

Semantic Web

1. Introduction and overview

PD Dr. Matthias Thimm

thimm@uni-koblenz.de

Institute for Web Science and Technologies (WeST)
University of Koblenz-Landau



What is the Semantic Web?

- ▶ “The Semantic Web is a Web of actionable information—information derived from data through a semantic theory for interpreting the symbols.”
- ▶ “The semantic theory provides an account of ‘meaning’ in which the logical connection of terms establishes interoperability between systems.”

(Shadbolt, Hall, Berners-Lee, The Semantic Web revisited, IEEE Intelligent Systems, May 2006)

Problems with the traditional web 1/3

- ▶ search and retrieval
 - ▶ keyword-based
 - ▶ meaning is not encoded



Problems with the traditional web 2/3

- ▶ presentation vs. content
 - ▶ HTML mixes layout and content
 - ▶ tags do not provide meaning

HTML

```
<div>
  <b>Title: Introduction to CS</b>
  <div>
    <i>Lecturer: Kant</i>
    <i>Office: C4</i>
  </div>
  ...
</div>
```

XML

```
<Event id="o1">
  <Lecture LNr="5001">
    <Title>Introduction to CS</Title>
    <Prof>
      <pnr>2137</pnr>
      <name>Kant</name>
      <loc>C4</loc>...
    </Prof>
  </Lecture>
  ...
</Event>
```

Problems with the traditional web 3/3

- ▶ aggregation of information from different sources
 - ▶ no shared semantics (even when using XML)
 - ▶ different interpretations



Create account Log in

Visit the main page

WIKIPEDIA
The Free Encyclopedia

Main page
Contents
Featured content
Current events
Random article
Donate to Wikipedia

Interaction
Help
About Wikipedia
Community portal
Recent changes
Contact Wikipedia

Toolbox
Print/export

Read Edit View history Search

Dodgson's method

From Wikipedia, the free encyclopedia

Dodgson's method is a voting system proposed by the author, mathematician and logician, Charles Dodgson (better known as Lewis Carroll). The method is extending the Condorcet method by swapping candidates until you find a Condorcet winner. The winner is the candidate which requires the minimum number of swaps. Dodgson proposed this voting scheme in his 1876 work "A method of taking votes on more than two issues". Given an integer k and an election, it is NP-complete to determine whether or not a candidate can become a Condorcet winner with less than k swaps.

Description [edit]

In Dodgson's method, each voter submits an ordered list of all candidates according to their own preference (from best to worst). The winner is defined to be the candidate for whom we need to perform the minimum number of pairwise swaps (added over all candidates) before they become a Condorcet winner. In particular, if there is already a Condorcet winner, they win the election. In short, we must find the voting profile with minimum Kendall tau distance from the input, such that it has a Condorcet winner; they are declared the victor. Computing the winner is an NP-hard problem.^[1]

References [edit]

1. ^ Barrao, M., C. A. Tovey, and M. A. Trick, "Voting schemes for which it can be difficult to tell who won the election", *Social Choice and Welfare*, Vol. 6, No. 2 (1989), pp. 157–165.

X This election-related article is a stub. You can help Wikipedia by expanding it.

Categories: Electoral systems | Voting systems | Non-monotonic Condorcet methods | Election stubs

This page was last modified on 14 June 2012 at 03:28.
Text is available under the Creative Commons Attribution-ShareAlike License; additional terms may apply. By using this site, you agree to the Terms of Use and Privacy Policy.
Wikimedia is a registered trademark of the Wikimedia Foundation, Inc., a non-profit organization.

Privacy policy About Wikipedia Disclaimers Contact Wikipedia Mobile view

WIKIMEDIA project Powered by MediaWiki

Part of the Politics series
Voting systems
Single-winner [show]
Multiple-winner [show]
Proxy voting [show]
Random selection [show]
Social choice theory [show]
Politics portal [show]

The solution

- ▶ Publish machine-processable data instead of natural language (or additionally to natural language)
- ▶ Using shared semantics across the web or link heterogeneous semantics to each other
- ▶ The Semantic Web is an infrastructure that provides linking and exchange of information with a shared semantical understanding

Semantic Web = Semantic Web Data +
Ontologies +
Internet +
Social Phenomenon

Outline

- 1 Some History
- 2 The Semantic Web Architecture
- 3 The Semantic Web today
- 4 Summary

Outline

- 1 Some History
- 2 The Semantic Web Architecture
- 3 The Semantic Web today
- 4 Summary

Some History 1/2

The web (as we know it) has been fundamentally shaped by Tim Berners-Lee (TBL), a former physicist working at CERN.



