The semantic Web: prospects & challenges

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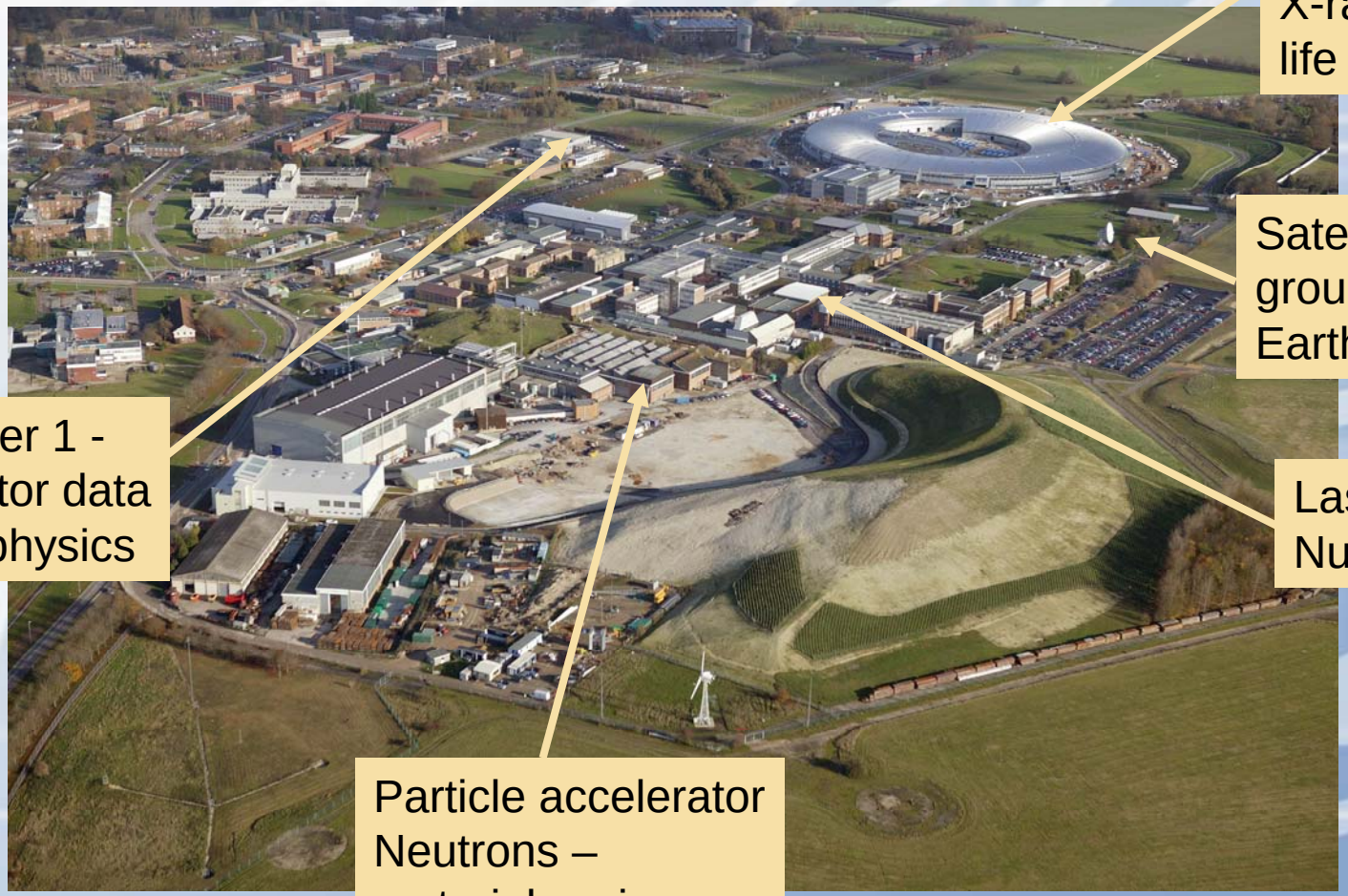


