
Web Ontology to Facilitate Semantic Web

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Abstract

Today most of the functions that we perform on Internet, like- searching, retrieving, interpreting, analyzing, tracking records, etc. depend on the concept of semantic web. Development of semantic networks largely depends on ontologies. This article focuses on various aspects of Web Ontology and some real time examples to make explicit the use of ontology for development of semantic web.

Keywords : Internet, Ontology, Semantic Web, Knowledge representation, Scholarly interpretation, Discourse.

0. Introduction

To begin, let's start with a very common term, i.e., INTERNET. Nature of Internet or Web can be loosely defined by using the following terms.

1. Web is *distributed*, i.e., information is scattered.
2. Web is *massive*. It is an unmanaged and uncontrolled beast of information hub.
3. Web is *dynamic*. It is ever changing, thus information on it is never permanent and keeps changing its addresses.
4. Web is *open source*, i.e., any person at any time from any location can access any information on Internet.

Looking at the above features of web, one thing that everyone is bound to think is that Internet needs to be controlled. Thus nowadays researchers are coming out with various solutions. They have created indexes and controlled vocabulary type of structures to manage the information on web. But nothing full-fledged has come up so far.

Now is the time to think of something more than normal indexes, which are being developed by computer professionals who are ideally not skilled for this job. We require to come up with something using librarians' skills, like developing structured vocabulary using ontologies, which will help in adding semantics to the web. This means that ontologies can be used to develop semantic network.

According to definition given by *Tim Berners-Lee, James Hendler, Ora Lassila, The Semantic Web, Scientific American, May 2001[1]* –

“The Semantic Web is not a separate Web but an extension of the current one, in which information is given well-defined meaning, better enabling computers and people to work in cooperation.”

Before going into details of ontology, let's have a brief look on how Semantic Network works:

1. Semantic Network

Geoffrey P. Malafsky explains the working of semantic network in the following way:

“Semantic networks use word meanings and usage to improve context sensitivity. Query terms are parsed against an electronic dictionary which allows any or all of the multiple meanings of the word to be used and assigned weighting factors. Each word meaning is then expanded into a set of synonyms and antonyms from a thesaurus, and tied together with Boolean operations. This entire set of terms is then used for the search. Statistical calculations assess both the physical proximity of terms and their semantic distances (word relationships) to further refine the conceptual fidelity. [2]”

Several compendiums have been developed which defines semantic relationships in different fields and are used for browsing and editing ontologies and knowledge bases, for example, Wordnet (<http://www.cogsci.princeton.edu/~wn/>) and Ontosaurus (http://ksi.cpsc.ucalgary.ca/KAW/KAW96/swartout/ontosaurus_demo.html, <http://mozart.isi.edu:8003/sensus2/>). About these we will discuss in little detail later in this article.

2. Nature of Jobs On Web

Basically we do three types of jobs on Internet, viz., *publishing*, *obtaining* (i.e. retrieval) and *interpreting* the documents.

Now the time is approaching when researchers are themselves going for publishing their documents on the Internet (or Intranet), leading to an unmanageable number of web documents. For this they use personal, institutional or discipline-specific servers. *Publishing* documents on web is only the initial step. Next harder function is *obtaining* the most relevant documents (i.e. information retrieval). And the most difficult job is to prepare code to support *interpretation* of these documents computationally. So basically in this article we will look upon the problem of describing information, which is in digitized form, on web.

The main problem in doing the third task discussed above, i.e., interpretation, is that in [3] open and evolving environments such as the World Wide Web, discovering, integrating and accessing information are difficult and complex tasks due to the semantic heterogeneities resulting from the different terminologies and conceptualizations employed by the various information providers and consumers, i.e., difference in terminological understanding of authors and readers belonging to same subject domain.

But the question is why we at all need to interpret the web documents?

