

Semantic Web

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Web „ Semantic Web

Most of the Web's content today is designed for human consumption and processing. Computers have no reliable way to manipulate & process the semantics. The Semantic Web will bring structure to the meaningful content of web pages so software agents can carry out sophisticated tasks for users.

Vision of the Semantic Web

; The Semantic Web is an extension of the current web in which information is given well-defined meaning, better enabling computers and people to work in cooperation.;

Tim Berners-Lee, James Hendler, Ora Lassila, [The Semantic Web](#), Scientific American, May 2001

Issues

; A new form of web content that is meaningful to computers will unleash a revolution of new possibilities; K
Expressing meaning
Knowledge representation
Ontologies
Agents
Evolution of knowledge

KR vs. Web

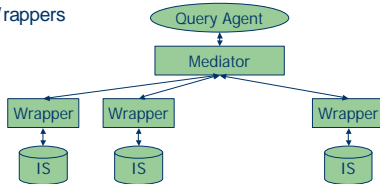
Limited expressiveness anything goes!
Brittle and demand consistency paradoxes and unanswered questions
Facts non-sterilized information
Centralized decentralized
Domain-specific General
Small scalable
Declarative data Multimedia data

Knowledge is Power

Knowledge acquisition & engineering
; Dealing with the bottleneck of acquiring and modeling knowledge
; The ;human-oriented; problem
Knowledge representation
; Dealing with the bottleneck of representing knowledge and reasoning about it
; The ;computer-oriented; problem

Querying the Web

Search engines
Web directories
Information extraction w/o semantics
Wrappers



Web „ Knowledge Base

Goal: To develop a probabilistic, symbolic knowledge base that mirrors the content of the world wide web. If successful, this will make text information on the web available in computer-understandable form, enabling much more sophisticated information retrieval and problem solving.

Approach: developing a system that can be trained to extract symbolic knowledge from hypertext, using a variety of machine learning methods.

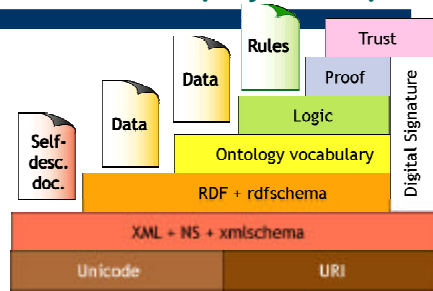
[Mitchell et al., 1998]

Semantic Web (Definition from W3C)

The Semantic Web is the abstract representation of data on the World Wide Web, based on the Resource Description Framework (RDF) standards and other standards to be defined.

It is being developed by the W3C, in collaboration with a large number of researchers and industrial partners.

Semantic Web ; Layer Cake;



Uniform Resource Identifier (URI)

All subjects and objects in web are represented by a URI just as a link in a page
An URL is a most common type of URI

Agent Markup Language

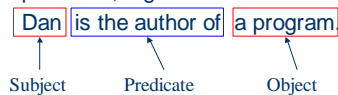
Vision of the semantic web
Perceived needs of DARPA
Experience with the standardization efforts at the World Wide Web Consortium (W3C)
Requirements discussions at a DAML Jumpstart workshop on 7/19/00 at MIT/LCS.

Aims

To allow the interchange of
Data in form of simple assertions, e.g. from DB
Conventional ontological information
Simple rules used by systems like SHOE
In the context of a technology designed for
Rules from arbitrarily expressive monotonic
inference systems
Proofs of correct inference on the same data

RDF Normal Form

Resource Description Framework
An emerging standard for knowledge exchange
In the form of directed, labeled graphs
Statement i subject and object related by a
predicate, e.g.



RDF/XML Syntax

```
Dan is the author of a program.  
<rdf:Description about=#Dan;>  
  <myOntology:isAuthorOf>aProgram  
  </myOntology:isAuthorOf>  
</rdf:Description>  
A person called Dan is an author of a program.  
<myOntology:Person>  
  <myOntology:givenName>Dan</myOntology:givenName>  
  <myOntology:isAuthorOf>  
    <myOntology:Program />  
  </myOntology:isAuthorOf>  
</myOntology:Person>
```

RDF in KIF Syntax

An RDF document is an atomic, simple, ground,
knowledge base, restricted to binary predicates.
For example,
(exists (?n1 ?n2)
 (http://#isAuthorOf ?n1 ?n2)
 (http://#givenName ?n1 ;Dan;)
 (http://;rdf-syntax-ns#type ?n1 #Person)
 (http://;rdf-syntax-ns#type ?n2 #Program)
)

Reification

1. Dan is the author of a program.

There are several other related statements:

2. i Dan is the author of a program i is a statement.
3. i Dan i is the subject of statement 1, i.e. the statement described in statement 2.
4. i is the author of i is the predicate of statement 1.
5. i a program i is the object of statement 1.

RDF Terms for Classes & Relations

The RDF specifications define terms for
Relating types/classes to their members
e.g. rdf:type
Arbitrary binary relations
Specialization of classes
e.g. rdf:subClassOf
Specialization of relations
e.g. rdf:subPropertyOf

RDF Schema (RDFS)

RDF just defines the data model
Need for definition of vocabularies for the data model -
an Ontology Language!
The RDF Schema mechanism provides a basic type
system for use in RDF models.
The RDF schema specification language is less
expressive, but much simpler to implement, than full
predicate calculus languages such as CycL and KIF.

RDF/RDFS

Pre-defined modeling primitives
The base of metadata search



Adapted from Dieter Fensel