knowledge outputs and outcomes liked to specific processes used) and *Concept* (regroups every subject related to the KMapper's application domain).

Secondly, the KMapper is to be a sophisticated knowledge exploitation tool. Namely, it allows viewing these knowledge assets as well as visualising the different links existing between them. The KMapper also allows the exploitation of knowledge assets through various search functions.

This document contains the functional specifications of the *KMapper Knowledge Inferring Services*. In addition, it contains development and technical specifications that will be useful for the development of the KMapper prototype.

Contents

1. Software Unit Definition

Note to the reader: These functional blue prints will help the developer understanding its software unit's functional and technical scopes.

1.1 Purpose

In the KMapper, inference rules will allow to create new relations between entities based on existing relations. For example, if it has been found that “Roger Tremblay” is the author of a document titled “The life of terrorists”, and that this document contains the subject “Ben Laden”, then it might be interesting to infer that “Roger Tremblay” has some knowledge on “Ben Laden”.

1.2 Terminology

Relation

Describe the relationship between two instances.

Association

Describe the relationship between an instance and an instance type.

1.3 Description

Two examples of inference rules are provided in order to give a more precise view of what an inference rule may look like for the KMapper.

knows(a?, ?b) ← (authorOf(?a, ?c) ^ authorOf(?b, ?c))

OR (emailSender(?a, ?d) ^ emailRecipient(?b, ?d))

OR (emailSender(?b, ?d) ^ emailRecipient(?a, ?d))

hasKnowledgeOf(?a, ?b) ← authorOf(?a, ?c) ^ hasSubject(?c, ?b)

1.4 Context of Use

The inference rules are inserted by the knowledge engineer in an activity that follows the realization of a domain ontology. Then, the inference rules will be automatically executed as long-running processes and it will result in the addition of new relations or associations in the KB. Finally, the end-user will see the inferred relations when using the KMapper.

2. Software Unit's Use Cases

2.1 Edit Inference Rule

A visual interface must allow the user to specify a name for the inference rule. Note that to be compliant with OWL (and Protégé), the name cannot contain any blank space (but underscores are allowed).

2.2 Insert Inference Rule

The knowledge engineer can submit an inference rule to the KMapper. This rule will be immediately added in the KB but no relations will be inferred until the scheduler starts the long-running processes.

Before the rule is inserted in the KB for future processing, the user should be given an option to preview the results. Please refer to *2.6 Preview Inference Rule* use cases.

2.3 Delete Inference Rule

The knowledge engineer can select an inference rule to delete it. A traditional confirmation message should be displayed. The user should be allowed to delete multiple inference rules at once.

The inference rule will be immediately deactivated in the KB, but modifications that result of the deletion of the rule will be performed when the long-running processes are executed. Indeed, removing an inference rule requires removing certain relations from the KB and it must be run as a long-running process.

2.4 Update Inference Rule

The knowledge engineer can modify any inference rule. When an inference rule is modified, it acts exactly as if the old rule was deleted, and then a new one is created. Therefore, refer to *2.2 Insert Inference Rule* and *2.3 Delete Inference Rule*.

2.5 Validate Inference Rule

Because of the complex syntax of inference rules, it is necessary to be able to validate the syntax of an inference rule to make sure that the system will be able to process the rule.

The inference rule will be validated when one of the following occurs:

- The user clicks on a “Validate” button.
- The user clicks on Submit. In this case, an automatic validation is performed.

2.6 Preview Inference Rule

Because inference rule can become complex, the knowledge engineer should be able to preview the result of an inference rule. That is, the rule should be executed and results displayed on the screen so that the user can validate that the newly create inference rule has the desired behaviour. [1]

[1] Note that if inference can be performed very quickly, implementing this feature makes sense. However, if executing an inference rules require a lot of time, then another strategy should be considered.

2.7 Update Inferred Knowledge

This is a long-running process that is called by the scheduler. It consists in:

- removing all the relations that were inferred via rules that have been updated or deleted;
- inferring new relations based on the new inference rules.

It is important to understand that only deleting the relations that have been inferred by the deleted inference rule is not sufficient. Indeed, the relations that were inferred may have been used in order to infer new knowledge. Therefore, each time an inferred relation is deleted, a check will also be performed to make sure that no other relation was inferred because of it.

