

Introduction to the Semantic Web

Questions

- What is the Semantic Web?
- Why do we want it?
- How will we do it?
- Who will do it?
- When will it be done?

“XML is Lisp's bastard nephew, with uglier syntax and no semantics. Yet XML is poised to enable the creation of a Web of data that dwarfs anything since the Library at Alexandria.”

-- Philip Wadler, *Et tu XML? The fall of the relational empire*, VLDB, Rome, September 2001.

“The web has made people smarter.
We need to understand how to use
it to make machines smarter, too.”

-- Michael I. Jordan, paraphrased
from a talk at AAAI, July 2002
by Michael Jordan (UC Berkeley)

“The Semantic Web will globalize knowledge representation, just as the WWW globalize hypertext”

-- Tim Berners-Lee

IOHO

- The web is like a universal acid, eating through and consuming everything it touches.
 - Web principles and technologies are equally good for wireless/pervasive computing
- The semantic web is our first serious attempt to provide semantics for XML sublanguages
- It will provide mechanisms for people and machines (agents, programs, web services) to come together.
 - In all kinds of networked environments: wired, wireless, ad hoc, wearable, etc.

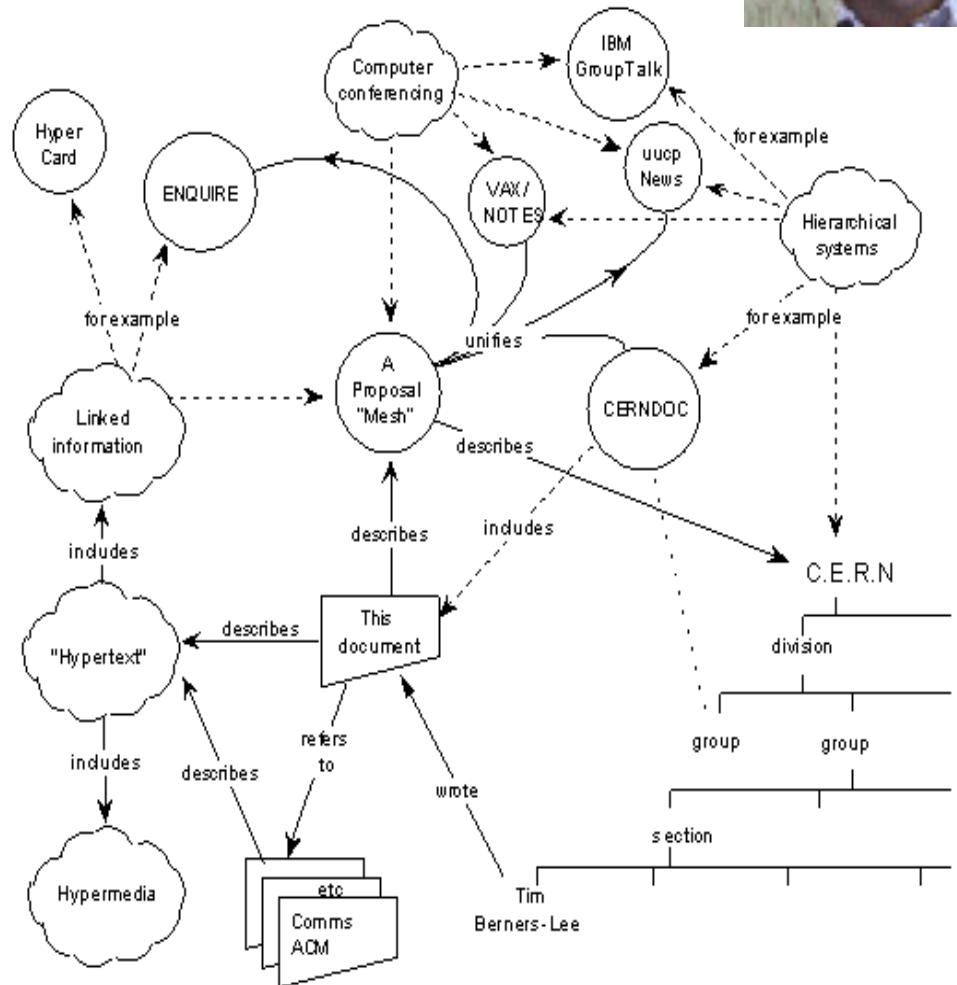
Origins



Tim Berners-Lee's original 1989 WWW proposal described a web of relationships among named objects unifying many info. management tasks.

Capsule history

- Guha's MCF (~94)
- XML+MCF=>RDF (~96)
- RDF+OO=>RDFS (~99)
- RDFS+KR=>DAML+OIL (00)
- W3C's SW activity (01)
- W3C's OWL (03)



<http://www.w3.org/History/1989/proposal.html>

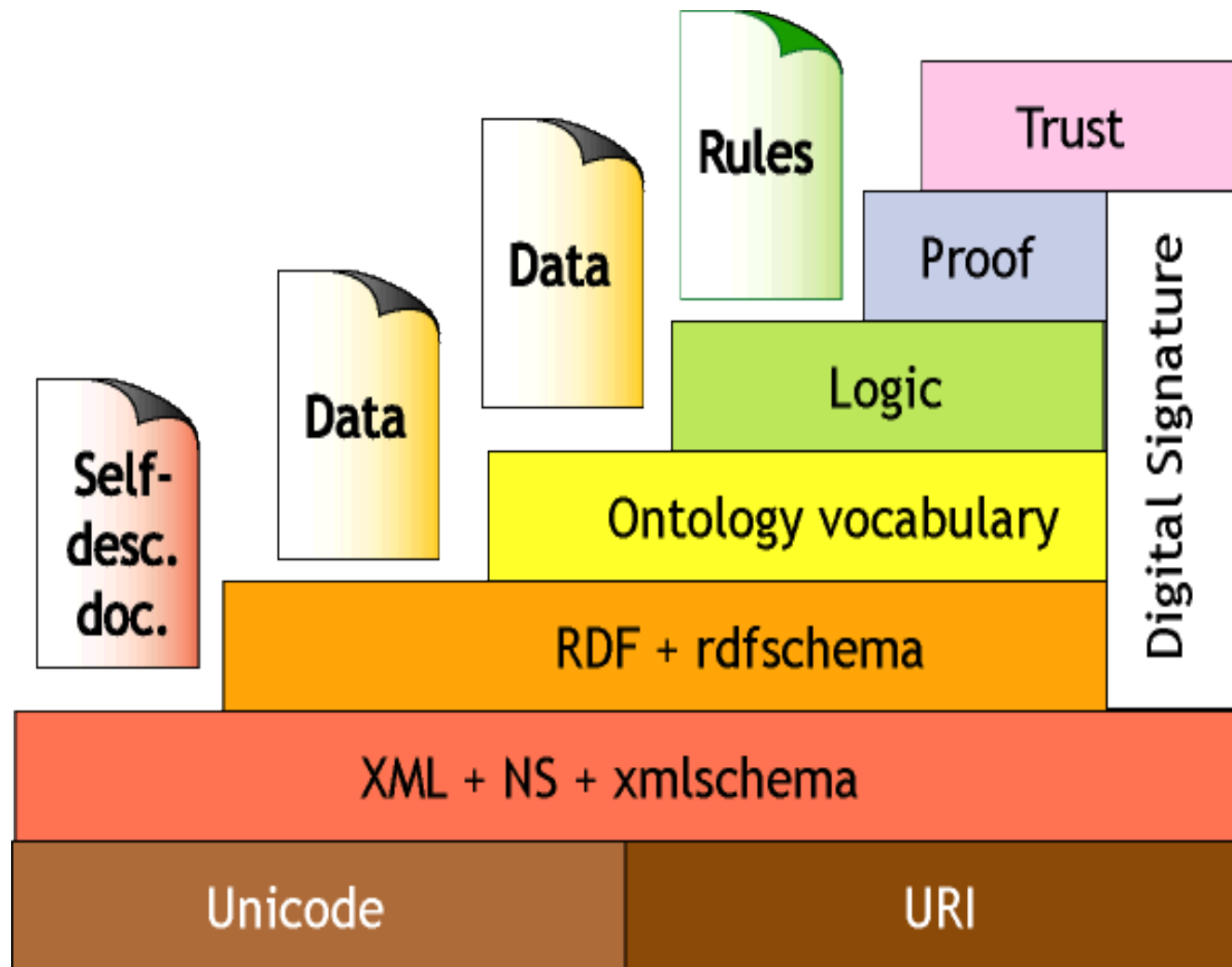
W3C' s Semantic Web Goals

Focus on machine consumption:

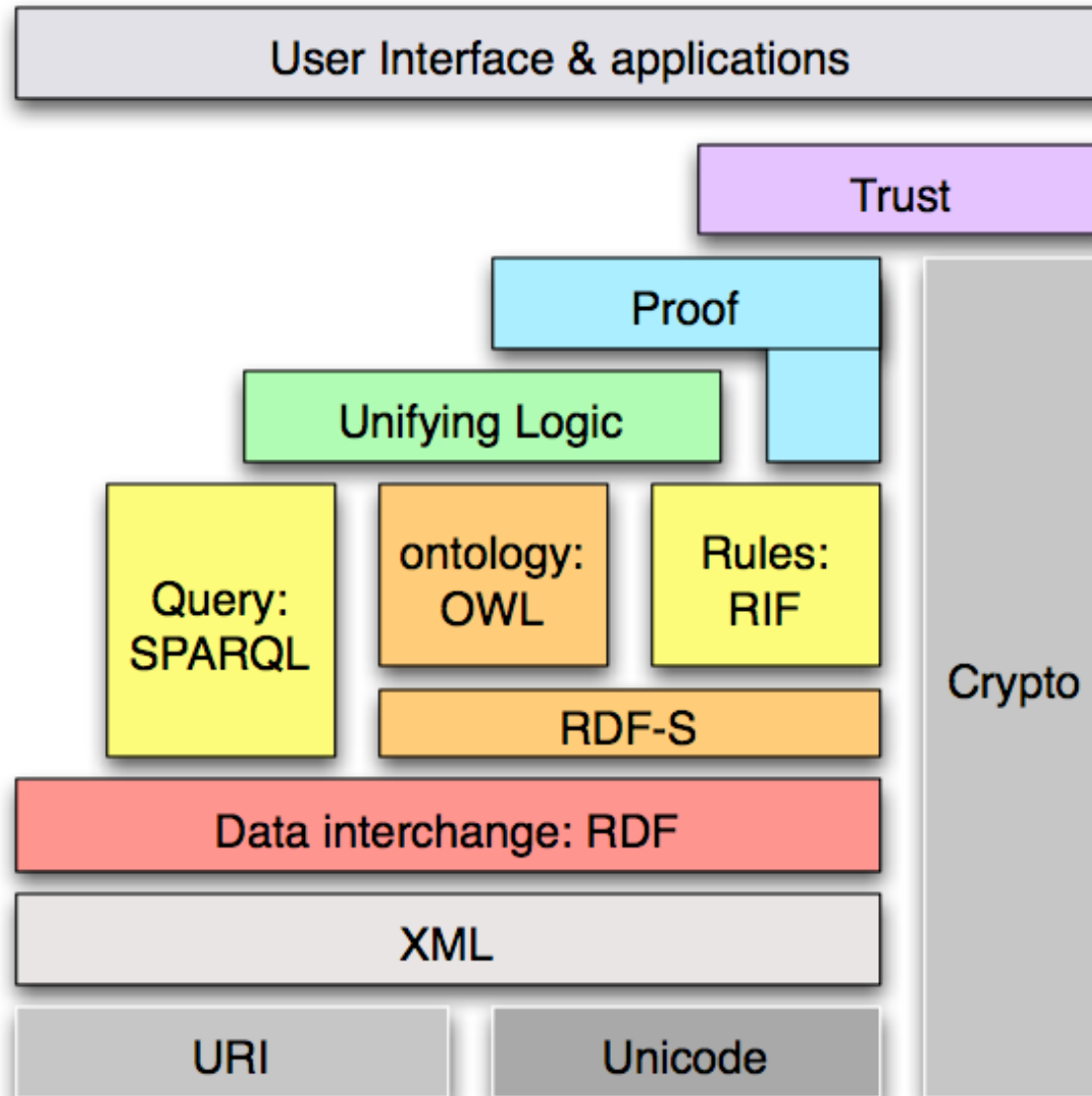
"The Semantic Web is an extension of the current web in which information is given well-defined meaning, better enabling computers and people to work in cooperation."

