Web Semantics in Practice

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Abstract (2)

Web semantics are interesting to be able to know more about the *meaning* of Web content, not only its syntactic representation. *Microformats* and more formal approaches such as the *Resource Description Framework (RDF)*, *RDF in Attributes (RDFa)*, and the *Web Ontology Language (OWL)* can be used to describe Web content semantically. After looking at Semantic Web concepts such as *Microformats* and the *Resource Description Framework (RDF)*, we look into some practical issues of how to express semantics on the Web.

Using Semantics (3)

- Expressing semantics is not easy, why should anybody do it?

1. Findability of resources
   - search engines can do a better job if they understand more
   - machine-readable semantics are more reliable than text processing
2. Usability of resources
   - browsers/devices can pick up information and use it
   - more understanding allows more sophisticated applications
   - in particular, recombining things is easier when you understand them
3. Utility of resources
   - recombining things is easier when you understand them
   - understanding is much easier in a "closed user group"

Microformats

HTML "Microformats" (5)

```
<html lang="en-US" xml:lang="en-US" xmlns="http://www.w3.org/1999/xhtml">
 <head>
  <title>Erik Wilde</title>
  <link rel="next" href="cv" title="CV"/>
  <link rel="prev" href="publications" title="Publications"/>
  <link rel="glossary" href="http://dret.net/glossary/"/>
  <link rel="stylesheet" type="text/css" href="http://dret.net/dretnet.css"/>
  <link rel="stylesheet" type="text/css" href="http://dret.net/netdret
/netdret.css"/>
  <link rel="meta" type="application/rdf+xml" title="FOAF"
href="http://dret.net/netdret/foaf.rdf"/>
  <link rel="icon" href="http://dret.net/favicon.ico" type="image/x-icon"/>
  <link rel="shortcut icon" href="http://dret.net/favicon.ico" type="image/x-
icon"/>
```

- HTML has some built-in "microformats"
  - support for attaching semantics to links
  - structured documents can be made explicit on the Web

vCard Microformat (hCard) (6)

```
  <div class="vcard">

       <span class="fn">Erik Wilde</span>

      <i class="email"><a href="mailto:dret@berkeley.edu" title="Send email
to dret@berkeley.edu">dret@berkeley.edu</a></i>

      <i class="tel"><a href="tel:+1-510-2061079" title="Call +1-510-2061079"
id="mobile">+1-510-2061079</a></i> /

      <i class="tel"><a href="tel:+1-510-6432253" title="Call +1-510-6432253"
id="tel">+1-510-6432253</a></i> /
```

Location Microformats (7)

```
<p><em>Geolocation</em> (GPS coordinates), for example
 <span class="geo">Grizzly Peak:
  <span class="latitude">37.882045</span>,
  <span class="longitude">-122.233698</span>
 </span>
</p>
<hr />
<p><em>Address information</em> (requires geocoding), for example
 <span class="adr">School of Information:
  <span class="extended-address">311 South Hall</span>,
  <span class="street-address">South Hall Road</span>,
  <span class="region">Berkeley</span>
  <span class="region">CA</span>
  <span class="postal-code">94720-4600</span>,
  <span class="country-name">USA</span>
 </span>
</p>
```


Islands of Semantics (8)

- Microformats solve very specific problems in a very specific way
  - encoding address information on a Web page
  - encoding a location of something represented by a Web resource
- Microformats can be compared to "tagging"
  - a very simple mechanism with a minimal barrier-to-entry
  - little flexibility in adapting the mechanism to slightly other uses
  - often underspecified and interpretation implementation-dependent
  - no unified rules across different platforms which makes processing hard
  - nice and easy to start with, but questionable for robust long-term solutions
- Currently there are about 10 reasonably popular microformats
  - calendar entries, addresses, licenses, outlines, geolocation, resumes, social networking, … [http://microformats.org/wiki/Main_Page]

Microformat Syntax (9)

- HTML has some underspecified and underused elements
  - dfn, code, samp, kbd, var, cite, abbr, acronym
  - they can be reused and augmented with additional information
- HTML allows non-HTML content in HTML pages
  - unknown elements and attributes must be ignored
- HTML allows class attributes to carry semantics
- HTML has a head which contains page metadata
  - for example, the link element specifies connections to other resources

Magic Names (10)

- A syntax defines where and how to embed information
  - what is embedded and how well is it defined semantically?
  - is there an underlying model for specifying dependencies?
  - how many assumptions does it take to implement a microformat?
- Names are never self-explanatory, they always represent concepts
  - nothing can remove the burden of defining a conceptual model
  - if this is not done, models evolve and there will be more than one
- "Microformats" and "tagging" share the same folklore
  - define simple things and good things will happen
  - this works by supporting a quickly growing ecosystem of diverging semantics
  - semantics are most useful when they are well-defined
  - loose semantics also have some utility

Microformats on the Web (11)

- Easy to embed for generated content
  - some of the very basic formats may even appear in browsers one day
  - combining well-designed URIs with document relationships is better than every site map
- Hard to rely on for applications that need dependable semantics
  - useful as a hint and as a starting point
  - microformats are not a good idea for complex information management tasks
- Use as foundation for representing common concepts
  - when formatting addresses, use adr [http://microformats.org/wiki/adr] class names
  - for structured documents use XOXO [http://microformats.org/wiki/xoxo]