Synchrotron: X-ray, light – life sciences

Satellite ground station – Earth observation

Laser beam: Nuclear fusion

Particle accelerator Neutrons – materials science

CERN Tier 1 - Accelerator data Particle physics

W3C Web Architecture

Comparing Web and semantic Web development

Web

- 1989 proposal
- +2 yrs portable browser
- +5 yrs commercial browser, index, crawler
- +6 yrs 73,500 servers
- +10 yrs 3% US GDP from web

Revolution

Semantic Web

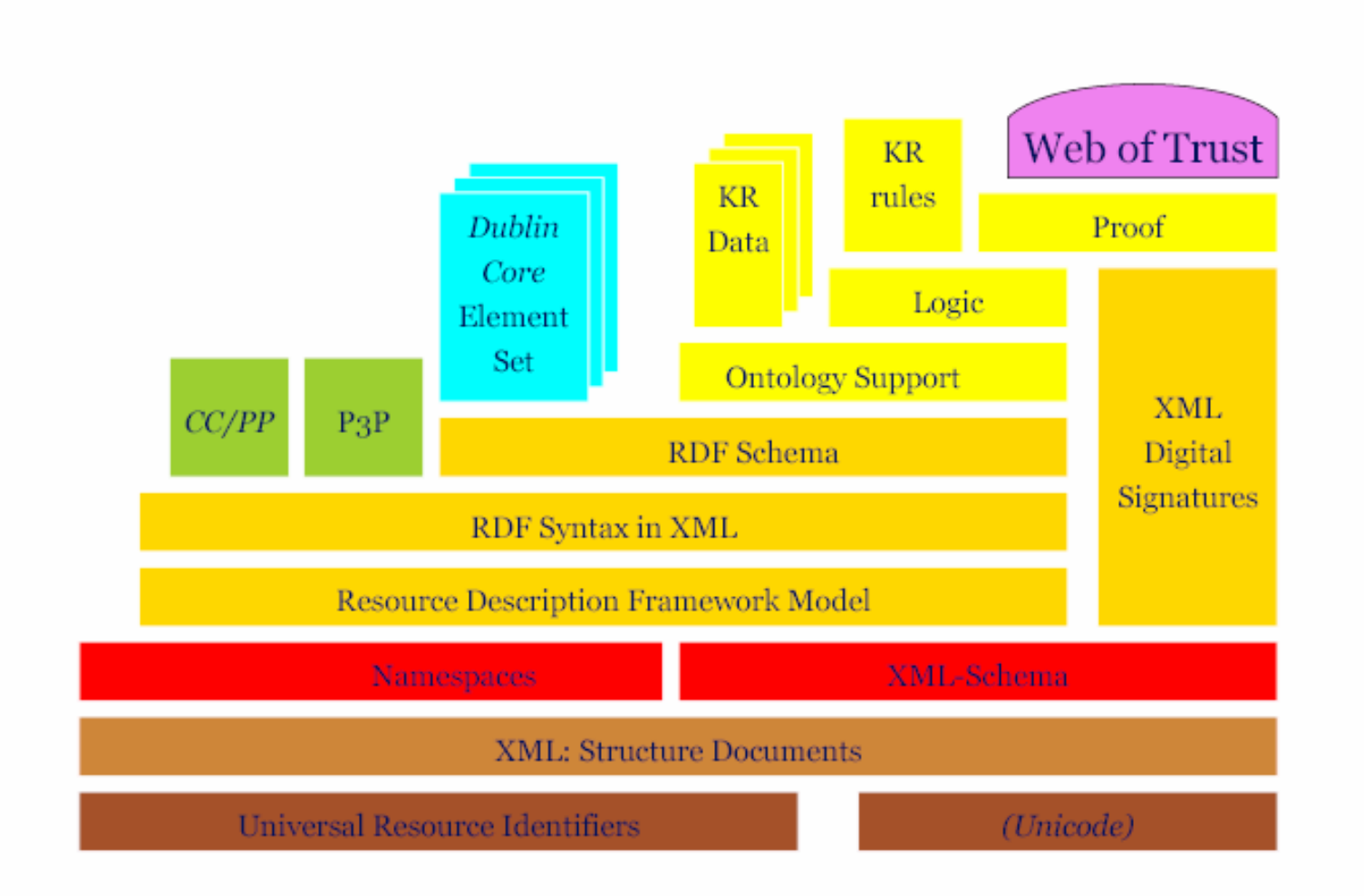
- 1996 proposal
- +3yrs RDF agreed
- +8yrs browser, OWL, RDF Schema
- +9 yrs demonstration applications
- +10 yrs commercial DB support