-- Berners-Lee, Hendler and Lassila, The Semantic Web, Scientific American, 2001

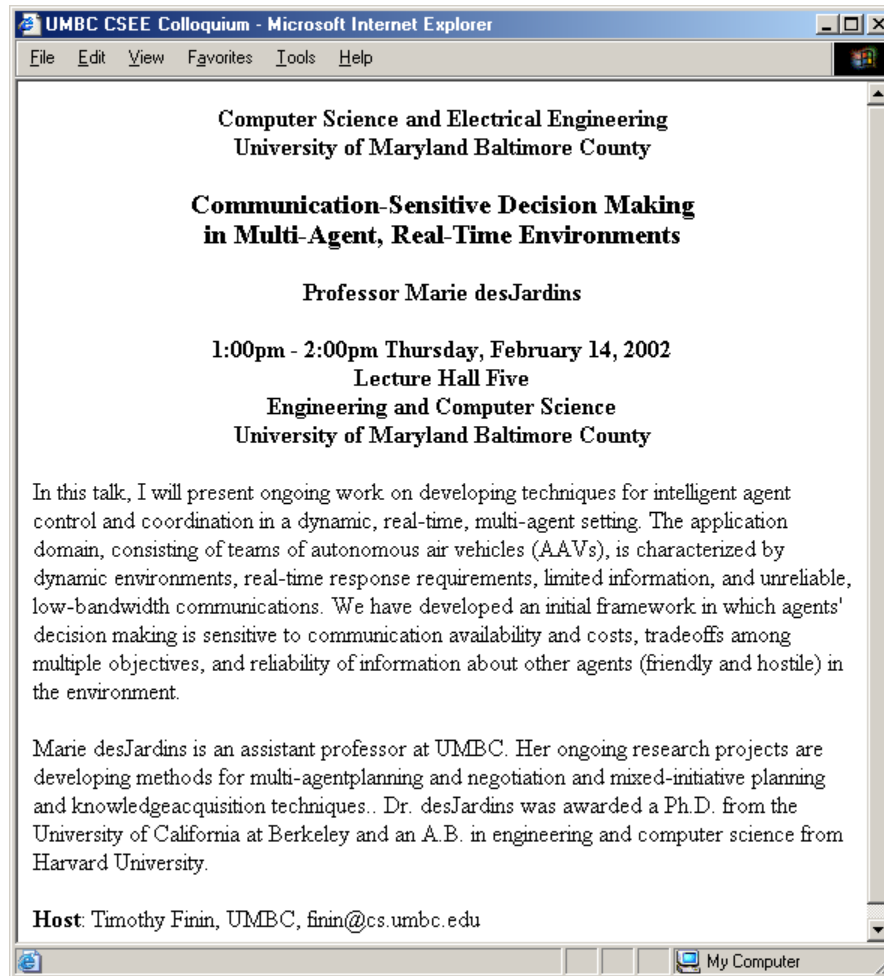
TBL's semantic web vision



Semantic web stack 2006

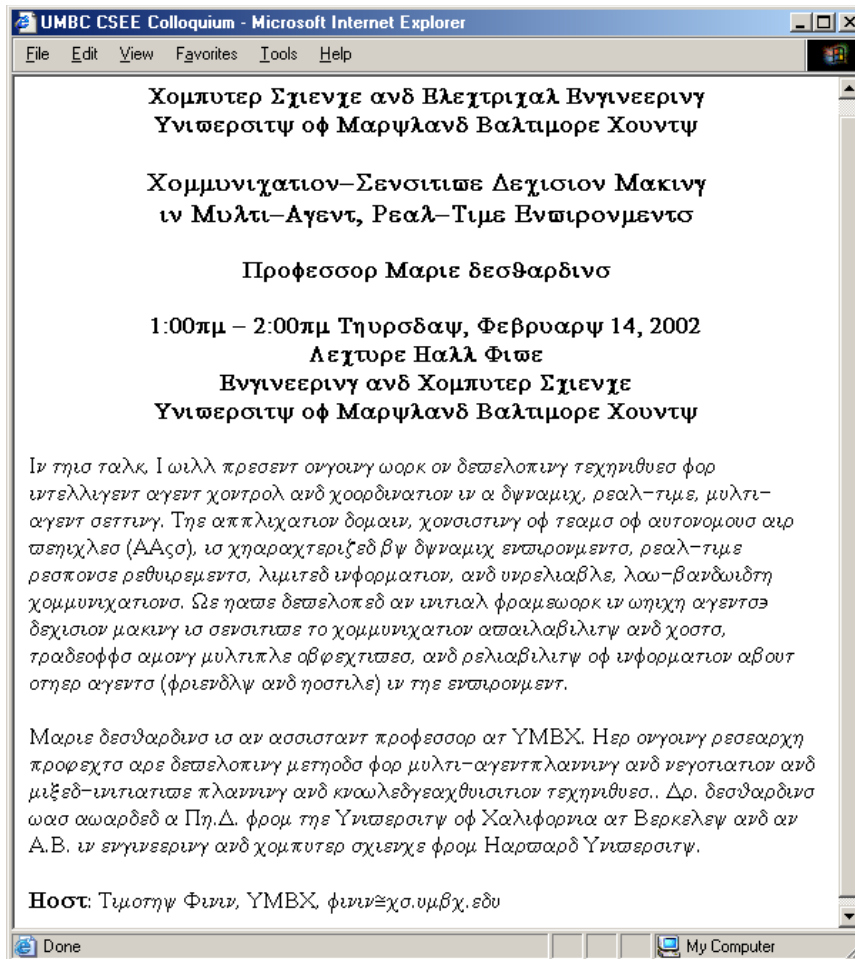


Why is this hard?



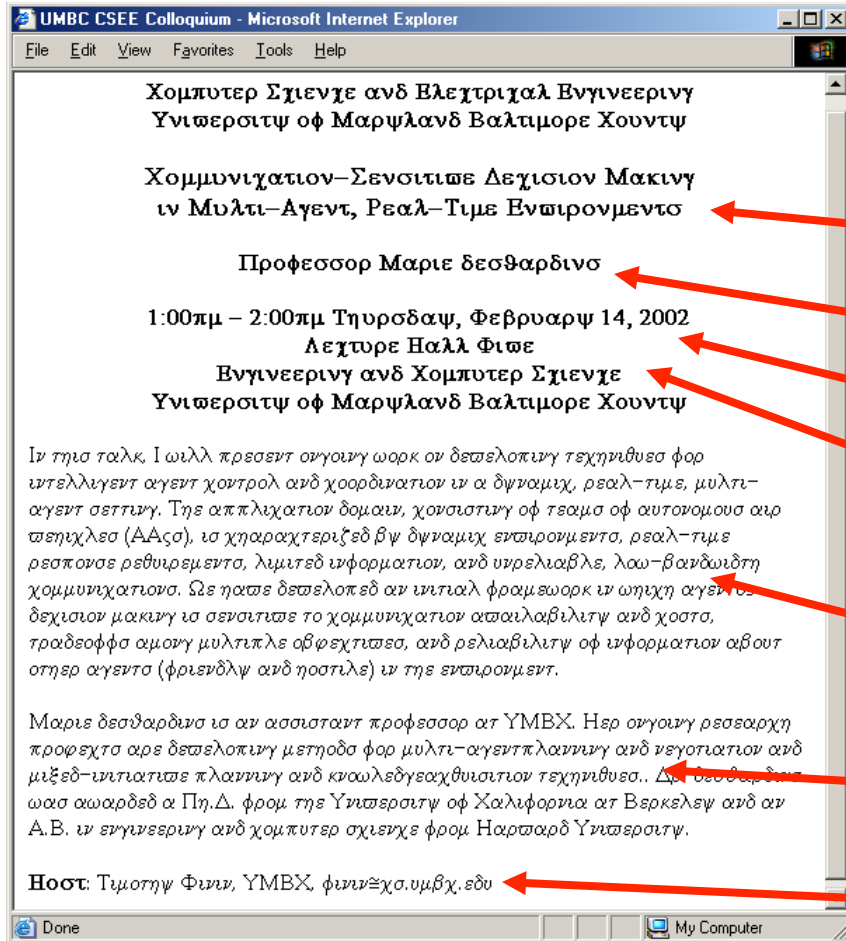
after Frank van Harmelen
and Jim Hendler

What a web page looks like to a machine...



after Frank van Harmelen
and Jim Hendler

OK, so HTML is not helpful



Maybe we can tell the machine
what the different parts of the
text represent?