Inferring all the new relations can be a lengthy operation depending on the number of inference rule, the size of the KB and the inference algorithm (to determine).

3. Local View on the Conceptual Data Model

Refer to the Database Design Description (DDD) document for the Conceptual Data Model.

4. Structure and Dynamics

4.1 Windows Interface

Inference rules will be edited via the SWRLTab plug-in that is embedded in Protégé. The plug-in has been tested and allows easily defining inference rules. A screenshot of the rule editor is provided below.

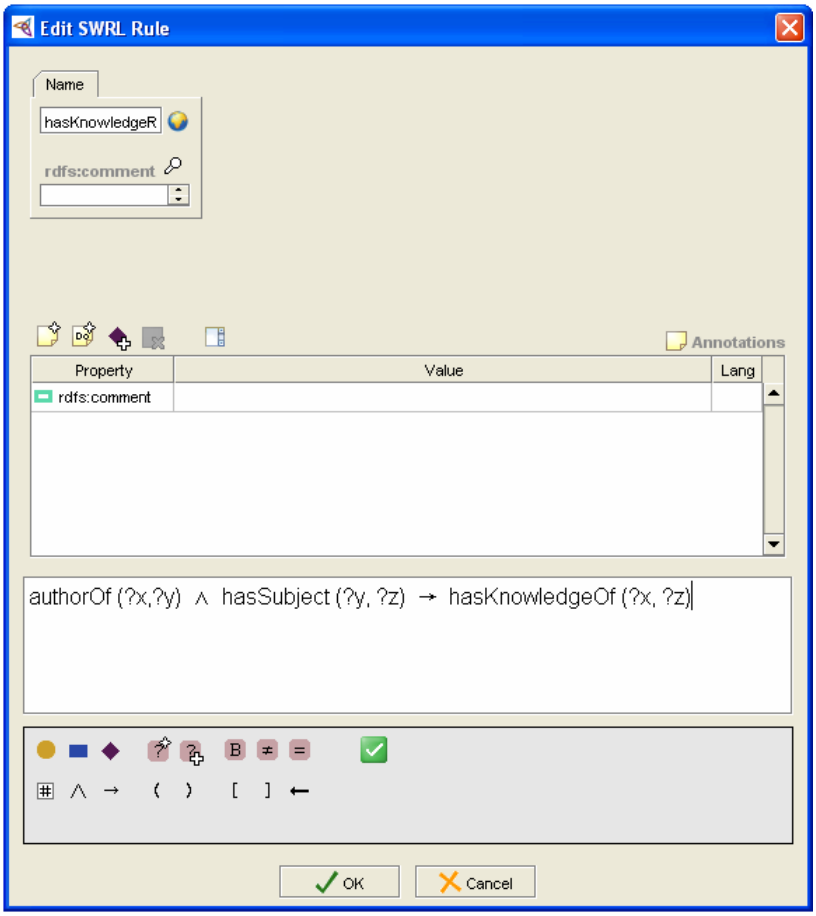

Figure 1 - SWRLTab Rule Editor

4.1.1 Navigation Elements

Standard with Protégé navigation elements.

5. Development Specifications

Note to the reader: Technical sections (5-6) of the Functional Blue Prints were beyond the scope of the present contract. These sections will be completed in parallel with the KMapper prototype realization:

- Software Unit Specifications
- Identified Services

5.1 General Specifications

The Knowledge Inferring services will use an inference library which implements an inference algorithm. Therefore, no inference algorithm will have to be developed in the KMapper.

Furthermore, inference rules will be created in SWRL by using the SWRLTab plug-in of Protégé.

This section describes how SWRL and the inference library can be used to manage all the inference needs of the KMapper.

6. Technical Specifications

Note to the reader: Technical sections (5-6) of the Functional Blue Prints were beyond the scope of the present contract. These sections will be completed in parallel with the KMapper prototype realization:

- General Specifications
- Database Specifications
- Tables
- Business Service Specifications
- Business Objects
- Web Client Specifications
- Windows Client Specifications

7. Requirements Traceability

No requirements have been established by the DRDC Scientific Authorities at this time.

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