Evolution

The semantic Web

- *1996 – metadata to describe the data on the Web.*
- *1998 – query languages, inference rules & proof validation*
- *2001 – bring structure to the meaningful content of web pages, creating an environment where software agents roaming from page to page can readily carry out sophisticated tasks for users.*
- *2006 –The "Semantic Web" is an infrastructure extending the current Web for the interchange and the integration of data on the Web* .

Semantic Web Architecture & Technologies - 2001



Semantic Web Architecture & Technologies - 2006

- To make data machine processable, we need:
  - unambiguous names for resources (that may also bind data to real world objects): URI
  - a common data model to access, connect, describe the resources: RDF
  - access to that data, join the web: SPARQL
  - common access to XML and RDF: GRDDL
  - define common vocabularies, ontologies: RDFS, OWL, SKOS
  - Hyperlinks and the semantic Web – RDF/A
  - Reasoning - Rule Interchange Format

GRDDL

- Gleaning Resource Descriptions from Dialects of Languages (GRDDL)
- mechanism to relate other XML syntaxes (especially XHTML dialects) to the RDF abstract syntax via transformations
- Example – HTML Snippet:

<html>

<head><title>Example of an HTML document</title>

</head>

Translates to RDF assertion:

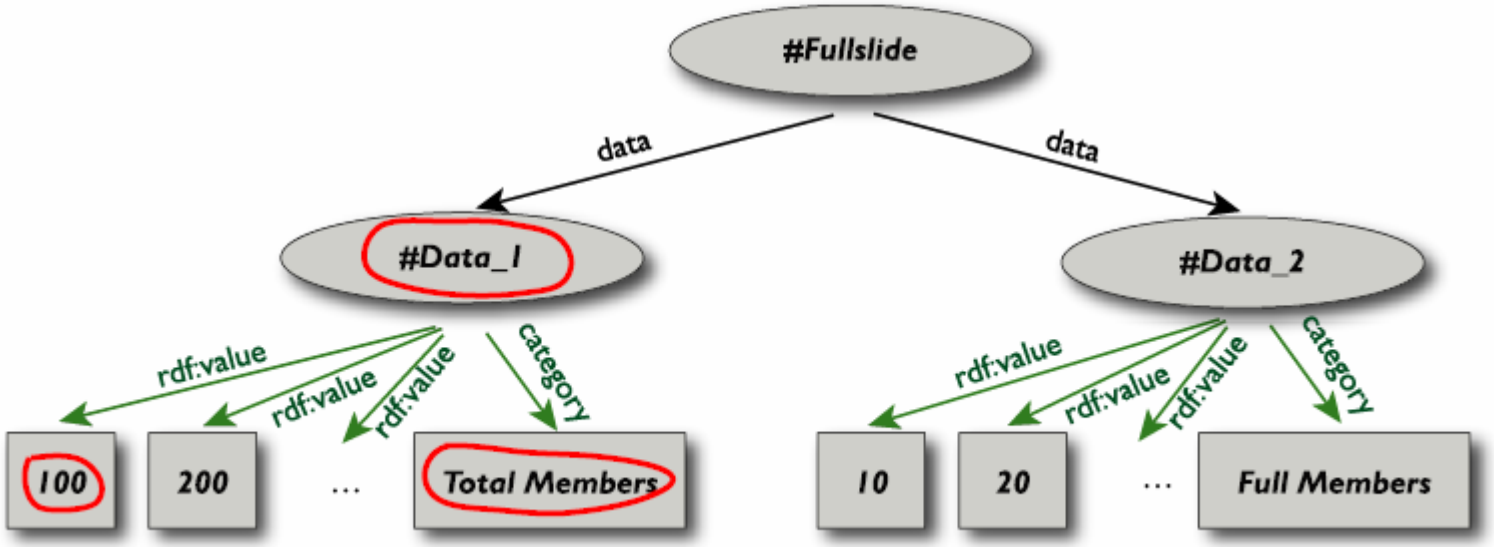
<document.html> dc:title "Example of an HTML document".