title

speaker

time

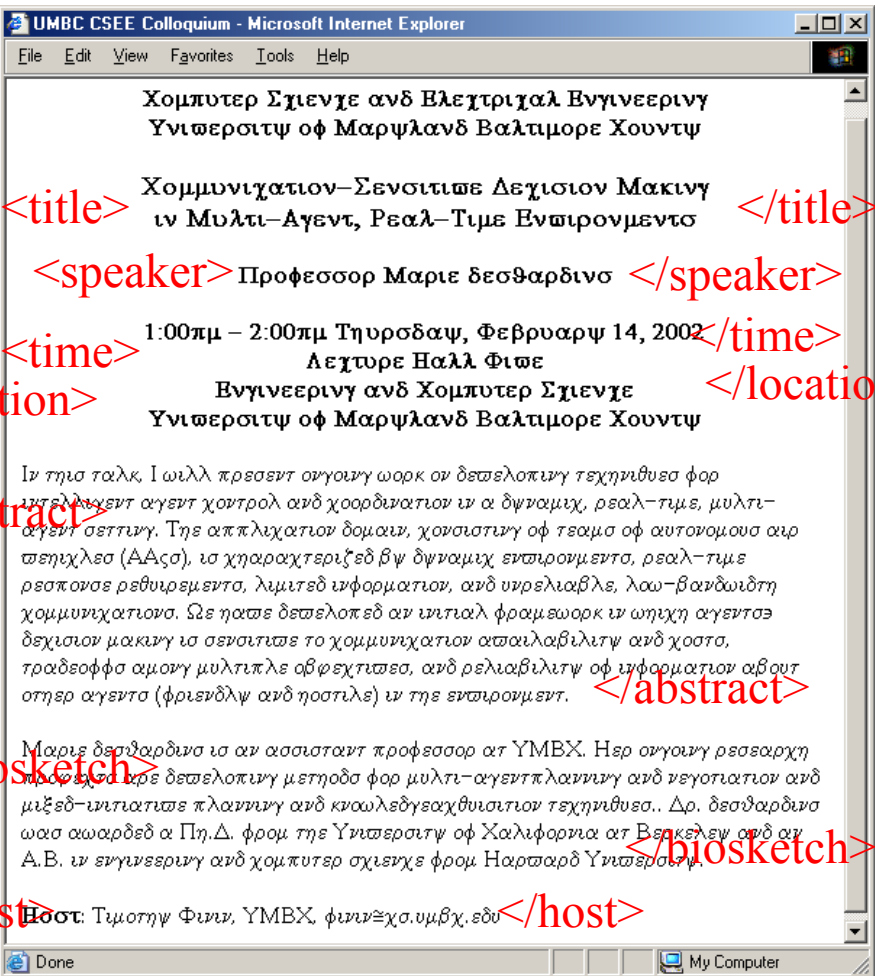
location

abstract

biosketch

host

XML to the rescue?



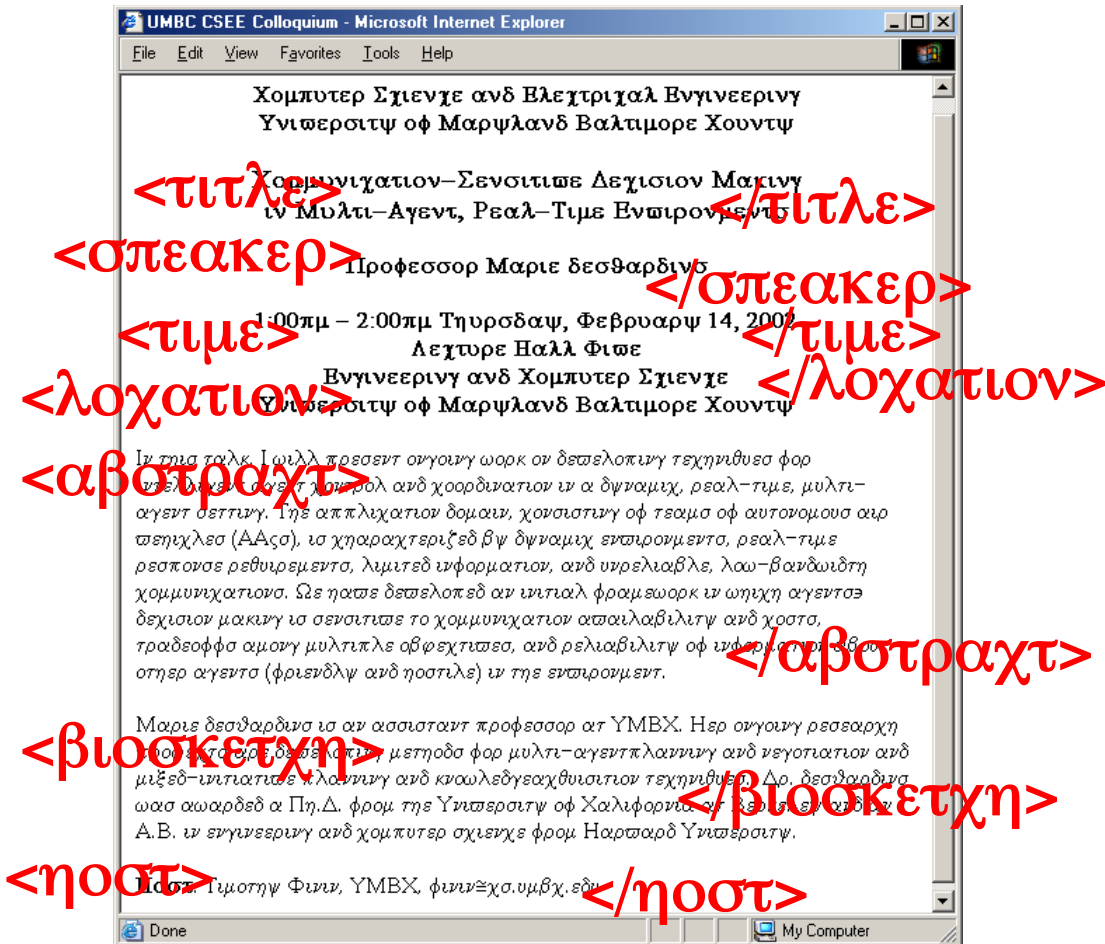
The screenshot shows a Microsoft Internet Explorer window titled "UMBC CSEE Colloquium". The page content is in Greek and describes a colloquium. Red XML tags are overlaid on the text to illustrate how the content can be structured:

- <title>** Χορμυτερ Σχιενχε ανδ Βλεχτριχαλ Βνγινεερινγ Υνιπερσιτω οφ Μαρψλανδ Βαλτιμορε Χουντψ **</title>**
- <speaker>** Προφεσσορ Μαριε δεσθαρινδινσ **</speaker>**
- <time>** 1:00πμ – 2:00πμ Τηυρσδαψ, Φεβρουαρψ 14, 2002 **</time>**
- <location>** Λεχτυρε Χαλλ Φιβε Βνγινεερινγ ανδ Χορμυτερ Σχιενχε Υνιπερσιτω οφ Μαρψλανδ Βαλτιμορε Χουντψ **</location>**
- <abstract>** *Ιν τηισ ταλλε, Ι ωιλλ πρεσεντ ονγουνγ ωορκ ον δεσπελοπιγγ τεχηνηθισε φορ ιντελλινγκεντ αγκεντ χοντρολ ανδ χοορδινατιον ιν α δηναμιχ, ρεαλ-τιμε, μυλτι-αγκεντ σεττιγγ. Τηε αππλιχατιον δομαιν, χορσιστιγγ οφ τεαμσ οφ αυτονομουσ αιρ πεχηχλεσ (ΑΑς), ισ χηαραχτεριζεδ βψ δηναμιχ ενπιρονμεντα, ρεαλ-τιμε ρεσπονσε ρεθυριμεντα, λιμιτεδ ινφορματιον, ανδ υνρελιαβιλε, λαω-βανδωιδτη χορμυνηχατιονα. Ωε ηαπε δεσπελοπεδ αν ιντιαλ φραμεωορκ ιν ωηιχη αγκεντα δεχισιον μακινγ ισ σενατιπεσ το χορμυνηχατιον απωιλιαβιλιτη ανδ χοστα, τραδεοφφα αμονγ μυλτιπλεσ οβφεχτιπεσ, ανδ ρελιαβιλιτη οφ ινφορματιον αβουτ οτηερ αγκεντα (φριενδλψ ανδ ηοστιλε) ιν τηε ενπιρονμεντ.* **</abstract>**
- <biosketch>** Μαριε δεσθαρινδινσ ισ αν ασισταντ προφεσσορ ατ ΥΜΒΧ. Ηερ ονγουνγ ρεσεαρχη ιντελλινγκεντ δεσπελοπιγγ μετηοδα φορ μυλτι-αγκεντπλανινγγ ανδ γεγοτιατιον ανδ μιξεδ-ιντιατιπεσ πλανινγγ ανδ κνωλεδγεαχθυσιστιον τεχηνηθισε.. Δρ. δεσθαρινδινσ ωασ αωαρδεδ α Πη.Δ. φρομ τηε Υνιπερσιτω οφ Χαλιφορνια ατ Βερκελεϋ ανδ αν Α.Β. ιν ενγινεερινγ ανδ χορμυτερ σχιενχε φρομ Χαρβαρνδ Υνιπερσιτω. **</biosketch>**
- <host>** Ηοστ: Τιμοτηψ Φινν, ΥΜΒΧ, φινηχσ.υμβχ.εδυ **</host>**

XML fans propose creating a XML tag set to use for each application.

For talks, we can choose <title>, <speaker>, etc.

XML ≠ machine accessible meaning



But, to your machine, the tags still look like this....

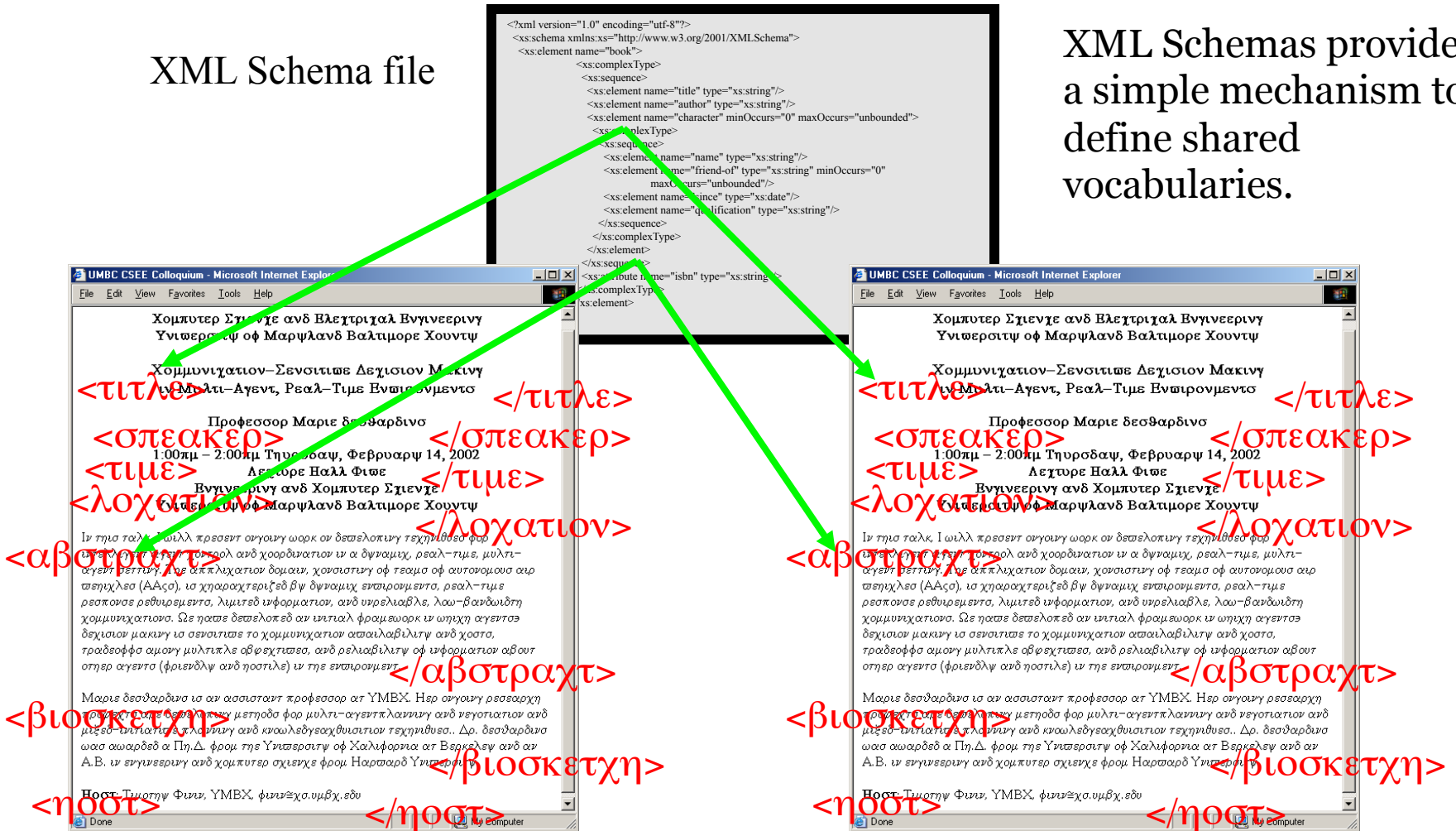
The tag names carry no meaning.