We need to understand the semantics of web documents computationally so as to manage and control it automatically. Interpretation of web information is required for:

- Knowledge Management. You can't manage knowledge without understanding it.
- Enable Web Commerce. Since last many years e-commerce is the buzzword in business world. The basic need of e-commerce is that one machine should understand the data available with other machine, or with some human agent, semantically, i.e., our computer should be able to interpret that data semantically.
- To support scholarly interpretation and discourse. The fundamental problem faced by author and readers today is how to contextualize ideas of a given document, i.e., getting answers for fundamental questions like – is the document in question new, significant and trustworthy? To help the scholars in searching, tracking, analyzing or debating concepts in a literature from scholarly perspectives, we need to develop some methodology. Web ontology can be suggested for solving this type of problem.

3. Difficulties in Interpretation

Difficulties in computerized interpretation can arise due to:

- Structural heterogeneity \neq Structure and syntax of web documents differ a lot making it difficult to establish conceptual relationship between semantically similar documents.
- Semantic heterogeneity \neq Semantic heterogeneity occurs when conceptually same documents use differing terminologies or same terminology is used to represent different concepts.

This means there should be proper conceptual mapping between concepts and terms, i.e., we need to add semantics to the web. For this we need representation languages (like OIL and OWL). Languages provide formal syntax and semantics, and also standardized vocabulary to share knowledge and information between machines and human agents. Languages provide all this by using ontologies.

Ontologies and thesauri can be considered as orthogonal ways for describing information. Web ontologies are nothing but declarative specifications of the concepts and roles in a domain of discourse, and provide structural, sharable views of information [3]. An ontology represents a scholarly community's consensus over conceptualization of a particular domain. Thus, this is the best way to interpret scholarly web documents.

To understand how to use ontology for controlling information available on web, lets first try to understand what is ontology and from where this term has originated.

4. What is Ontology

The term "ontology" has been used in many disciplines including Philosophy, Knowledge Management, Library Science, Knowledge Engineering and now also in Artificial Intelligence. A general definition of ontology, which we can put as common to all disciplines, is –

"An ontology is a logical structure which is composed of concepts with complete hierarchy, properties of each concept, relationships between concepts and also constraints associated with each concept."

Ontology is a very old concept which originated some 2000 years ago as part of philosophy at the time of Aristotle, which according to Aristotle himself is [4] –

— *"The metaphysical study of the nature of being and existence"*

This term later was picked up by the Artificial Intelligence as [4]

— *"A shared and common understanding of some domain that can be communicated between people and application systems"*

— Gruber (1994)

Ontology is the theory of objects and their ties. The unfolding of ontology provides criteria for distinguishing various types of objects (concrete and abstract, existent non-existent, real and ideal, independent and dependent) and their ties (relations, dependence and predication) [5].

5. Web Ontology

We saw that ontology is a philosophical theory about the nature of existence, but artificial intelligence guys have given their own definition to this term as [6] –

“Ontology means the construction of *knowledge models* which specify concepts or objects, their attributes, and their inter-relationships.”

A knowledge model is a specification of a domain, or problem-solving behaviour, which abstracts from implementation-specific considerations and focuses instead on the concepts, relations, and reasoning steps characterizing the phenomenon under investigation [6].

It refers to the shared understanding of some domain of interest, which is often conceived as a set of classes (concepts), relations, functions, axioms and instances (Gruber, 1993) [7]. For AI (Artificial Intelligence) systems, what “exists” is that which can be represented. When the *knowledge* about a *domain* is represented in a *declarative language*, the set of objects that can be represented is called the “*universe of discourse*”. We can describe the ontology of a program by defining a set of representational terms. Definitions associate the names of entities in the *universe of discourse* (e.g. classes, relations, functions or other objects) with human-readable text describing what the names mean, and formal *axioms* that constrain the interpretation and well-informed use of these terms. Formally, an ontology is the statement of a *logical theory* [8].

In the web environment, ontologies are used to share and exchange information between sources. In the field of information systems, and database systems, an ontology would be represented by a conceptual schema [3] (for which metadata schema like RDF can be used).