- Further work in W3C to take GRDDL to a recommendation

SPARQL – RDF Query Language

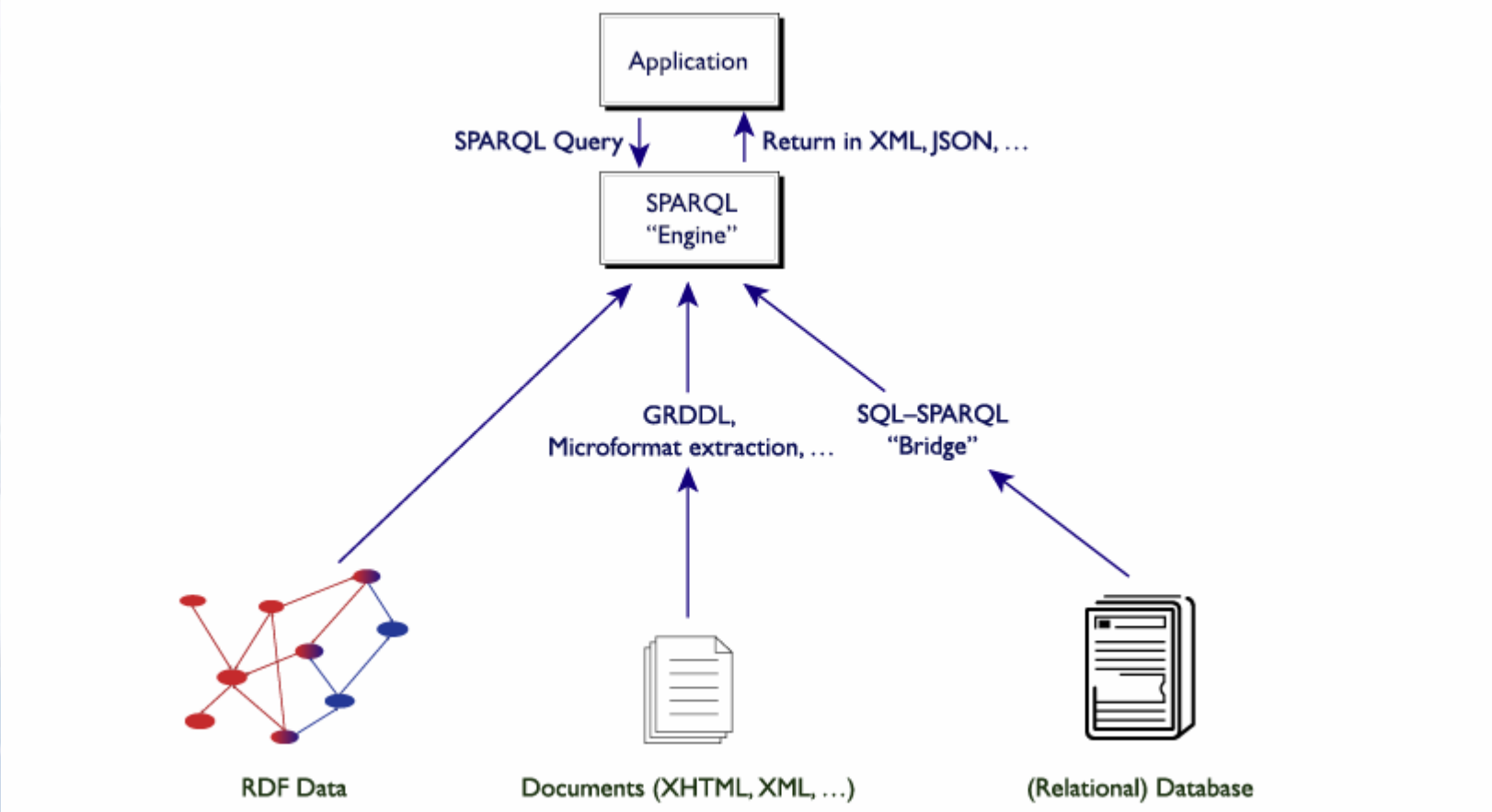
```
SELECT ?cat ?val # note: not ?x!
WHERE { ?x rdf:value ?val. ?x category ?cat }
```

Returns: `[["Total Members",100],["Total Members",200],…,["Full Members",10],…]`



- Waiting on XQuery to go to recommendation before SPARQL can.