XML DTDs and Schemas have little or no semantics.

XML Schema helps

XML Schema file

XML Schemas provide a simple mechanism to define shared vocabularies.



after Frank van Harmelen and Jim Hendler

But there are many schemas

XML Schema file 1

XML Schema file 2

```
<?xml version="1.0" encoding="utf-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema">
  <xs:element name="book">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="title" type="xs:string"/>
        <xs:element name="author" type="xs:string"/>
        <xs:element name="character" minOccurs="0" maxOccurs="unbounded"/>
        <xs:complexType>
          <xs:sequence>
            <xs:element name="name" type="xs:string"/>
            <xs:element name="friend-of" type="xs:string" minOccurs="0"
              maxOccurs="unbounded"/>
            <xs:element name="since" type="xs:date"/>
            <xs:element name="qualification" type="xs:string"/>
          </xs:sequence>
        </xs:complexType>
      </xs:sequence>
    </xs:complexType>
  </xs:element>
</xs:schema>
```

Χομπιτερ Σεινιε ανδ Βλεπτριχαλ Βνηνεερινγ
Υνιπερσιτυ οφ Μαρψλανδ Βαλτιμορε Χουντυφ

Χομμυνιχατιον-Σενσιτιβιε Δεχισιον Μακινγ
ανδ Μυλτι-Αγεντ, Ρεαλ-Τιμε Ενπιρονμεντο

Προφεσσορ Μαριε δεσθαρινδο

1.00πμ - 2.00πμ Τηυροδαψ, Φεβρουαρψ 14, 2002
Λεχτυρε Χαλλ Φιβε

Βνηνεερινγ ανδ Χομπυτερ Σεινιε
Υνιπερσιτυ οφ Μαρψλανδ Βαλτιμορε Χουντυφ

Ιν τηια ταλκ, Ι ωιλλ πρεσεντ ονγουνγ ωορκ ον δεσπελοπινγ τεχνηνιδαα φορ
μυλτι-αγεντ επανταλινγ ανδ χοορδινατιον ιν α δυναμικ, ρεαλ-τιμε, μυλτι-
αγεντ βετινιγ. Τηια αππλιχατιον δομειν, χορσιστινγ οφ τσαμο οφ αυτονομουο αιρ
απειχλαιο (ΑΑζο), ιο χηραρχτεριζεδ βψ δυναμικ ενπιρονμεντα, ρεαλ-τιμε
ρεσπονοο ρεθυρεμεντο, λιμιτεδ ινφορματιον, ανδ ινρελιαβιλε, λαυ-βανδωιδη
χομμυνιχατιονα. Ωε ηωασε δεσπελοπεδ αν ιντιαλ φορμειωορκ ιν ωηχη αγεντα
δεχισιον, μακινγ ιο σενσιτιβε το χομμυνιχατιον απαιλαβιλιτη ανδ χοοστο,
τραδεοφφο αιμονγ μυλτιπλεσ αφερχητωο, ανδ ρελιαβιλιτη οφ ινφορματιον αβουτ
στηερ αγεντα (φοιενδλψ ανδ ηοστιλε) ιν τηια ενπιρονμεντ.

Μαριε δεσθαρινδο ιο αν ασισταντ προφεσσορ ατ ΥΜΒΧ. Ηερ ονγουνγ ρεσσεαρχη
μεθοδα φορ μυλτι-αγεντπλανινγ ανδ νεγοτιατιον ανδ
μυλτι-ιντιαλ επανταλινγ ανδ κνωλιδεγχαχθινιαιον τεχνηνιδαα. Δρ. δεσθαρινδο
ωασ αωααρδεδ α Πη.Δ. φορμ τηια Υνιπερσιτυ οφ Χαλιφορνια ατ Βερκελεψ ανδ αν
Α.Β. ιν εγγινεερινγ ανδ χομπυτερ σχινηε φορμ Ηαρισαρδ Υνιπερσιτυ.

Ηοοτ-Τιμοτψ Φινν, ΥΜΒΧ, φινν@χα.υμβχ.εδυ

```
<?xml version="1.0" encoding="utf-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema">
  <xs:element name="book">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="title" type="xs:string"/>
        <xs:element name="author" type="xs:string"/>
        <xs:element name="character" minOccurs="0" maxOccurs="unbounded"/>
        <xs:complexType>
          <xs:sequence>
            <xs:element name="name" type="xs:string"/>
            <xs:element name="friend-of" type="xs:string" minOccurs="0"
              maxOccurs="unbounded"/>
            <xs:element name="since" type="xs:date"/>
            <xs:element name="qualification" type="xs:string"/>
          </xs:sequence>
        </xs:complexType>
      </xs:sequence>
    </xs:complexType>
  </xs:element>
</xs:schema>
```

Χομπιτερ Σεινιε ανδ Βλεπτριχαλ Βνηνεερινγ
Υνιπερσιτυ οφ Μαρψλανδ Βαλτιμορε Χουντυφ

Χομμυνιχατιον-Σενσιτιβιε Δεχισιον Μακινγ
ανδ Μυλτι-Αγεντ, Ρεαλ-Τιμε Ενπιρονμεντο

Προφεσσορ Μαριε δεσθαρινδο

1.00πμ - 2.00πμ Τηυροδαψ, Φεβρουαρψ 14, 2002
Λεχτυρε Χαλλ Φιβε

Βνηνεερινγ ανδ Χομπυτερ Σεινιε
Υνιπερσιτυ οφ Μαρψλανδ Βαλτιμορε Χουντυφ

Ιν τηια ταλκ, Ι ωιλλ πρεσεντ ονγουνγ ωορκ ον δεσπελοπινγ τεχνηνιδαα φορ
μυλτι-αγεντ επανταλινγ ανδ χοορδινατιον ιν α δυναμικ, ρεαλ-τιμε, μυλτι-
αγεντ βετινιγ. Τηια αππλιχατιον δομειν, χορσιστινγ οφ τσαμο οφ αυτονομουο αιρ
απειχλαιο (ΑΑζο), ιο χηραρχτεριζεδ βψ δυναμικ ενπιρονμεντα, ρεαλ-τιμε
ρεσπονοο ρεθυρεμεντο, λιμιτεδ ινφορματιον, ανδ ινρελιαβιλε, λαυ-βανδωιδη
χομμυνιχατιονα. Ωε ηωασε δεσπελοπεδ αν ιντιαλ φορμειωορκ ιν ωηχη αγεντα
δεχισιον, μακινγ ιο σενσιτιβε το χομμυνιχατιον απαιλαβιλιτη ανδ χοοστο,
τραδεοφφο αιμονγ μυλτιπλεσ αφερχητωο, ανδ ρελιαβιλιτη οφ ινφορματιον αβουτ
στηερ αγεντα (φοιενδλψ ανδ ηοστιλε) ιν τηια ενπιρονμεντ.

Μαριε δεσθαρινδο ιο αν ασισταντ προφεσσορ ατ ΥΜΒΧ. Ηερ ονγουνγ ρεσσεαρχη
μεθοδα φορ μυλτι-αγεντπλανινγ ανδ νεγοτιατιον ανδ
μυλτι-ιντιαλ επανταλινγ ανδ κνωλιδεγχαχθινιαιον τεχνηνιδαα. Δρ. δεσθαρινδο
ωασ αωααρδεδ α Πη.Δ. φορμ τηια Υνιπερσιτυ οφ Χαλιφορνια ατ Βερκελεψ ανδ αν
Α.Β. ιν εγγινεερινγ ανδ χομπυτερ σχινηε φορμ Ηαρισαρδ Υνιπερσιτυ.

Ηοοτ-Τιμοτψ Φινν, ΥΜΒΧ, φινν@χα.υμβχ.εδυ

There's no way to relate schema

The diagram illustrates the lack of semantic relationship between two XML Schema files, labeled 'XML Schema file 1' and 'XML Schema file 42'. The schemas are shown as XML documents with various elements like `<xs:element>`, `<xs:complexType>`, and `<xs:sequence>`. Below each schema is a screenshot of an XML document rendered in a browser window titled 'UMBC CSEE Colloquium - Microsoft Internet Explorer'. The documents contain Greek text and are annotated with red XML-like tags to show semantic mapping:

- XML Schema file 1:**
 - `<title>` maps to the main title of the colloquium.
 - `<speaker>` maps to the speaker's name.
 - `<time>` maps to the date and time.
 - `<location>` maps to the location.
 - `<abstract>` maps to the abstract text.
 - `<biosketch>` maps to the biosketch text.
 - `<host>` maps to the host information.
- XML Schema file 42:**
 - `<title>` maps to the main title of the colloquium.
 - `<speaker>` maps to the speaker's name.
 - `<time>` maps to the date and time.
 - `<location>` maps to the location.
 - `<abstract>` maps to the abstract text.
 - `<biosketch>` maps to the biosketch text.
 - `<host>` maps to the host information.

Either manually or automatically.
XML Schema is weak on semantics.