6. Functions of Ontologies

Dagobert Soergel defines functions of ontologies as follows [9]:

- Provide a semantic road map to individual fields and the relationships among fields, thus serving as a reference tool. Ontologies relate concepts to terms and provide definitions.
- Improve communication and learning by providing conceptual frameworks and challenging students to produce such frameworks. It also assists writers and readers.
- Provide the conceptual basis for the design of good research and implementation. It also helps in structuring the research problem and exploring the conceptual context of a research.
- Support information retrieval: provide knowledge-based support of end-user searching (menu trees, guided faceted analysis of a search topic, browsing a hierarchy or concept map to identify search concepts, mapping from the user's query terms to descriptors used in one or more databases or to the multiple natural language expressions for free-text searching). It also supports well-structured displays of search results and provides a tool for indexing.
- Provide the conceptual basis for knowledge-based systems.
- Do all this across disciplines, languages, and cultures.
- Serves as dictionary/knowledge-base for natural language processing.

7. Benefits of Web Ontology

Ontologies help people and computers to access the information they need, and effectively communicate with each other. Few benefits of ontologies are [10]:

- Reusability : the ontology forms the basis for formal representation of entities, attributes, processes and their inter-relationships in a particular domain of interest. This formal representation may be a reusable and/or shared component in a software system.
- Search : an ontology may be used as metadata serving as an index into a repository of information.
- Reliability : A formal representation makes possible the automation of consistency checking resulting in more reliable software.
- Maintenance : use of ontologies in system development can render maintenance easier in a number of ways. Systems which are built using explicit ontologies serve to improve documentation of the software which reduces maintenance costs.

8. Examples of Some Web Ontologies

Here are some important ontologies developed by the artificial intelligence community and language engineering community. These ontologies stand as landmarks in the development of ontology based knowledge representation.

- Cyc. : Cyc ontology is one of the important parts of the CYC project (Cycorp). The Cyc knowledge base (KB) is a formalized representation of a vast quantity of fundamental human knowledge: facts, rules of thumb, and heuristics for reasoning about the objects and events of everyday life.

Cycused Cycorp's self developed representation language – CycL.

(<http://www.cyc.com/cyc-2-1/intro-public.html>)

- Enterprise Ontology : The Enterprise Ontology is a collection of terms and definitions relevant to business enterprises. The ontology was developed in the "Enterprise Project" by the Artificial Intelligence Applications Institute at the University of Edinburgh with its partners: IBM, Lloyd's Register, Logica UK Limited, and Unilever. The project was support by the UK's Department of Trade and Industry under the Intelligent Systems Integration Programme (project no IED4/1/8032)
- STEP. : [7] It is a draft ISO standard for the exchange of CAD data. ISO 10303 is an international standard for the computer-interpretable representation and exchange of product data. STEP (Standard for The Exchange of Product model data) is a kind of semi-informal ontology used for the interoperability and exchanges of product among different computer systems. (Uschold & Grunigue, 1996).
- WordNet : It is a general linguistic ontology formed by synsets - terms grouped into semantic equivalence sets, each one assigned to a lexical category (noun, verb, adverb, adjective). Each synset represents a particular sense of an English word and is usually expressed as a unique combination of synonym words. WordNet can be downloaded free of cost from the web site —

<http://www.cogsci.princeton.edu/~wn/obtain.shtml>

- Sensus : SENSUS is a 70,000-node terminology taxonomy, as a framework into which additional knowledge can be placed. SENSUS is an extension and reorganization of WordNet (built at Princeton University by George Miller, Christiane Fellbaum and colleagues). SENSUS can be browsed using the viewer Ontosaurus (<http://mozart.isi.edu:8003/sensus2>).

