Possible applications of knowledge approaches

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Abstract. *The paper nears problems of knowledge approaches and explains basic terms. It focuses on modern development tendencies in this field and so construes language for semantic description – OWL.*

The article also describes the theory of ontology and methodology of their development, as part of knowledge management. It don't forget on one of accessible solution for resulting usage representation and sharing knowledge in knowledge systems, i.e. subject maps subjects – the Topic Maps which are suitable implementation to the C2IS in the military area. The integral part of article is a view of available solutions and achieved the results of our semantic data access application research in commercial software.

Keywords

Ontology, OWL, knowledge management and development, Topic maps.

1. Introduction

The professionalization of the army generally is associated with an increase in requirements for information support of command and control processes, management and operation. Current issues are in the NEC (Network Enabled Capability) on acquisition of information superiority over the enemy by means of ICT (Information and Communication Technologies). Learning volumes of data that come primarily from information systems with databases, communication infrastructure, systems with sensors, fund unstructured data and applicable external data sources (Internet) can be used for finding broader connections between data and information that are carried by data. We try to draw from them the facts - knowledge that can be applied and used currently in the process of deciding commanders and their units. Knowledge base, which gathers knowledge, is used by knowledge systems that enable the collection, unification, presentation and maintenance of knowledge for subsequent use of the developed software applications.

Obtaining information superiority is regarded as one of the main objectives of the development of the armies all over the world. At a time when all the comprehensive combat systems controlled by automated computational units or centers that are properly kept secret, it can hardly be a person physically affect the final outcome of the fight. On the basis of information and knowledge can not predict and prevent devastating consequences. The civilian community is talking about information superiority in competing companies and the concept of Business Intelligence (BI), whose main task is the strategy, the determinant of the quality and efficiency of corporate management, is competitive. Linking BI and ICT solves problems of information - transaction systems (lack of availability or lack of analytical information), thus creating a space for improvement of management organization.

2. Basic terms

In the knowledge society are processed data - information - knowledge and used to improve productivity, decision making, thinking and innovation development. First, as we understand these concepts [1]:

data - in information and communication technologies, data can be characterized by a sequence of symbols or numbers, such as a sequence of units and zeros bearing;

information - can be defined as data whose content is unknown (semantics);

knowledge - the information is understood in the context, i.e., we can deduce facts from the information provided, use them and work with them.

We understand knowing like an area around the subject, which includes facts, concepts, relationships between them and the mechanism of their combination. Among the basic techniques of knowledge representation can be regarded as a triple (object - attribute - value), uncertain and fuzzy facts, rules, semantic networks and frames. Knowledge-based systems used for its operation, which is still updated with new knowledge from data. Of course we can not get a functional application, without including the language, or template, from which we were able to create relationships between related data, which are derived from the reams of data. Solution offers implementation of two basic standards - RDF (Resource Description Framework) and OWL, which is mentioned below.

2.1 Ontology and OWL

Definitions explaining the concept of ontology is several, the best known definition [2] characterizes the ontology as an explicit specification of conceptualization [3]. Conceptualization is meant to create an abstract model of real-world concepts of identifying the relevant section. Explicitly means clarity of the definition of the concept and conditions of using. Ontology is defined system of recording reality, which is at its core a universal, portable formally expressible and can be shared. These basic characteristics are a prerequisite for its applicability. As mentioned, ontology is a tool that provides variability and dynamics for Word Wide Web, which is required an ever growing amount of data.

Ontologies present simplification for knowledge-based design application, because ontologies separate application logic from data. In terms of the military ontology can be understood as an advanced use of thesauri and dictionaries to obtain the required data to a general request covering a wide range of concepts. Ontology can be divided into domain ontologies - which describes the restricted area (transport ground troops), task-ontology - focusing on the processes of decision-making (planning, exercise) and application ontologies - adapted to the specific application. Ontology structure is given by instances (individual) or session (functions, characteristics, attributes). For formal representation of ontologies has been created OWL (Web Ontology Language) standard by the W3C (World Wide Web Consortium) [4], consisting of three constructs (OWL Lite, OWL DL, OWL Full). It builds on previous experience with language DAML (DARPA Agent Markup Language) + OIL (Ontology Interchange Language). Other languages known as the "Semantic Web Languages" are RDF Core Model, RDFS Schema Language and SPARQL. All these languages are based on XML (eXtended Markup Language) and in many cases use its syntax. The primary use of ontologies is a derivation of facts and possible consequences from given information, which may interfere with nature just to NEC.