An Ontology level is needed

XML
Ontology
256

imports

XML Ontology 1

```
<?xml version="1.0" encoding="utf-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema">
  <xs:element name="book">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="title" type="xs:string"/>
        <xs:element name="author" type="xs:string"/>
        <xs:element name="character" minOccurs="0" maxOccurs="unbounded"/>
        <xs:complexType>
          <xs:sequence>
            <xs:element name="name" type="xs:string"/>
            <xs:element name="friend-of" type="xs:string" minOccurs="0"
              maxOccurs="unbounded"/>
            <xs:element name="since" type="xs:date"/>
            <xs:element name="qualification" type="xs:string"/>
          </xs:sequence>
        </xs:complexType>
      </xs:sequence>
    </xs:complexType>
  </xs:element>
  <xs:attribute name="isbn" type="xs:string"/>
</xs:schema>
```

```
<?xml version="1.0" encoding="utf-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema">
  <xs:element name="book">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="title" type="xs:string"/>
        <xs:element name="author" type="xs:string"/>
        <xs:element name="character" minOccurs="0" maxOccurs="unbounded"/>
        <xs:complexType>
          <xs:sequence>
            <xs:element name="name" type="xs:string"/>
            <xs:element name="friend-of" type="xs:string" minOccurs="0"
              maxOccurs="unbounded"/>
            <xs:element name="since" type="xs:date"/>
            <xs:element name="qualification" type="xs:string"/>
          </xs:sequence>
        </xs:complexType>
      </xs:sequence>
    </xs:complexType>
  </xs:element>
  <xs:attribute name="isbn" type="xs:string"/>
</xs:schema>
```

Ontologies add

- Structure
- Constraints
- mappings

imports

XML Ontology 42

```
<?xml version="1.0" encoding="utf-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema">
  <xs:element name="book">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="title" type="xs:string"/>
        <xs:element name="author" type="xs:string"/>
        <xs:element name="character" minOccurs="0" maxOccurs="unbounded"/>
        <xs:complexType>
          <xs:sequence>
            <xs:element name="name" type="xs:string"/>
            <xs:element name="friend-of" type="xs:string" minOccurs="0"
              maxOccurs="unbounded"/>
            <xs:element name="since" type="xs:date"/>
            <xs:element name="qualification" type="xs:string"/>
          </xs:sequence>
        </xs:complexType>
      </xs:sequence>
    </xs:complexType>
  </xs:element>
  <xs:attribute name="isbn" type="xs:string"/>
</xs:schema>
```

We need a way to define ontologies in XML
So we can relate them
So machines can understand (to some degree) their meaning

Semantic Web

Use Semantic Web Technology
to publish shared data &
knowledge

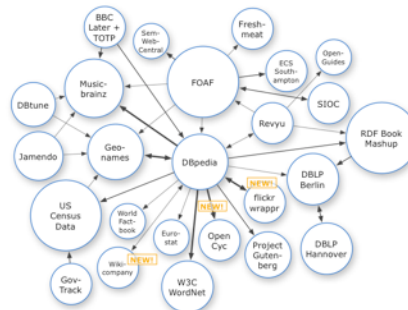
Semantic web technologies
allow machines to share
data and knowledge using
common web language and
protocols.

~ 1997

Semantic Web beginning

Semantic Web => Linked Open Data

Use Semantic Web Technology
to publish shared data &
knowledge



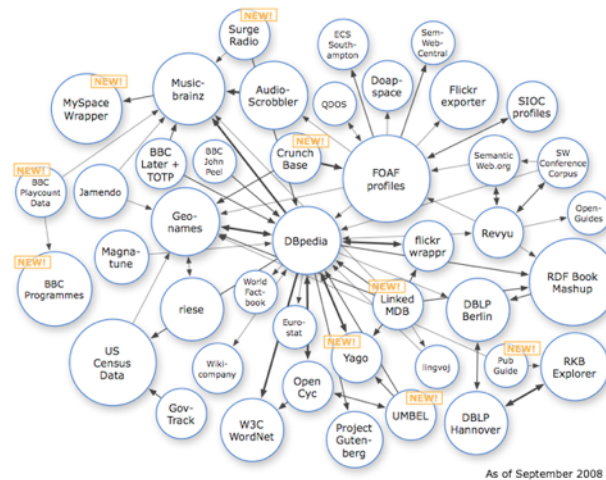
2007

Data is inter-
linked to support inte-
gration and fusion of knowledge

LOD beginning

Semantic Web => Linked Open Data

Use Semantic Web Technology
to publish shared data &
knowledge



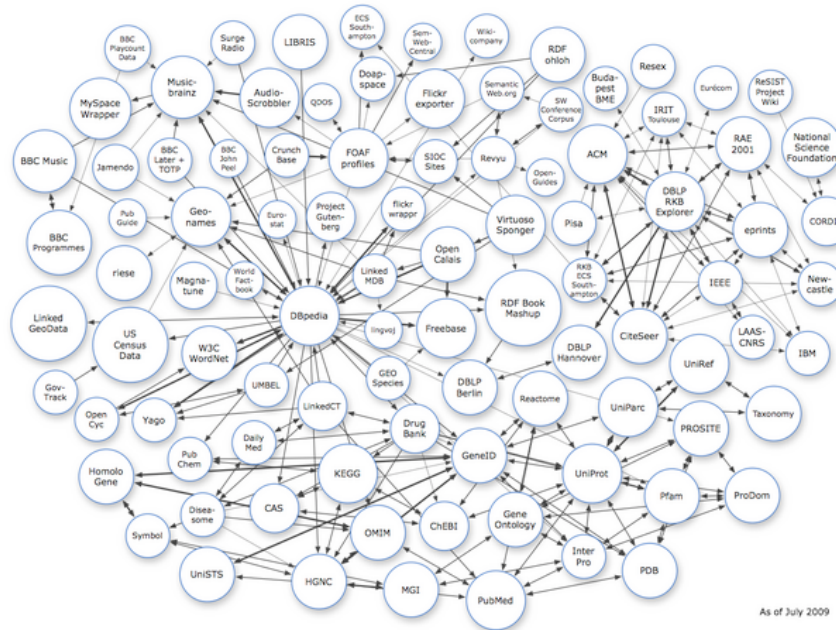
2008

Data is inter-
linked to support inte-
gration and fusion of knowledge

LOD growing

Semantic Web => Linked Open Data

Use Semantic Web Technology to publish shared data & knowledge



2009

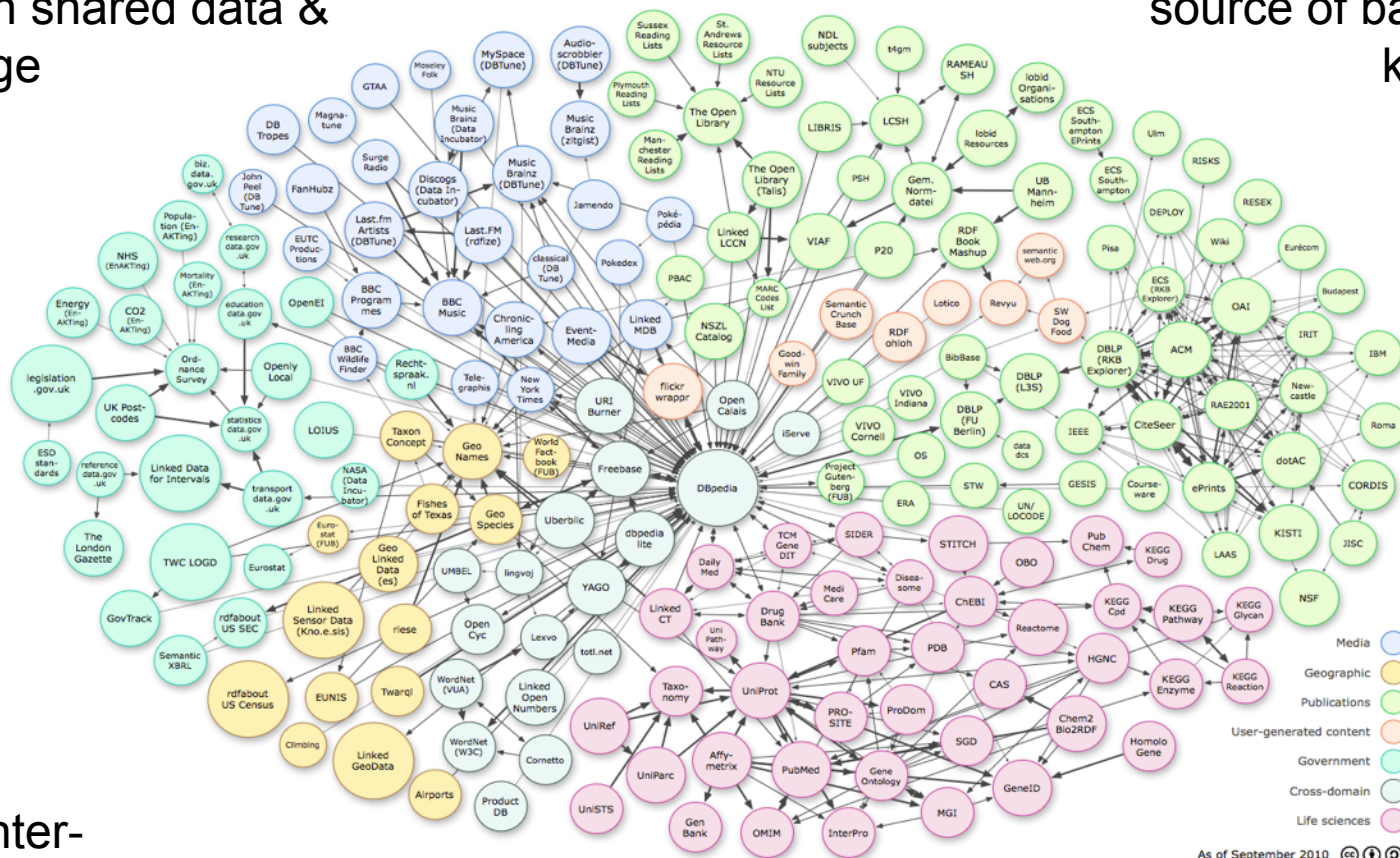
Data is inter-linked to support integration and fusion of knowledge