SPARQL – Application



RDF-A

- RDF/A is a set of attributes used to embed RDF in XHTML.
- Instead of:

```
If you want to contact me at work, you can either
<a href="mailto:jo.lambda@example.org">
email me</a>,
or call +1 777 888 9999.
```

Use:

```
If you want to contact me at work, you can either
<a rel="foaf:mbox" href="mailto:jo.lambda@example.org">
email me</a>,
or call <span property="foaf:phone">+1 777 888
  9999</span>.
```

To produce RDF triples:

foaf:mbox = "mailto:jo.lambda@example.org"

foaf:phone = "+1 777 888 9999"

Layering of the semantic Web

- Each layer should meet a new market need
- Each layer should build on previous ones
- Each layer should provide ROI by itself

Commercial RDF support

- Oracle v10.2
- Native RDF store
- Converters / loaders for existing RDF data
- RDF Query – An RDF_MATCH function which can be used in SQL to find graph patterns in RDF (similar to SPARQL)
- Over 100 Partners Thoroughly Test and Support Oracle Database 10g Release 2

Small Applications

Small apps in RDF provide ROI:

RSS/Podcast

Dublin Core

XFN: bloggers

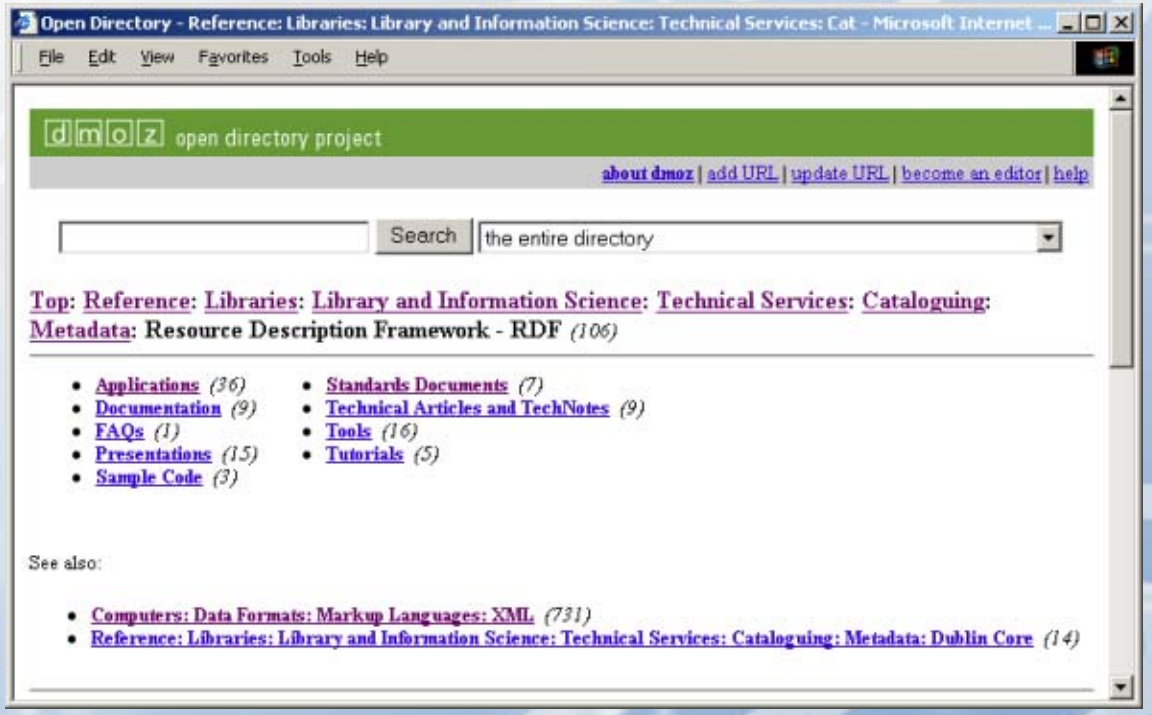
Calendar

Geo URL

FOAF

Thesaurus

XML & RDF



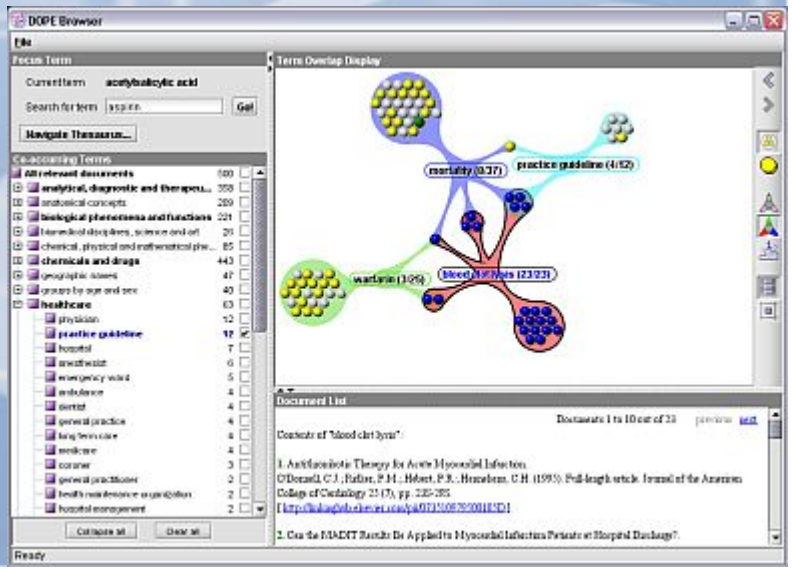
DMOZ is an open directory project represents the directory an its contents in RDF.

Applications: Data Integration

- No "one schema" that can be used for describing everything
- No "right way" for describing / organizing anything
- Importance of "Partial Understanding"
- Things change, plan up front for it
- The value in "as needed" data integration
- Big wins come from many little ones
- The power of links - network effect
- Open-world, open solutions are cost effective

Application: data integration

- Semantic integration of different data sources
- RDF/RDFS (possibly with OWL and/or SKOS) based vocabularies as an “interlingua” among system components
- Many different projects and R&D on this: Boeing, MITRE Corp., Elsevier, EU Projects like Sculpteur and Artiste, national projects like MuseoSuomi, …



Applications: Portals

- Vodafone's Live Mobile Portal