The original vision (1990) of the web was much more ambitious than what exists today:

“... a goal of the Web was that, if the interaction between person and hypertext could be so intuitive that the machine-readable information space gave an accurate representation of the state of people’s thoughts, interactions, and work patterns, then machine analysis could become a very powerful management tool, seeing patterns in our work and facilitating our working together through the typical problems which beset the management of large organizations.”

Some History 2/2

The Intelligence is in the Connections

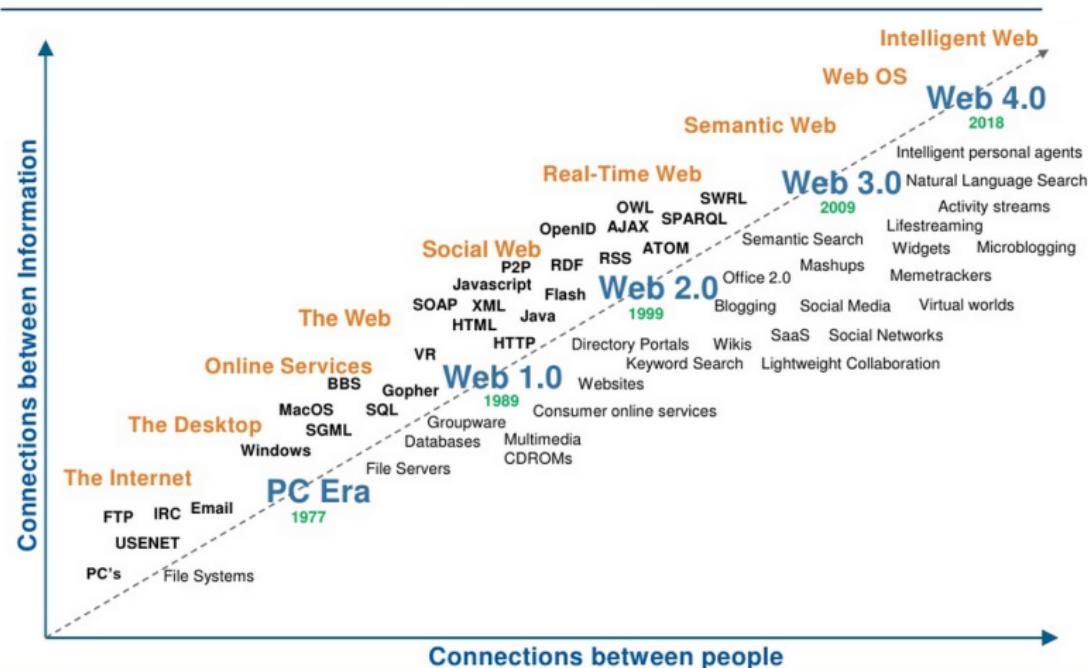


Image by Nova Spivack

Outline

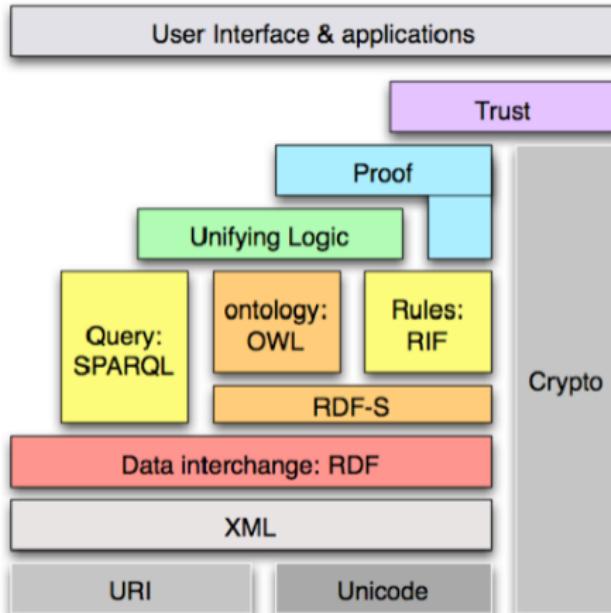
1 Some History

2 The Semantic Web Architecture

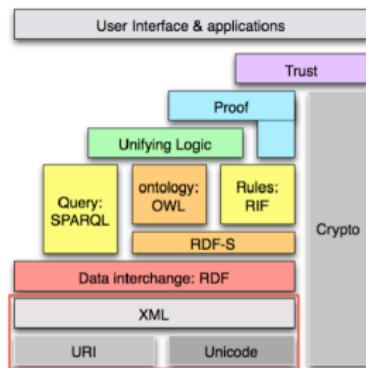
3 The Semantic Web today

4 Summary

Semantic Web Architecture

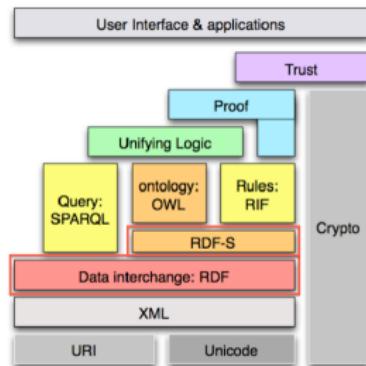


Layers: URI, Unicode, XML



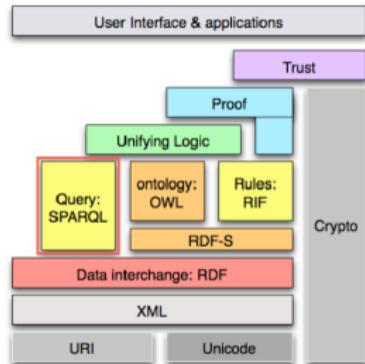
- ▶ Unicode
 - ▶ Standard for text encoding