9. Practical Implementations of Ontologies

The ontologies given below have been developed under Computer Aided Knowledge Engineering (CAKE) Project, by DRC (Dynamics Research Corporation, US). These are real world examples of DAML (DARPA Agent Markup Language) Ontologies [11].

```
<?xml version="1.0" encoding="ISO-8859-1" ?>
- <rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#" xmlns:rdfs="http://
www.w3.org/2000/01/rdf-schema#" xmlns:daml="http://www.daml.org/2001/03/daml+oil#"
xmlns:xsd="http://www.w3.org/2001/XMLSchema#" xmlns:ves="http://orlando.drc.com/
SemanticWeb/DAML/Ontology/VES/ver/0.1.0/drc-ves-ont#" xmlns:dc="http://orlando.drc.com/
SemanticWeb/DAML/Ontology/DC/ver/0.1.0/dces-ont#" xmlns="http://orlando.drc.com/
SemanticWeb/DAML/Ontology/DC/ver/0.1.0/dces-ont#">
- <!--
DRC DCES Ontology metadata
-->
<!--Ontology has been defined below: --!>
- <daml:Ontology rdf:about="">
- <ves:versioning>
- <ves:VersionData>
<dc:title>The Dublin Core Element Set Ontology</dc:title>
<ves:version>0.1.0</ves:version>
<dc:creator>DRC</dc:creator>
<dc:contributor>Dan King</dc:contributor>
<ves:email>TeamXML@drc.com</ves:email>
<ves:releaseDate>2002-09-05</ves:releaseDate>
<ves:releaseLevel>beta</ves:releaseLevel>
<ves:status>current</ves:status>
</ves:VersionData>
</ves:versioning>
<daml:imports rdf:resource="http://www.daml.org/2001/03/daml+oil" />
<daml:comment>This DCES ontology was derived from the v1.1 Element Set from Dublin
Core. This ontology should be used until DC creates an official DAML version of their
Element Set.</daml:comment>
<daml:comment>IMPORTANT: The true Namespace for Dublin Core ES v1.1 is 'http://
purl.org/dc/elements/1.1/'. However, the DAML Validator produces an warning/error when it
is used because DC does not have a DAML document at the Namespace location. Hence
for the pupose of DAML validation, this document references a DRC Namespace for the
DCES.</daml:comment>
- <!--
DCES metadata
-->
<dc:title>The Dublin Core Element Set (ver 1.1)</dc:title>
<dc:publisher>The Dublin Core Metadata Initiative</dc:publisher>
<dc:description>The Dublin Core metadata vocabulary is a simple vocabulary intended to
facilitate discovery of resources.</dc:description>
<dc:language>English</dc:language>
<dc:relation>http://dublincore.org/documents/dces/</dc:relation>
<dc:date>2000-07-02</dc:date>
</daml:Ontology>
```

```

<!--Here Ontology part ends --!>
<!--DC elements have been defined below --!>
- <daml:DatatypeProperty rdf:ID="title">
<daml:label>Title</daml:label>
<daml:comment>A name given to the resource.</daml:comment>
<daml:comment>Typically, a Title will be a name by which the resource is formally known.</
daml:comment>
</daml:DatatypeProperty>

<!--similarly other elements have been defined which can be viewed by clicking on "+" sign
against the statements below on the xml web page --!>
+ <daml:DatatypeProperty rdf:ID="contributor">
<daml:label>Contributor</daml:label>
<daml:comment>An entity responsible for making contributions to the content of the
resource.</daml:comment>
<daml:comment>Examples of a Contributor include a person, an organisation, or a service.
Typically, the name of a Contributor should be used to indicate the entity.</daml:comment>
</daml:DatatypeProperty>
+ <daml:DatatypeProperty rdf:ID="creator">
<daml:label>Author/Creator</daml:label>
<daml:comment>An entity primarily responsible for making the content of the resource.</
daml:comment>
<daml:comment>Examples of a Creator include a person, an organisation, or a service.
Typically, the name of a Creator should be used to indicate the entity.</daml:comment>
</daml:DatatypeProperty>
+ <daml:DatatypeProperty rdf:ID="publisher">
<daml:label>Publisher</daml:label>
<daml:comment>An entity responsible for making the resource available.</daml:comment>
<daml:comment>Examples of a Publisher include a person, an organisation, or a service.
Typically, the name of a Publisher should be used to indicate the entity.</daml:comment>
</daml:DatatypeProperty>
+ <daml:DatatypeProperty rdf:ID="subject">
<daml:label>Subject</daml:label>
<daml:comment>The topic of the content of the resource.</daml:comment>
<daml:comment>Typically, a Subject will be expressed as keywords, key phrases or
classification codes that describe a topic of the resource. Recommended best practice is to
select a value from a controlled vocabulary or formal classification scheme.</
daml:comment>
</daml:DatatypeProperty>
+ <daml:DatatypeProperty rdf:ID="description">
<daml:label>Description</daml:label>
<daml:comment>An account of the content of the resource.</daml:comment>
</daml:DatatypeProperty>
+ <daml:DatatypeProperty rdf:ID="date">
<daml:label>Date</daml:label>
<daml:comment>A date associated with an event in the life cycle of the resource.</
daml:comment>