... and growing

Linked Open Data

Use Semantic Web Technology
to publish shared data &
knowledge

LOD is the new Cyc: a common
source of background
knowledge



Data is inter-
linked to support inte-
gration and fusion of knowledge

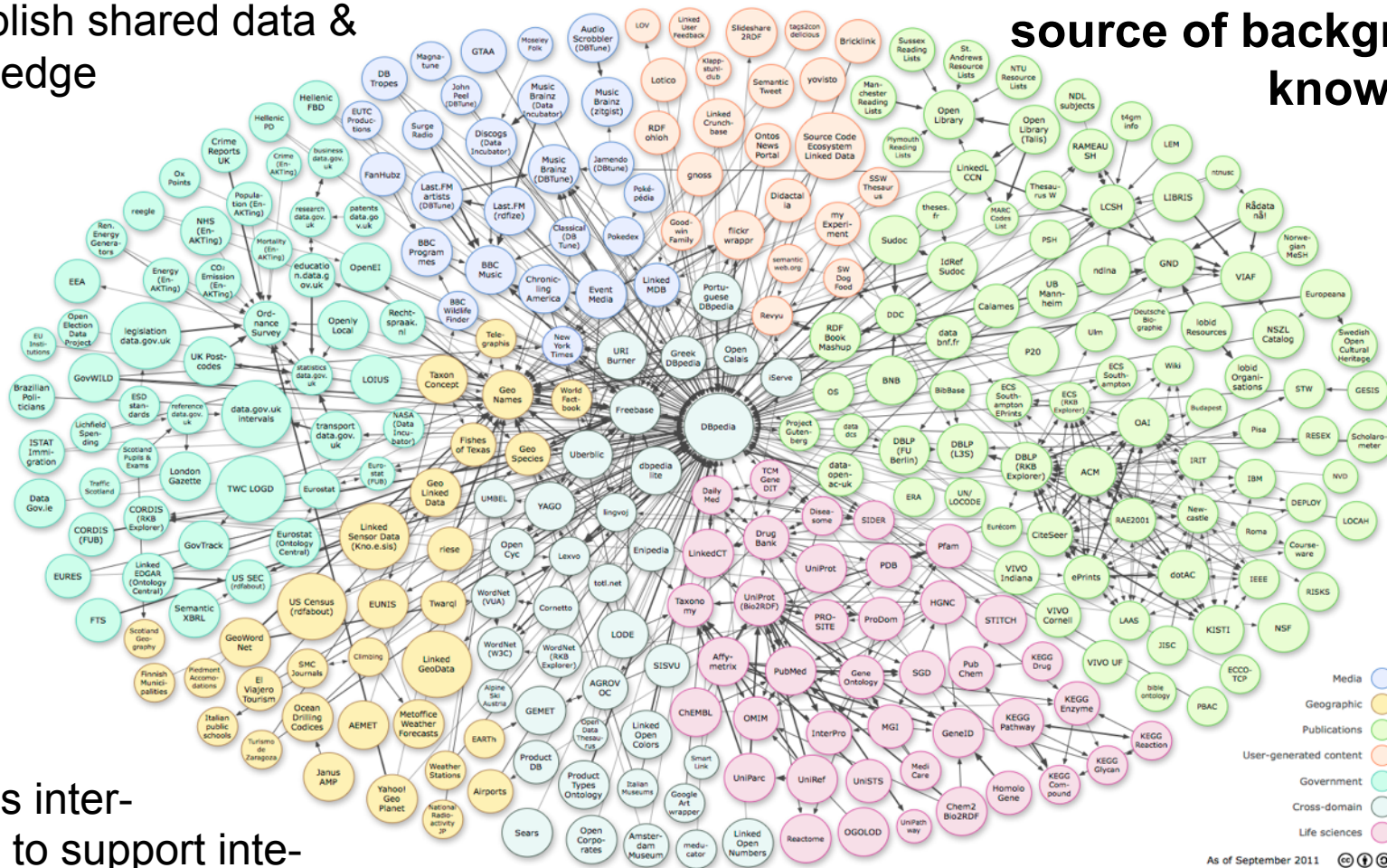
2010

...growing faster

Linked Open Data

Use Semantic Web Technology
to publish shared data &
knowledge

LOD is the new Cyc: a common
source of background
knowledge



Data is inter-
linked to support inte-
gration and fusion of knowledge

2011: 31B facts in 295 datasets interlinked by 504M assertions on ckan.net

Semantic Web: 1, 2, 3

Traditionally, all languages are divided into three parts:

- 1. Syntax:** legal forms that make up the sentences in a language
- 2. Semantics:** mapping of sentences to meaning (perhaps truth theoretic)
- 3. Pragmatics:** everything else (how to do things with language, knowledge of world, etc.)

1: Syntax

- Use URIs to denote classes, properties, objects, relations
 - http://live.dbpedia.org/resource/Alan_Turing
 - <http://schema.org/Person>
 - <http://www.w3.org/1999/02/22-rdf-syntax-ns#type>
- Use strings for literals
- Use triples to make statements
 - dbpedia:Alan_Turing rdfs:type schema:Person .
 - “Alan Turing is a Person”

2: Semantics

- Semantics maps URIs to the things they denote in “the world”
- Some of this is in your mind or in how you write your program
- The meaning of some URIs allow automatic inference
 - The parent relation is the inverse of the children relation
 - `schema:parent owl:inverseOf schema:children`

3: Pragmatics

- Semantics is more than just about truth (statements that assert things)
- We also have to account for commands, requests, questions, context, etc.
 - Some of this is handled by Web protocols (GET, POST)
 - Some by special SQ protocols (e.g., SPARQL for queries and updates)
 - Some by having reference KBs of the world (e.g., Dbpedia) to help identify common entities

Where are we

- The W3C version of the open semantic web has been growing steadily
- The languages and standards are being used in government and industry
 - BBC uses RDF to make up some of its content online
 - Google detects (some) RDF embedded in html pages and exploits it
 - Data.gov has many datasets in RDF

Wikipedia data
in RDF

DBpedia



The screenshot shows the DBpedia page for Alan Turing. The browser address bar displays 'dbpedia.org/page/Alan_Turing'. The page content is organized into a table with two columns: property names (e.g., 'dbpedia-owl:almaMater') and their corresponding values (e.g., 'dbpedia:King's_College,_Cambridge'). A blue callout box is overlaid on the page, containing the triple: 'dbpedia:Alan_Turing dbpedia-owl:doctoralAdvisor dbpedia:Alonzo_Church.'.

dbpedia-owl:almaMater	- dbpedia:King's_College,_Cambridge - dbpedia:Princeton_University
dbpedia-owl:award	- dbpedia:Royal_Society - dbpedia:Order_of_the_British_Empire - dbpedia:Fellow_of_the_Royal_Society - dbpedia:Officer_of_the_Order_of_the_British_Empire
dbpedia-owl:birthDate	1912-06-23 (xsd:date) 1912-06-23 (xsd:date)
dbpedia-owl:birthName	Alan Mathison Turing
dbpedia-owl:birthPlace	- dbpedia:Paddington - dbpedia:Maida_Vale
dbpedia-owl:deathDate	1954-06-07 (xsd:date)
dbpedia:Alan_Turing dbpedia-owl:doctoralAdvisor dbpedia:Alonzo_Church .	
dbpedia-owl:doctoralAdvisor	- dbpedia:Wilmslow - dbpedia:Alonzo_Church
dbpedia-owl:doctoralStudent	dbpedia:Robin_Gandy
dbpedia-owl:field	- dbpedia:Computer_science - dbpedia:Mathematics - dbpedia:Cryptanalysis
dbpedia-owl:individualisedPnd	118802976
dbpedia-owl:knownFor	- dbpedia:Turing_machine - dbpedia:Cryptanalysis_of_the_Enigma - dbpedia:Automatic_Computing_Engine - dbpedia:Turing_test

Wikidata

- [Wikidata](#) aims to create a free rdf-like KB about the world that can be read/edited by humans & machines
 - Wikimedia project started in April 2012 with external funding
- Wikidata clients use the repository, e.g., to populate Web pages or Wikipedia infoboxes
- Based on ideas from [Semantic MediaWiki](#) and [Freebase](#)

Open source
since 2005

Semantic Media Wiki

Store infobox
info in a KB

The screenshot shows the Semantic MediaWiki (SMW) website interface. At the top, the browser address bar displays `semantic-mediawiki.org/wiki/Semantic_MediaWiki`. The page header includes a navigation bar with tabs for "Page" (selected), "Discussion", "View", "View source", and "History". A search bar is located on the right. The main content area features a large blue box with the SMW logo and the text "Semantic MediaWiki". Below this, a sidebar on the left contains links for "Navigation", "Main page", "Introduction", "User manual", "Admin manual", "Community portal", "Recent changes", "Register your wiki", "Links", "Download SMW", "Report a bug", "Source code", "Code documentation", "MediaWiki", "OSDA", "Toolbox", "What links here", "Related changes", "Special pages", "Printable version", "Permanent link", and "Page information". The main content area is divided into three columns. The left column has a blue box titled "More about Semantic MediaWiki" with links to "Introduction to SMW", "FAQ", "Talks and publications", and "Testimonials". Below this is a blue box titled "Wiki of the Month - January 2013" featuring the "triple A wiki" logo and text: "Triple A is a site that provides IT architecture information for educational organizations. It supports *MBO-scholen* (Dutch secondary schools) wanting to innovate educational processes." The middle column has a blue box titled "Installation" with a large orange "Download" button labeled "Current version: SMW 1.8". Below this is a list of links: "Semantic MediaWiki 1.8", "Administrator manual", "Installation", "Configuration", and "Related extensions". The right column has a blue box titled "User community" with links to "Getting support", "SMW Community Wiki", "List of SMW-using wikis", and "SMWCon, the Semantic MediaWiki Conference". Below this is a blue box titled "The SMW project" with links to "About the project", "Version history", "Development roadmap", and "Programmer's guide". At the bottom right, there is a "News" section with links to "RSS" and "Atom" and a list item: "10 January 2013: Survey: What do you think of SMW?".

semantic-mediawiki.org/wiki/Semantic_MediaWiki

Create account Log in

Page Discussion View View source History Search

Semantic MediaWiki (SMW) is a free, open-source extension to [MediaWiki](#) – the wiki software that powers Wikipedia – that lets you store and query data within the wiki's pages.

Semantic MediaWiki is also a full-fledged framework, in conjunction with many spinoff extensions, that can turn a wiki into a powerful and flexible "collaborative database". All data created within SMW can easily be published via the [Semantic Web](#), allowing other systems to use this data seamlessly.

More about Semantic MediaWiki

- Introduction to SMW
- FAQ
- Talks and publications
- Testimonials

Wiki of the Month - January 2013

triple A wiki

Triple A is a site that provides IT architecture information for educational organizations. It supports *MBO-scholen* (Dutch secondary schools) wanting to innovate educational processes.

Installation

Download
Current version: SMW 1.8

- Semantic MediaWiki 1.8
- Administrator manual
- Installation
- Configuration
- Related extensions

Usage

- User manual
- SMW reference
- Try out SMW online
- Reporting bugs and wishes

User community

- Getting support
- SMW Community Wiki
- List of SMW-using wikis
- SMWCon, the Semantic MediaWiki Conference

The SMW project

- About the project
- Version history
- Development roadmap
- Programmer's guide

News RSS Atom

- 10 January 2013: Survey: What do you think of SMW?

Freebase

Acquired by
Google in 2010

Freebase

Find topics... Data Schema Apps Docs finin Settings Sign Out

Alan Turing

Scroll to:
People
Literature Subject
Influence Node
Computers
Name source
Academic
Chivalric Order Member
Inventor
Author
Person Or Being In Fiction
Organization member
Film subject
TV subject
More...