- ▶ Uniform Resource Identifier (URI)
 - ▶ universal naming system for web resources
 - ▶ URIs are the “ground terms” of the Semantic Web
 - ▶ <http://www.w3.org/>,
<http://example.org/#john>
- ▶ eXtensible Markup Language (XML)
 - ▶ Markup language for (semi-)structured text
 - ▶ common interchange format

Layers: RDF, RDF-S



- ▶ Resource Description Framework (RDF)
 - ▶ Data modeling language
 - ▶ Relates URIs to each other using “triples”
(ex=<http://example.org>):
ex:john ex:father-of ex:jack
 - ▶ W3C standard (1999)
- ▶ RDF Schema (RDF-S)
 - ▶ Provides a basic vocabulary for relations such as ex:father-of
 - ▶ W3C standard (2004)

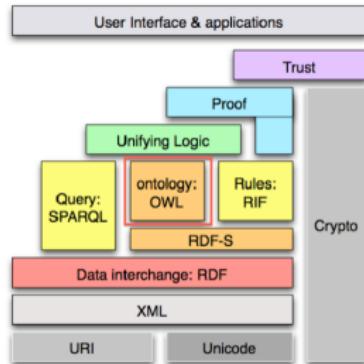
Layer: SPARQL



► SPARQL Protocol and RDF Query Language (SPARQL)

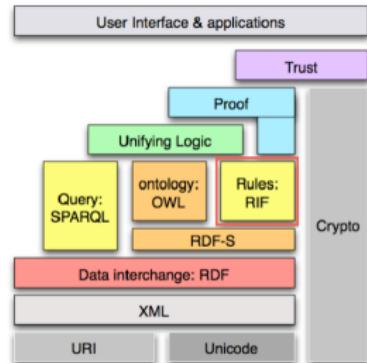
- Query language for RDF data
- SELECT ?child WHERE ex:john ex:father-of ?child
- SPARQL : RDF = SQL : RDBMS

Layer: OWL



- ▶ Web Ontology Language (OWL)
 - ▶ Brings (more) semantics to RDF
 - ▶ Shared semantics for different RDF data sets
 - ▶ Allows to draw inferences