In addition, OWL provides the following inference tasks:

- *consistency* checks whether each of the defined concept has at least one chap;
- *checks* the individual, whether they fall under the concept;
- *implementation* - found the most specific concept, under which the individual comes;
- *searching* - find all individuals falling under the specified concept;
- *control of subsumpce* - control hierarchy of concepts.

The best known editors for creating ontologies include Protégé. Protégé represents one of the few available open-source tools for creating ontologies. The functionality of the Protégé includes a rich set of structures for modelling knowledge, components for creation and manipulation of ontologies in different formats. It offers the possibility of enrichment work in an environment of implementing the so-called plug-ins (add-on modules) used for visualization of ontologies (OWLViz plug-in), import, export, validation, natural language processing, etc. Protégé offers two basic ways of modelling ontologies [5], and editors. Frames Editor gives users the possibility to create ontologies, which are called frame-based course in terms of protocol OKCB (Open Knowledge Base Connectivity protocol). In such a model is an ontology based on a set of classes arranged in a hierarchy (super class and subclasses), characterizing a given domain concept and set of attributes belonging to various classes to describe their characteristics, relations and instances.

OWL editor is used to create ontologies for semantic web applications according to the W3C standards and standards for OWL. OWL ontology may include a description of classes, their properties and instances. Ontology thus generated can then be used to work with semantic data for deductive logic of the facts contained in them. The follow-up facts can be linked with one or more documents using OWL.

All sources of data and the data itself respect the access rights. To create ontologies in the military is a need to earmark specialists (KW, Knowledge Workers) caring for analytical detection and identification of new knowledge, systematic management and creation of knowledge creation and knowledge layers for user defined types. Applying Knowledge approaches lies mainly in the systematic work with the available information for decision support, reducing the time required to find information and increase control over information flows.

2.2 Ontology development

Creation of ontology is not a simple task. There is a brief procedure how to create ontology, but does not guarantee well-designed ontology for a specific domain. Common ontology creation process is as follows. The first step is the analysis of selected problematic area. The analysis consists in determining the conceptual apparatus that defines the entities and relationships between them, their description, etc. Based on the obtained apparatus is then derived conclusions and folded model situations. Now these results can be called ontologies in information technology [6, 7].

The cornerstones of each ontology are:

- *terminology (thesaurus);*
- *knowledge of basic relations (session);*
- *taxonomy.*

Most of common ontologies for web typically consist of taxonomy and sets of rules. The taxonomy defines classes of objects and their relations. Classes, subclasses and relations allow expression of a large number of relationships between entities. In fact, the subclass inherits properties of classes. Using inference rules, the computer is capable of already known facts to derive new facts.

Created ontologies used for its creation of the following steps:

1. Determination of scope and goals of ontology.
2. Identification of entities in the specific domain.
3. Arrangement of entities into a hierarchy.
4. Entity definition.
5. Entity properties.
6. Identifying relationships.
7. Clarification and extension.

Procedures for creating ontologies are different. There is no standardized model, method or methodology for creating ontologies right now. There were familiar methods and methodologies for building ontologies:

- Uschold and King.
- Grüninger a Fox.
- Amaya Berneras et al.
- Methondology
- Cyc

2.3 *Topic Maps*

Knowledge that can be stored in ontologies is needed to present and share so that the user of information systems gains benefits. For intuitive knowledge representation of ontology was developed standard ISO 13 250 Topic Maps (TM). The standard takes pride in having access to ontologies based on the idea of a register book. Individual index entries represent the index as a tool for finding information. Index themselves also bear on the specification of the extension of the concept, which represent a particular type of result given query. Topic Maps offer a way to navigate the information sources and present the formalism for knowledge representation. They are based on key themes - topics, which are comparable to the indices, which facilitate easier orientation in the web environment.

Topic Maps consist of the following:

- *theme (topic)* - can be characterized as a key word, which is essential for us to search for connections with him, then themes are named entities of interest and may have multiple names;
- *association* - to express relationships between themes expressed is bidirectional connection, the effect of expressing so-called background role. Can be closer to the sessions for data models DB;
- *occurrence* - contains information relevant to the topic may have the type of information and can refer directly or contain.