```

```
<daml:comment>Typically, Date will be associated with the creation or availability of the
resource. Recommended best practice for encoding the date value is defined in a profile of
ISO 8601 [W3CDTF] and follows the YYYY-MM-DD format.</daml:comment>
</daml:DatatypeProperty>
+ <daml:DatatypeProperty rdf:ID="type">
<daml:label>Resource Type</daml:label>
<daml:comment>The nature or genre of the content of the resource.</daml:comment>
</daml:DatatypeProperty>
+ <daml:DatatypeProperty rdf:ID="format">
<daml:label>Format</daml:label>
<daml:comment>The physical or digital manifestation of the resource.</daml:comment>
<daml:comment>Typically, Format may include the media-type or dimensions of the
resource. Format may be used to determine the software, hardware or other equipment
needed to display or operate the resource. Examples of dimensions include size and
duration. Recommended best practice is to select a value from a controlled vocabulary (for
example, the list of Internet Media Types [MIME] defining computer media formats).</
daml:comment>
</daml:DatatypeProperty>
+ <daml:DatatypeProperty rdf:ID="identifier">
<daml:label>Resource Identifier</daml:label>
<daml:comment>An unambiguous reference to the resource within a given context.</
daml:comment>
<daml:comment>Recommended best practice is to identify the resource by means of a
string or number conforming to a formal identification system. Example formal identification
systems include the Uniform Resource Identifier (URI) (including the Uniform Resource
Locator (URL)), the Digital Object Identifier (DOI) and the International Standard Book
Number (ISBN).</daml:comment>
</daml:DatatypeProperty>
+ <daml:DatatypeProperty rdf:ID="language">
<daml:label>Language</daml:label>
<daml:comment>A language of the intellectual content of the resource.</daml:comment>
<daml:comment>Recommended best practice for the values of the Language element is
defined by RFC 1766 [RFC1766] which includes a two-letter Language Code (taken from
the ISO 639 standard [ISO639]), followed optionally, by a two-letter Country Code (taken
from the ISO 3166 standard [ISO3166]). For example, 'en' for English, 'fr' for French, or 'en-
uk' for English used in the United Kingdom.</daml:comment>
</daml:DatatypeProperty>
+ <daml:DatatypeProperty rdf:ID="relation">
<daml:label>Relation</daml:label>
<daml:comment>A reference to a related resource.</daml:comment>
<daml:comment>Recommended best practice is to reference the resource by means of a
string or number conforming to a formal identification system.</daml:comment>
</daml:DatatypeProperty>
+ <daml:DatatypeProperty rdf:ID="source">
<daml:label>Source</daml:label>
<daml:comment>A Reference to a resource from which the present resource is derived.</
daml:comment>
<daml:comment>The present resource may be derived from the Source resource in whole
or in part. Recommended best practice is to reference the resource by means of a string or
number conforming to a formal identification system.</daml:comment>
</daml:DatatypeProperty>
```



```

+ <daml:DatatypeProperty rdf:ID="coverage">
<daml:label>Coverage</daml:label>
<daml:comment>The extent or scope of the content of the resource.</daml:comment>
<daml:comment>Coverage will typically include spatial location (a place name or
geographic coordinates), temporal period (a period label, date, or date range) or jurisdiction
(such as a named administrative entity). Recommended best practice is to select a value
from a controlled vocabulary (for example, the Thesaurus of Geographic Names [TGN]) and
that, where appropriate, named places or time periods be used in preference to numeric
identifiers such as sets of coordinates or date ranges.</daml:comment>
</daml:DatatypeProperty>
+ <daml:DatatypeProperty rdf:ID="rights">
<daml:label>Rights</daml:label>
<daml:comment>Information about rights held in and over the resource.</daml:comment>
<daml:comment>Typically, a Rights element will contain a rights management statement
for the resource, or reference a service providing such information. Rights information often
encompasses Intellectual Property Rights (IPR), Copyright, and various Property Rights. If
the Rights element is absent, no assumptions can be made about the status of these and
other rights with respect to the resource.</daml:comment>
</daml:DatatypeProperty>
</rdf:RDF>