Alan Mathison Turing, OBE, FRS (/ˈtjʊərɪ/ TEWR-ing; 23 June 1912 – 7 June 1954), was a British mathematician, logician, cryptanalyst, and computer scientist. He was highly influential in the development of computer science, giving a formalisation of the concepts of "algorithm" and "computation" with the Turing machine, which can be considered a model of a general purpose computer. Turing is widely considered to be the father of computer science... [More](#)
[Read article at Wikipedia](#)

Date of birth: Jun 23, 1912
Date of death: Jun 7, 1954 (age 41 years)
Profession: [Mathematician](#), [Philosopher](#), [Computer Scientist](#), [Logician](#)
Country of nationality: [United Kingdom](#)
Also known as: [Alan Mathison Turing](#)

These people have edited this topic:



[Edit this topic](#)
Last edited Dec 12, 2012 [See all topic history »](#)

Related Topics

 [Edward Thomas Hall](#)

 [Alan Turing](#)

 [William Kingdon Clifford](#)

 [Ada Lovelace](#)

Alan Turing elsewhere on the web

★ [Official Website](#)
[Wikipedia](#)

People

Place of birth: [Maida Vale, United Kingdom](#)

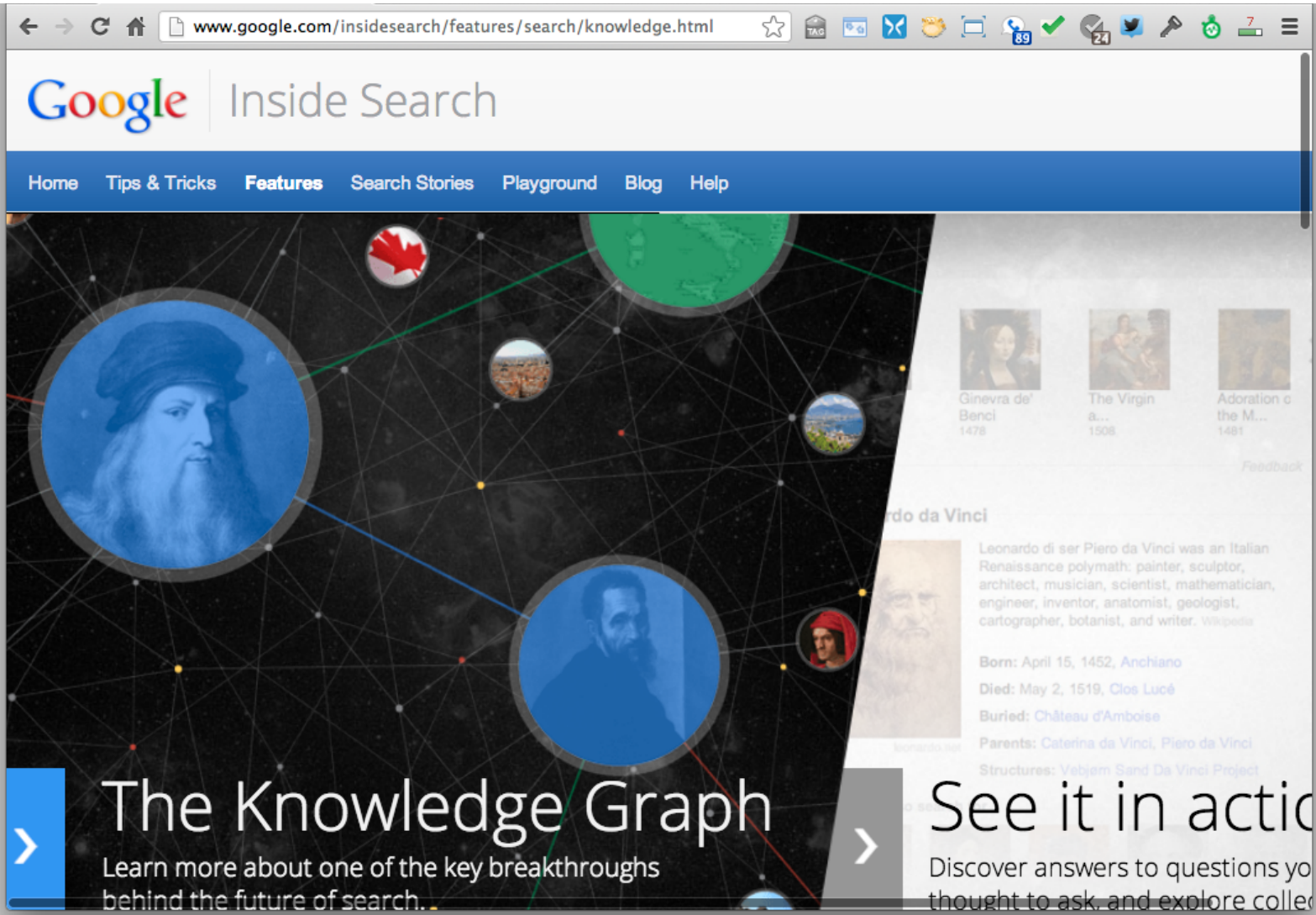
Alan Turing Quotes

“ Mathematical reasoning may be regarded... ”

“ No, I'm not interested in developing a powerful brain... ”

“An entity graph of people, places and things, built by a community that loves open data”

Google Knowledge Graph



The screenshot shows the Google Knowledge Graph interface. At the top, the Google logo is followed by "Inside Search". Below this is a navigation bar with links: Home, Tips & Tricks, **Features**, Search Stories, Playground, Blog, and Help. The main content area features a large, dark background with a network of interconnected nodes. The nodes are represented by various images: a large blue circle with a portrait of Leonardo da Vinci, a red Canadian flag, a green globe, and several smaller circular images of artworks. Lines connect these nodes, illustrating the relationships between them. On the right side, there is a detailed information panel for Leonardo da Vinci, including his birth and death dates, parents, and a list of his structures. Below the main content area, there is a section titled "The Knowledge Graph" with a blue arrow pointing right, and another section titled "See it in action" with a grey arrow pointing right. The text "Learn more about one of the key breakthroughs behind the future of search..." is visible under the first section, and "Discover answers to questions you thought to ask, and explore collected..." is visible under the second section.

Google Inside Search

Home Tips & Tricks **Features** Search Stories Playground Blog Help

The Knowledge Graph

Learn more about one of the key breakthroughs behind the future of search...

See it in action

Discover answers to questions you thought to ask, and explore collected...

Google's slogan for the knowledge graph: "things, not strings"

Map “mention strings” to entities

Knowledge Graph

Uses data from Freebase

The screenshot shows a Google search for "alan turing". The search bar contains "alan turing" and the search button is highlighted. Below the search bar, there are tabs for "Web", "Images", "Maps", "Shopping", "News", "More", and "Search tools". The "Web" tab is selected. The search results show 30 personal results and 4,130,000 other results. The first result is "Alan Turing - Home Page" with the URL "www.turing.org.uk/turing/". The second result is "Alan Turing - Wikipedia, the free encyclopedia" with the URL "en.wikipedia.org/wiki/Alan_Turing". The third result is "BBC - History - Alan Turing (pictures, video, facts & news)" with the URL "www.bbc.co.uk/history/people/alan_turing". The fourth result is "BBC News - Alan Turing: Inquest's suicide verdict 'not supportable'" with the URL "www.bbc.co.uk/news/science-environment-18561092". The fifth result is "Alan M. Turing (British mathematician and logician) -- Britannica ..." with the URL "www.britannica.com/EBchecked/topic/609739/Alan-M-Turing". The sixth result is "The Alan Turing Year - 2012 Turing Centenary". On the right side of the search results, there is a knowledge panel for "Alan Turing". It features a large portrait of Alan Turing and four smaller portraits. Below the portraits, it says "More images". The panel contains the following information: "Alan Turing" (title), "Alan Mathison Turing, OBE, FRS, was a British mathematician, logician, cryptanalyst, and computer scientist." (description), "Wikipedia" (source), "Born: June 23, 1912, Maida Vale" (birth information), "Died: June 7, 1954, Wilmslow" (death information), "Books: Computing machinery and intelligence, More" (books), "Education: Princeton University (1936 – 1938), More" (education), "Parents: Ethel Sara Stoney, Julius Mathison Turing" (parents), and "Siblings: John Turing" (siblings).

30 personal results. 4,130,000 other results.

[Alan Turing - Home Page](#)
www.turing.org.uk/turing/
Alan Turing Home Page. Guide to a large website maintained by Andrew Hodges, biographer of **Alan Turing** (1912-1954).

[Alan Turing - Wikipedia, the free encyclopedia](#)
en.wikipedia.org/wiki/Alan_Turing
Alan Mathison **Turing**, OBE, FRS was a British mathematician, logician, cryptanalyst, and computer scientist. He was highly influential in the development of ...
Turing machine - Turing test - Halting problem - Logic

[BBC - History - Alan Turing \(pictures, video, facts & news\)](#)
www.bbc.co.uk/history/people/alan_turing
Alan **Turing** was an English mathematician, wartime code-breaker and pioneer of computer science. Photo: **Alan Turing** with two colleagues and a Ferranti...

[BBC News - Alan Turing: Inquest's suicide verdict 'not supportable'](#)
www.bbc.co.uk/news/science-environment-18561092
Jun 26, 2012 – **Alan Turing**, the British mathematical genius and codebreaker, may not have committed suicide, as is widely believed, claims an academic.
George Wiman shared this on Google+

[Alan M. Turing \(British mathematician and logician\) -- Britannica ...](#)
www.britannica.com/EBchecked/topic/609739/Alan-M-Turing
British mathematician and logician, who made major contributions to mathematics, cryptanalysis, logic, philosophy, and biology and to the new areas later ...

[The Alan Turing Year - 2012 Turing Centenary](#)

Alan Turing

Alan Mathison Turing, OBE, FRS, was a British mathematician, logician, cryptanalyst, and computer scientist.
Wikipedia