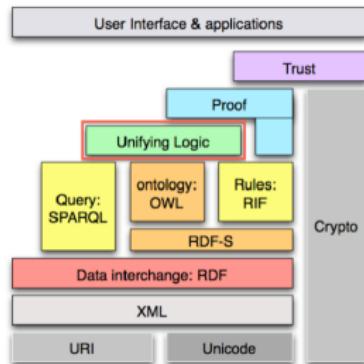
Layer: Rules



► Rules

- ▶ Many KR approaches deal with rules (e.g. logic programming)
- ▶ RIF (Rule Interchange Format) allows to use the approaches with RDF data
- ▶ W3C Recommendation (2010)

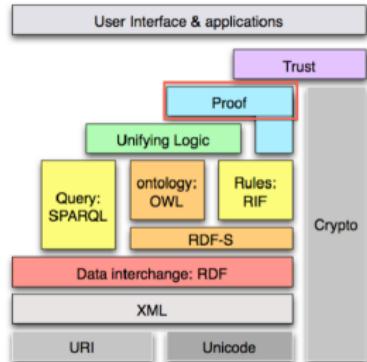
Layer: Unifying logic



► Unifying logic

- ▶ acts as an umbrella logic for RDF, OWL, RIF
- ▶ should also take uncertain reasoning into account
- ▶ no standard
- ▶ one of the challenging open issues in Semantic Web research

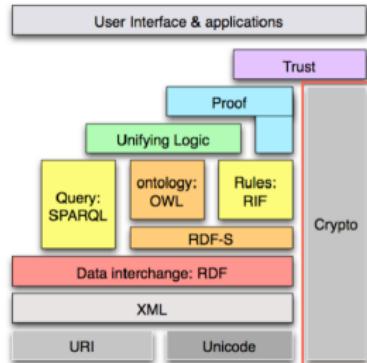
Layer: Proof



▶ Proof

- ▶ Efficient reasoning mechanisms for the Semantic Web
- ▶ no standard, open problem in Semantic Web research

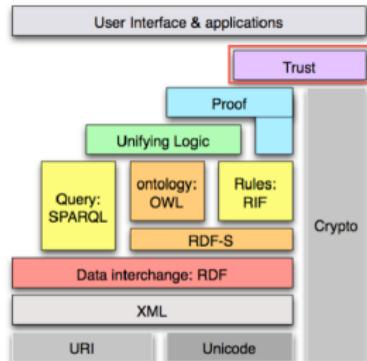
Layer: Crypto



► Cryptography

- ▶ Information exchanged over the Semantic Web should be protected
- ▶ Automatically extracting semantic information about users is even more privacy-violating than ordinary information
- ▶ no standard, open problem in Semantic Web research

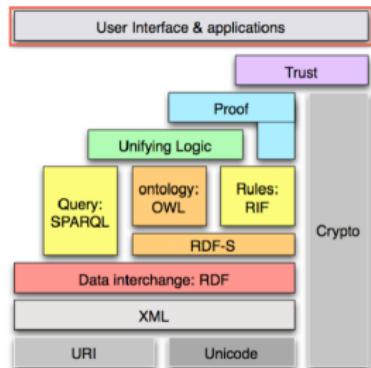
Layer: Trust



► Trust

- ▶ Where does the information come from?
- ▶ Is it trustworthy?
- ▶ What data sets have contributed in answering my query?
- ▶ no standard, open problem in Semantic Web research

Layer: User interface and applications



- ▶ User interface and applications
 - ▶ Semantic Web services
 - ▶ Semantic Web agents
 - ▶ open problem in Semantic Web research