```

9.1 National Security Ontology

This ontology represents the high-level classes and relationships for the National Security Organization of the US. It is also developed using 0.1.0 version of DAML. XML page looks like:

```

<?xml version="1.0" encoding="ISO-8859-1" ?>
- <rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#" xmlns:rdfs="http://
www.w3.org/2000/01/rdf-schema#" xmlns:daml="http://www.daml.org/2001/03/daml+oil#"
xmlns:xsd="http://www.w3.org/2001/XMLSchema#" xmlns:dc="http://orlando.drc.com/
SemanticWeb/DAML/Ontology/DC/ver/0.1.0/dces-ont#" xmlns:ves="http://orlando.drc.com/
SemanticWeb/DAML/Ontology/VES/ver/0.1.0/drc-ves-ont#" xmlns:nso="http://
orlando.drc.com/SemanticWeb/DAML/Ontology/NationalSecurity/ver/0.1.0/NSO-ont#"
xmlns="http://orlando.drc.com/SemanticWeb/DAML/Ontology/NationalSecurity/ver/0.1.0/
NSO-ont#">
- <daml:Ontology rdf:about="">
- <ves:versioning>
- <ves:VersionData>
<dc:title>National Security Organization Ontology</dc:title>
<ves:version>0.1.0</ves:version>
<ves:email>TeamXML@drc.com</ves:email>
<dc:creator>DRC</dc:creator>
<ves:releaseDate>2002-09-05</ves:releaseDate>
<ves:release>beta</ves:release>
<ves:status>current</ves:status>
<dc:source>AFCS Pub 1; The Joint Staff Officer's Guide, 2000</dc:source>
</ves:VersionData>
</ves:versioning>
<daml:imports rdf:resource="http://www.daml.org/2001/03/daml+oil" />
<daml:imports rdf:resource="http://orlando.drc.com/SemanticWeb/DAML/Ontology/VES/ver/
0.1.0/drc-ves-ont" />

```

```

<daml:comment>This ontology represents the high-level classes and relationships for the
National Security Organization of the US.</daml:comment>
</daml:Ontology>
- <!--
  Abstract Classes *****
  -->
<daml:Class rdf:ID="Role">
<daml:label>Role</daml:label>
<daml:comment>A position/job/function that is held by a person.</daml:comment>
• </daml:Class>
+ <daml:Class rdf:ID="Secretary">
<daml:label>Secretary</daml:label>
<daml:comment>A national secretarial role.</daml:comment>
<daml:subClassOf rdf:resource="#Role" />
</daml:Class>
+ <daml:Class rdf:ID="JointChiefOfStaff">
<daml:label>Joint Chief of Staff</daml:label>
<daml:comment>A Joint Chief of Staff.</daml:comment>
<daml:subClassOf rdf:resource="#Role" />
</daml:Class>
+ <daml:Class rdf:ID="MilitaryServiceChief">
<daml:label>Military Service Chief</daml:label>
<daml:subClassOf rdf:resource="#JointChiefOfStaff" />
</daml:Class>
+ <daml:Class rdf:ID="NationalCommandAuthority">
<daml:label>National Command Authority</daml:label>
<daml:comment>A National Command Authority of the US, of which there are only two: the
President and the Secretary of Defense.</daml:comment>
<daml:subClassOf rdf:resource="#Role" />
</daml:Class>
+ <daml:Class rdf:ID="Commander">
<daml:label>Commander</daml:label>
<daml:subClassOf rdf:resource="#Role" />
</daml:Class>
+ <daml:Class rdf:ID="Organization">
<daml:label>Organization</daml:label>
</daml:Class>
+ <daml:Class rdf:ID="Department">
<daml:label>Department</daml:label>
<daml:subClassOf rdf:resource="#Organization" />
</daml:Class>
+ <daml:Class rdf:ID="ArmedForceDepartment">
<daml:label>Armed Force Department</daml:label>
<daml:subClassOf rdf:resource="#Department" />
- <daml:subClassOf>
- <daml:Restriction>
<daml:onProperty rdf:resource="#hasIndividualMember" />
<daml:hasClass rdf:resource="#Secretary" />
</daml:Restriction>
</daml:subClassOf>