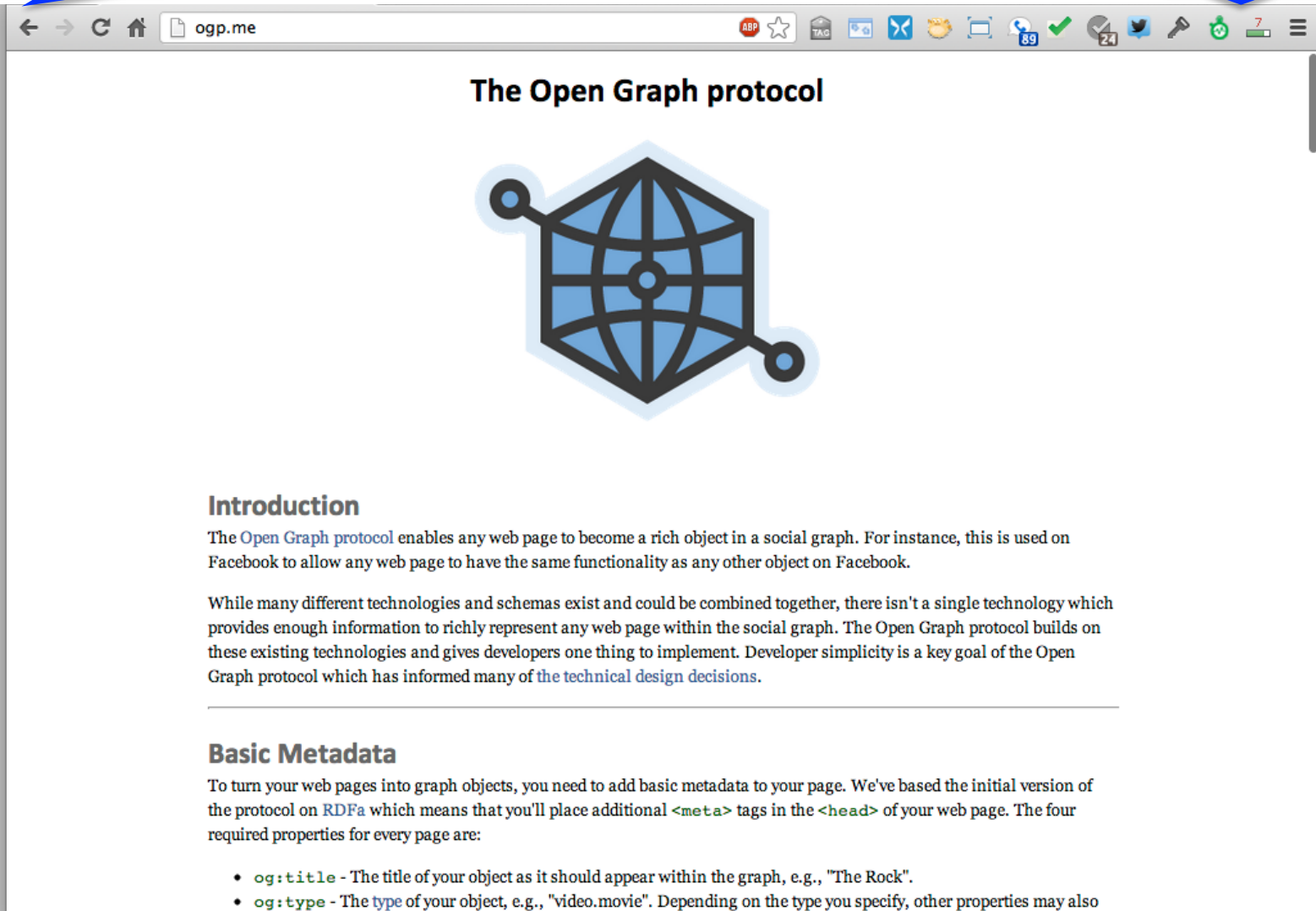
Born: June 23, 1912, Maida Vale
Died: June 7, 1954, Wilmslow
Books: Computing machinery and intelligence, More
Education: Princeton University (1936 – 1938), More
Parents: Ethel Sara Stoney, Julius Mathison Turing
Siblings: John Turing

Google’s slogan for the knowledge graph: “things, not strings”

Annotate your web pages in RDFa

Facebook Open Graph

=> object in the FB graph

A screenshot of a web browser displaying the ogp.me website. The browser's address bar shows 'ogp.me'. The page title is 'The Open Graph protocol'. Below the title is a large blue hexagonal icon with a globe inside, representing the Open Graph protocol. The page content includes an 'Introduction' section and a 'Basic Metadata' section. The 'Introduction' section explains that the Open Graph protocol enables any web page to become a rich object in a social graph, used by Facebook. The 'Basic Metadata' section explains that to turn web pages into graph objects, basic metadata must be added to the page, based on the initial version of the protocol on RDFa. It lists four required properties for every page: og:title, og:type, og:image, and og:url. The 'og:title' property is described as the title of the object as it should appear within the graph, e.g., 'The Rock'. The 'og:type' property is described as the type of the object, e.g., 'video.movie'. Depending on the type you specify, other properties may also be required.

The Open Graph protocol



Introduction

The [Open Graph](#) protocol enables any web page to become a rich object in a social graph. For instance, this is used on Facebook to allow any web page to have the same functionality as any other object on Facebook.

While many different technologies and schemas exist and could be combined together, there isn't a single technology which provides enough information to richly represent any web page within the social graph. The Open Graph protocol builds on these existing technologies and gives developers one thing to implement. Developer simplicity is a key goal of the Open Graph protocol which has informed many of [the technical design decisions](#).

Basic Metadata

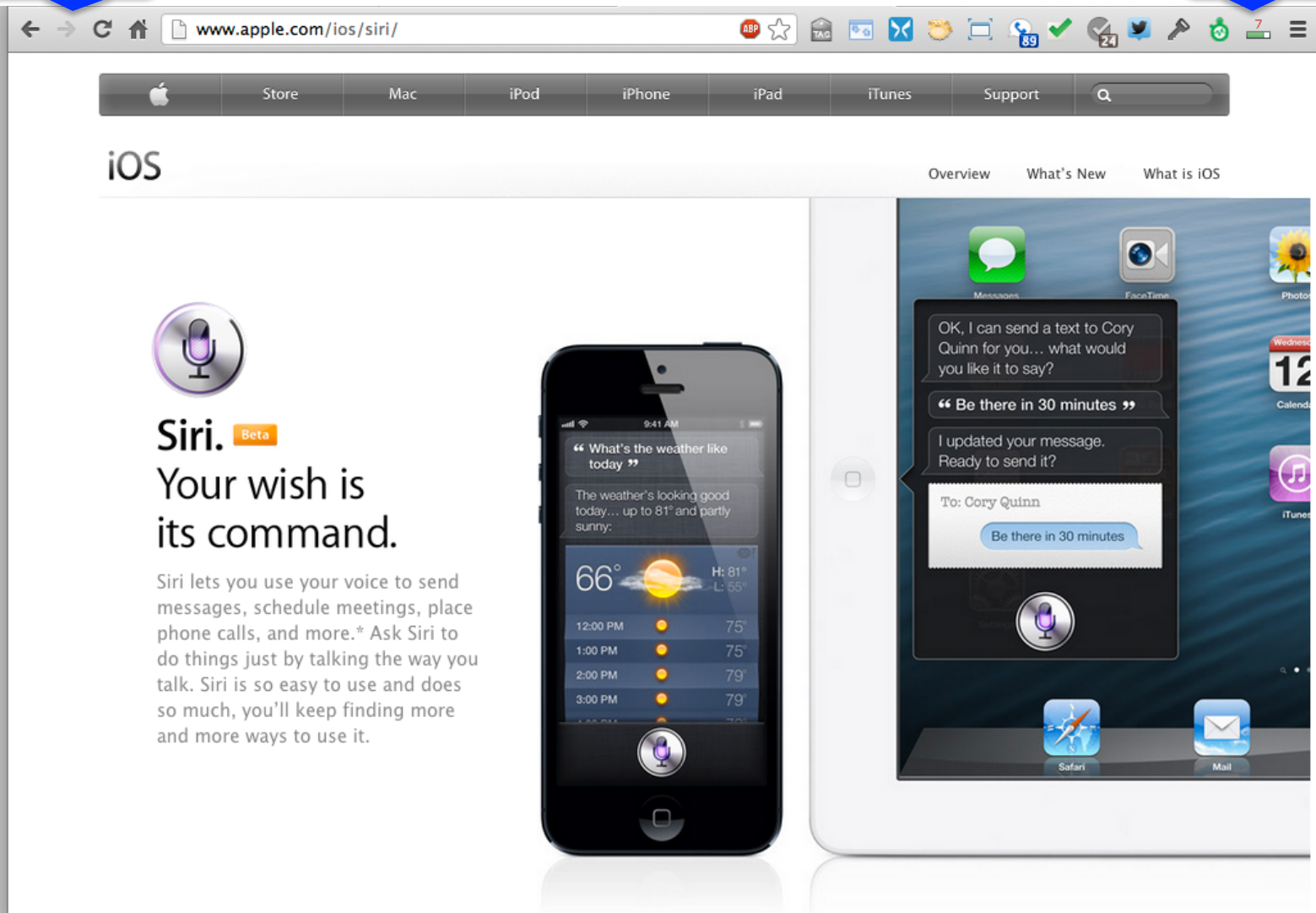
To turn your web pages into graph objects, you need to add basic metadata to your page. We've based the initial version of the protocol on [RDFa](#) which means that you'll place additional `<meta>` tags in the `<head>` of your web page. The four required properties for every page are:

- `og:title` - The title of your object as it should appear within the graph, e.g., "The Rock".
- `og:type` - The type of your object, e.g., "video.movie". Depending on the type you specify, other properties may also

speech => text =>
entities => task

Apple's SIRI

SIRI engineers
from AI/SW
community



SIRI needs lots of semantic data about entities in the world

IBM's Watson

The screenshot shows the IBM Watson website with a browser address bar at www-03.ibm.com/innovation/us/watson/. The page features the IBM logo and navigation links for Industries & solutions, Services, Products, Support & downloads, and My IBM. A search bar is also present. The main headline reads "IBM Watson: Ushering in a new era of computing". Below this, a section titled "What's next for Watson?" invites users to join a discussion. A large graphic of a globe with blue and yellow lines represents cognitive connections. A horizontal menu includes links to Watson, Putting Watson to work, Science behind Watson, Getting ready for Watson, and News/events. The "Putting Watson to work" section contains a video thumbnail titled "Watson goes to work (1.53MB)" and a text block stating: "Cognitive systems like Watson may transform how organizations think, act, and operate in the future. Learning through interactions, they deliver evidence based responses driving better outcomes." To the right, a "Contact IBM about Watson" section provides an email link, a phone number (1-800-966-9875), and a priority code (109HF03W). Below this is a "Follow IBM Watson" section with a YouTube icon. The "Recent news" section lists two items: "IBM hopes its Watson will become doctor's sidekick" and "IBM Exploring Ways to Use, Sell Watson Cloud Services", with a link to "More Watson news". At the bottom, a "Putting Watson to work" section features five blue human icons and the text "Data is growing at extraordinary rates - 800". A "Take the next step" section asks "Is your business ready for Watson? Discover how to prepare your" and is accompanied by a graphic of five green and blue chevrons pointing right.

IBM Watson: Ushering in a new era of computing

What's next for Watson?
We want to hear how YOU would put Watson to work. Join the discussion
[Learn more](#)

Watson | Putting Watson to work | Science behind Watson | Getting ready for Watson | News/events

Watson goes to work (1.53MB)

Cognitive systems like Watson may transform how organizations think, act, and operate in the future. Learning through interactions, they deliver evidence based responses driving better outcomes.

Contact IBM about Watson
[Email IBM](#)
Or call us at: 1-800-966-9875
Priority code: 109HF03W

Follow IBM Watson

Recent news
[IBM hopes its Watson will become doctor's sidekick](#)
[IBM Exploring Ways to Use, Sell Watson Cloud Services](#)
[More Watson news](#)

Putting Watson to work
Data is growing at extraordinary rates - 800

Take the next step Is your business ready for Watson? Discover how to prepare your

IBM used Semantic Web technology and data in Watson, see <http://bit.ly/X44aIE>

Summary

- The Web's made people smarter by letting us share information and knowledge as text, audio and images
- Machines should also be able to use the web to publish and retrieve information and knowledge
- Human forms of knowledge are hard for machines to understand and generate
- The Semantic Web is a collection of languages, ontologies, software tools, services and KBs that are designed to support machines