Outline

1 Some History

2 The Semantic Web Architecture

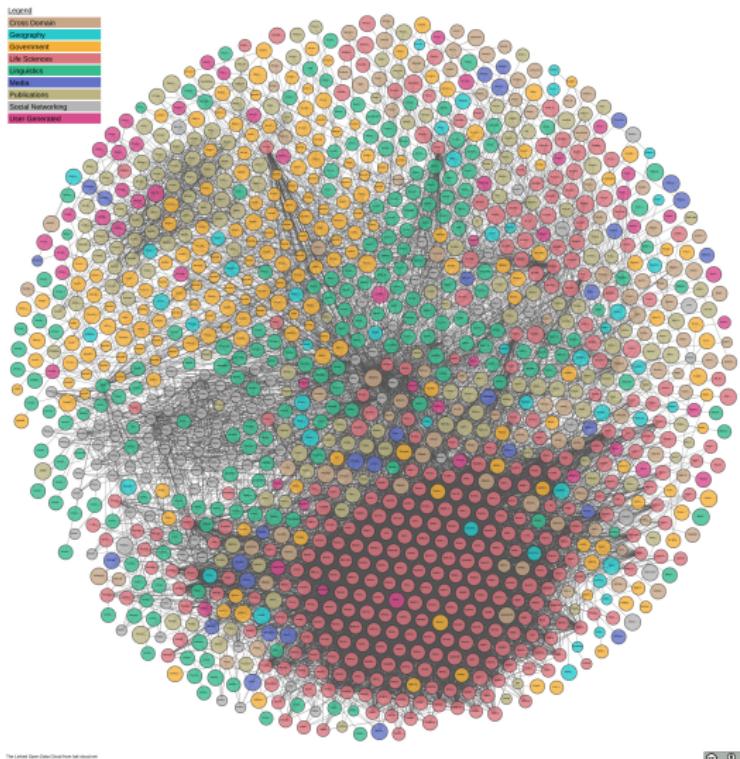
3 The Semantic Web today

4 Summary

The Semantic Web today

- ▶ Standards for the representation of Semantic Web data do exist today (Unicode, XML, RDF, ...)
 - ▶ Representation and linkage of semantic data is possible
 - ▶ Issues exist for the “AI-parts” of the Semantic Web (reasoning, intelligent retrieval, etc.)
 - ▶ Another challenge is scalability
- Today's most successful “product” of Semantic Web research is the Linked Open Data Initiative.

Linked Open Data 1/2



Linked Open Data 2/2

- ▶ Linked Data Principles
 1. Use URIs to identify things
 2. Use HTTP URIs so that people can look up those names
 3. Upon lookup of an URI provide useful information, using the standards (RDF, RDFS, SPARQL)
 4. Include links to other URIs, so that users can discover more things.
- ▶ The principles are recommended best practices for publishing semantic information with RDF
- ▶ “The goal of the W3C Semantic Web Education and Outreach group’s Linking Open Data community project is to extend the Web with a data commons by publishing various open datasets as RDF on the Web and by setting RDF links between data items from different data sources. In October 2007, datasets consisted of over two billion RDF triples, which were interlinked by over two million RDF links. ” [Wikipedia]



- ▶ “*DBpedia is a crowd-sourced community effort to extract structured information from Wikipedia and make this information available on the Web.*”
- ▶ “Semantification” of Wikipedia:
 - ▶ 764,000 persons
 - ▶ 573,000 places
 - ▶ 333,000 creative works
 - ▶ 192,000 organizations
 - ▶ 202,000 species
 - ▶ 5,500 diseases.

Other Semantic Data Repositories



GoPubMed is a knowledge-based search engine for biomedical texts



LinkedGeoData uses the comprehensive OpenStreetMap spatial data collection to create a large spatial knowledge base



The New York Times publishes most of its content as semantic data as well



Google's knowledge graph is inspired by semantic technologies

Outline

1 Some History

2 The Semantic Web Architecture

3 The Semantic Web today

4 Summary

Summary

- ▶ What is the Semantic Web?
- ▶ The Semantic Web Architecture
 - ▶ Unicode, URIs, XML
 - ▶ RDF, RDF-S, SPARQL
 - ▶ OWL, RIF
 - ▶ Unifying Logic, Proof, Trust, Crypto
 - ▶ User interfaces and applications
- ▶ Linked Open Data

Pointers to further reading

- ▶ http://en.wikipedia.org/wiki/Semantic_web
- ▶ Semantic Web Case Studies and Use Cases:
<http://www.w3.org/2001/sw/sweo/public/UseCases/>
- ▶ Grigoris Antoniou, Frank van Harmelen (March 31, 2008). A Semantic Web Primer, 2nd Edition. The MIT Press. ISBN 0-262-01242-1.