Basic concept model TM consists of two layers - a layer of knowledge, including topics, associations and occurrences and layers of information sources providing the content data. Layers are interconnected by means of occurrence - Figure 1.

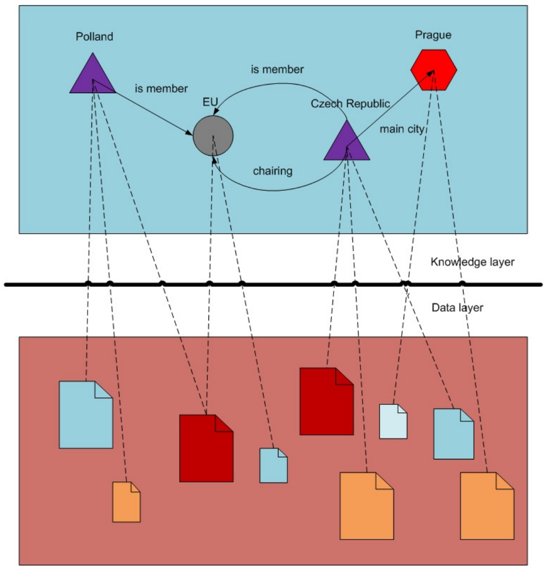

Fig. 1. Basic model of Topics Map

Topics represent items that we want to express. Each theme represents just one subject. The theme is a place in Topic Maps, where relations with and all known occurrences available information about the subject. Subject locator calls address - link, which uniquely identifies the subject (Subject Locator). Principal object is an information resource that is not directly addressable, but there's addressable indicator - the identifier object (Subject Identifier). The last element of Topic Maps is a public subject indicator (PSI, Published Subject Indicator) designed for the global sharing, see Figure 2.

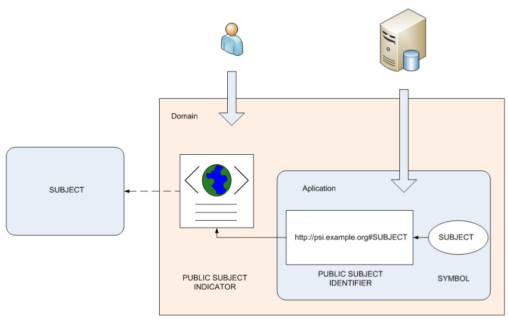

Fig. 2. Schema of constructs in the Topic Maps

3. Application research in Oracle

Oracle database semantic technologies support is focus of Resource Description Framework (RDF) and a subset of the Web Ontology Language (OWL). The main assumptions of semantic technologies work are familiar with the major concepts associated with RDF and OWL, such as triples {subject, predicate, object}, URIs (Universal Resource Identifier), literals and ontologies. The semantic support in Oracle is a part of data spatial work – survival net of objects. Semantic technologies in Oracle are in relations as shown on the picture below (Figure 3). It contains four modules. The modules are STORE (memory area), QUERY (request), INFER (deduction) and user database.

Oracle database provides module Oracle Spatial [8, 9] for semantic technologies. Packages are the main components of Oracle Spatial, for example SEM_APIS package with functions and procedures for semantic data manipulation. Semantic data modeling is based on triples {subject, object, predicate}. Every component has own title and is saving to dedicated column of the table. The triple takes entire and unique information about specific domain and it is introducing by link in oriented graph. The triples are database objects.

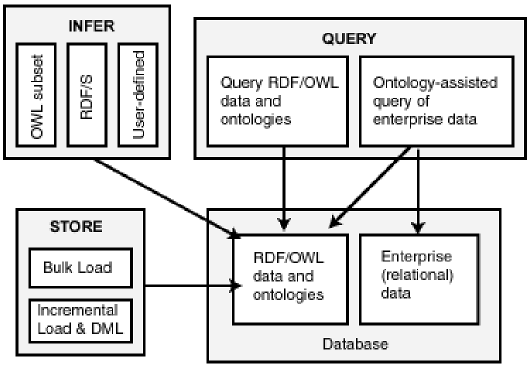

Fig. 3. Oracle Semantic technologies

Semantic data in DBMS must fulfil the following requirements:

- a subject must be a URI or a blank node;
- a link must be a URI;
- object can be any type, such as a URI, a blank node, or a literal, but not NULL values.

The standard database model of triples includes OWNER (schema of the model owner), ID (automatically generated identifier), TABLE_NAME (name of the table to hold references to semantic data for the model), COLUMN_NAME (name of the column of triples type) and TABLESPACE (name of the tablespace to be used for storing the triples).