```

```

- <daml:subClassOf>
- <daml:Restriction>
<daml:onProperty rdf:resource="#hasIndividualMember" />
<daml:hasClass rdf:resource="#MilitaryServiceChief" />
</daml:Restriction>
</daml:subClassOf>
- <daml:subClassOf>
- <daml:Restriction>
<daml:onProperty rdf:resource="#hasArmedForce" />
<daml:hasClass rdf:resource="#ArmedForce" />
</daml:Restriction>
</daml:subClassOf>
</daml:Class>
+ <daml:Class rdf:ID="ArmedForce">
</rdf:RDF>

```

10. Conclusion

The web has established itself as a medium for research document dissemination [6]. To metamorphise the web into semantic web, ontologies have proved themselves to be the basic stepping-stone. Ontologies help in interpreting the information content of web documents. To develop web ontologies we can use various representation languages which have been developed in due course, like, OIL, OWL, DAML+OIL, OCML (Operational Conceptual Modelling Language), etc. We can also call ontologies as web classification or web taxonomies.

Thus in one line we can say that web ontologies have been developed to lead us one step ahead in the area of Artificial Intelligence.

```
<daml:label>Armed Force</daml:label>
```

```
</daml:Class>
```

11. References

1. Tim Berners-Lee, James Hendler and Ora Lassila. "The Semantic Web", <<http://www.scientificamerican.com/article.cfm?articleID=00048144-10D2-1C70-84A9809EC588EF21&pageNumber=1&catID=2>> (30 November, 2003).
2. Geoffrey P. Malafsky. "Technology for Acquiring and Sharing Knowledge Assets". In *Handbook on Knowledge Management*, Volume 2: Knowledge Directions, edited by C.W. Holsapple, 85-107. Berlin: Springer- Verlag, 2003.
3. Bernd Amann, Irini Fundulaki, Michel Scoll. "Integrating Ontologies & Thesauri for RDF schema creation and metadata querying". *International Journal on Digital Libraries*, Volume 3, Number 3, October 2000, pp. 221-236.
4. D.Fensel. "Lecture Telecooperation". <<http://www.nextwebgeneration.org/telecoop03/lecture1.pp>> (15 October, 2003).
5. Raul Corazzon. "Descriptive and Formal Ontology". <<http://www.formalontology.it/>> (22 September, 2003).

6. Simon Buckingham Shum, Enrico Motta, John Domingue. "ScholOnto: an ontology-based digital library server for research documents and discourse". *International Journal on Digital Libraries*, Volume 3, Number 3, October 2000, pp. 237-248.
7. Ying Ding. "Ontology: The enabler for the Semantic Web". <<http://homepage.uibk.ac.at/~c703205/download/ontology.pdf>>, (18 October, 2003).
8. "FOLDOC (Free On-Line Dictionary Of Computing)". <<http://wombat.doc.ic.ac.uk/foldoc/foldoc.cgi?query=ontology>>, (15 October, 2003).
9. Dagobert Soergel. "The rise of ontologies or the reinvention of classification". *JASIS*, Volume 50, Number 12, October 1999, pp. 1119-1120.
10. Robert Jasper and Mike Uschold. "A Framework for Understanding and Classifying Ontology Applications". <<http://sern.ucalgary.ca/KSI/KAW/KAW99/papers/Uschold2/final-ont-apn-fmk.pdf>> (9 November, 2003).
11. "Ontologies: Computer Aided Knowledge Engineering (CAKE) Project", <<http://orlando.drc.com/SemanticWeb/Topics/Ontology/Ontologies.htm>> (1 December, 2003).

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