Resource Description Framework (RDF)

Describing Resources (13)

- RDF describes everything in *triples*
  - making a statement about a *resource* (identified by a URI [Web Foundations (URI and HTTP); Uniform Resource Identifier (URI) (1)])
  - describing a certain *property* of the resource
  - specifying a *value* for that property

```
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:contact="http://www.w3.org/2000/10/swap/pim/contact#">
  <contact:Person rdf:about="http://www.w3.org/People/EM/contact#me">
    <contact:fullName>Eric Miller</contact:fullName>
    <contact:mailbox rdf:resource="mailto:em@w3.org"/>
    <contact:personalTitle>Dr.</contact:personalTitle>
  </contact:Person>
</rdf:RDF>
```

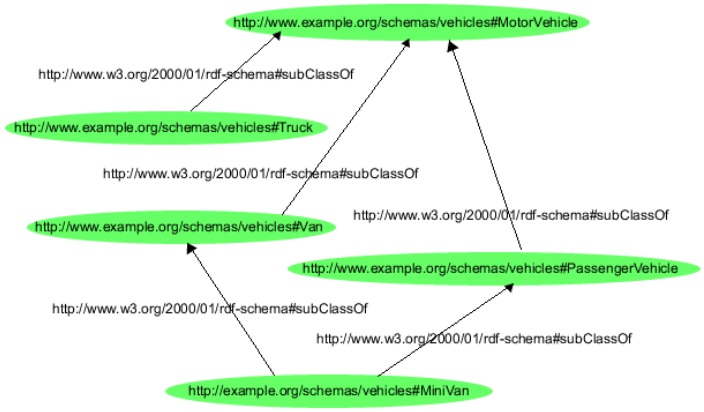
[http://www.w3.org/TR/REC-rdf-syntax/#intro]

RDF Graphs (14)

RDF is Simple and Complex (15)

- RDF's abstract model [http://www.w3.org/TR/rdf-concepts/] is the idea of descriptive triples
  - the actual RDF model is rooted in *description logic*
  - RDF itself can only describe individuals (something identified by URI)
- RDF/XML [http://www.w3.org/TR/rdf-syntax-grammar/] is an XML syntax for encoding triples
  - the syntax allows a variety of ways to represent the same RDF statements
  - processing RDF/XML with XML tools is likely to fail
  - use RDF parsers to parse all variations of RDF/XML into an abstract RDF graph
- RDF Schema [http://www.w3.org/TR/rdf-schema/] supports the creation of *RDF vocabularies*
  - describe the *classes of things* that can be used in statements
  - describe the *properties* which can be used for each of these classes
  - describe the *allowed* values for the supported properties

RDF Schema Graph (16)



RDF in Attributes (RDFa) (17)

- Microformats can use any kind of markup design
  - this makes it hard to detect microformats when processing a Web page
  - combining microformats can become complicated and ill-designed
- RDFa defines only a syntax for embedding metadata into XHTML
  - the vocabulary must be described by some RDF schema language

```
<p>This document is licensed under a <a xmlns:cc="http://creativecommons.org
/licenses/" rel="cc:license" href="http://creativecommons.org/licenses/by/nc-
nd/3.0/">Creative Commons License</a>.</p>
```

- RDFa uses and extends HTML for embedding RDF
  - it uses HTML's rel, rev, href, and src attributes
  - it defines a number of new attributes for HTML elements [http://www.w3.org/TR/rdfa-syntax/#s_metaAttributes]
  - it defines a processing model [http://www.w3.org/TR/rdfa-syntax/#s_model] for deriving RDF triples from these attributes

More Languages

SPARQL (19)

- RDF graphs can be large and hard to handle
  - querying RDF graphs using XML technologies is hard and slow
  - special data structures need special query languages
  - SPARQL is a query language for querying RDF graphs
- Using RDF without using SPARQL does not make a lot of sense
  - if the data is simple and restricted, why use RDF?
  - processing unrestricted RDF without a special language is very hard
- Semantic Web search engines can harvest the Web for RDF
  - the result is a huge graph of RDF describing all semantic Web resources
  - querying into this graph retrieves all formalized semantics on the Web

Web Ontology Language (OWL) (20)

- RDF and RDF Schema are rather basic languages
- OWL adds more sophisticated features to RDF Schema
  - constructions of classes using existing ones
  - characterize relationships (e.g., whether they are transitive, symmetric, functional, etc.)
- Formal semantics are hard to write and compute
  - no property expressions or datatypes in RDF Schemas
  - not all set operators, restricted cardinality in *OWL Lite*
  - some restrictions, but a computational guarantee in *OWL DL*
  - full expressive power in *OWL Full* (but no computational guarantee)

Semantics are Important and Hard (21)

- Semantics must be captured somewhere
- Most semantic definitions are using prose and some formalism
- Completely formal semantics are hard to define and hard to use
- Semantic Web technologies may share the fate of AI