Semantic approaches include definition of rules and rulebase creation, which returns logical results on query. For example all relations about term engaged in query. A relation between semantic data can be described by rules; each rule is identified by name and consists of:

- condition, an IF side pattern for the antecedents;
- filter condition, matched by the IF side pattern;
- consequence, a THEN side pattern.

A rulebase supports RDFS, RDF, OWLSIF, RDFS++ and OWLPRIME. The important concept is a rules index. It is an object containing precomputed triples that can be inferred from a specified set of rulebases or models. Semantic model of RDMS can work with a virtual model. The virtual model is a logical graph that can be used in a semantic query. A virtual model is the result of the UNION or the UNION ALL operations on one or more models and the corresponding rules index. Using a virtual model we can create one shared interface that simplifies management of access privileges and fast access for each semantic model.

3.1 OWL support

OWL is interpreted RDF database. In fact, a network of RDF graphs and cooperation between entities and their relationships, which on the basis of these facts is to derive the logical connections.

Such facts

:part of	**rdf: type**	**owl: transitive property**
:Brno	:part of	:South Moravia
:South Moravia	:part of	:Czech Republic

Derived facts

:Brno	:part of	: Czech Republic

Tab. 1. OWL in RDF support

3.2 Module for working with RDF

Ontology is a formal and explicit specification of shared knowledge conceptualization in a particular domain. It consists of sets of classes and their instances. RDFS based ontologies describe classes, relations between them, their cardinality and extensions. Simple OWL ontology example in our environment follows. Firstly we create the table for storing the ontology (CREATE TABLE) and activate it (EXECUTE). Then, we insert the triples into the table:

```
CREATE TABLE owltable(id number, triple
sdo_rdf_triple_s);
EXECUTE
sem_apis.create_sem_model('owltable','owltable',
'triple');
```

```
INSERT INTO owltable VALUES (1,
sdo_rdf_triple_s('owltable',
  'http://unob.cz/name/Petr',
    'http://portal.unob.cz/2009/owl#sameAs',
      'http://unob.cz/name/PetrDo'));
```

Using SEM_MATCH command we can perform a simple query:

```
SELECT s,p,o FROM table (SEM_MATCH('(?s ?p ?o)',
SEM_MODELS('owltable'),null, null, null ));
```

On the next example the ontology with the user-defined rules is created and processed:

```
INSERT INTO owltable VALUES (1,
sdo_rdf_triple_s('owltable',
          'http://unob.cz/name/Petr',
          'http://unob.cz/rel/studentOf',
          'http://unob.cz/name/Ladislav'));
INSERT INTO owltable VALUES (1,
sdo_rdf_triple_s('owltable',
          'http://unob.cz/name/Vojta',
          'http://unob.cz/rel/ classmateOf',
          'http://unob.cz/name/Petr'));
       // Create a user-defined rulebase
EXECUTE
sem_apis.create_rulebase('user_rulebase');
       // Insert a simple "teacher" rule
INSERT INTO mdsys.semr_user_rulebase VALUES
('teacher_rule','
(?x<http://unob.cz/rel/classmateOf> ?y)
(?y<http://unob.cz/rel/studentOf> ?z)',NULL,'
(?z <http://unob.cz/rel/teacherOf> ?y)', null);
```

As a result of the previous query we get correct statement about defined rule. Ladislav is a teacher of both Vojta and Petr.

```
:Ladislav :teacherOf :Vojta is inferred
```

Ultimate form of knowledge system will achieve by developing a software application that will be able to work together with ontology, i.e. tables with semantic data store in the database [9]. On the basis of the knowledge system can be deployed, providing the interface between the user and semantic data. This is achieved just smarter, more efficient, faster and most accurate return value to the user's query. Using elements of Topic Maps can also obtain the correlation between various systems and maximize information resources.

Conclusion

This paper aims to bring the issue of knowledge engineering and knowledge management, focusing on the possibility of deploying ontologies for the modern applications development. Provides an overview of commonly used ontology development methodologies, shows the appropriate implementation software environments that have been deployed to tackle projects at the University of Defence.

Using knowledge approaches generally could help form an integral part of web applications. It offers conditions for the implementation of the existing information systems without the need for their integration. Guarantee the implementation of migration could be the ISO standards of knowledge issues like RDF and Topic Maps.

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