- search application (e.g. ringtone, game, picture) using RDF
  - page views per download decreased 50%
  - ringtone up 20% in 2 months
- Sun's SwordFish: public queries for support, handbooks, etc, go through an internal RDF engine for White Paper Collections and System Handbook collections
- Nokia has a somewhat similar support portal

Common Themes to successful SW applications

- No "one schema" that can be used for describing everything
- No "right way" for describing / organizing anything
- Importance of "Partial Understanding"
- Things change, plan up front for it
- The value in "as needed" data integration
- Big wins come from many little ones
- The power of links - network effect
- Open-world, open solutions are cost effective

Summary

- Evolution not the revolution of the Web
- Small parts added to the architecture
- Development and adoption are progressing and continuing

But …
Research Challenges …

Six research problems for the SW

- Understanding ontological modelling
- Logical basis for inference
- Translating between ontologies
- Reasoning about agent's intentions
- Sociology of agents
- Governance of agents

Understanding ontological modelling

- Guizzardi addressed some of these issues yesterday.
- OWL is an epistemological language for ontologies
- What is the development method for ontologies ?
- What are the design languages ?
- What are the design trade-offs in ontology development ?
- What is the ontological status of objects and relations ?

Logical basis for inference

- Are Description Logics insufficient for rule based reasoning?
- Are Horn clause logics required instead ?
- The constraints on Horn clause logic and description logics are different.
- What are the consequences of using the two together ?

Translating between ontologies

- Today
  - transform to common syntax
  - Take union of concepts & axioms
  - Define bridging axioms through an inference engine.
- Eventually
  - Metaphors are assertions of conceptual identity
  - Translation using metaphoric relations

Reasoning about agent's intentions

- Certified Assertion based confidence
- Transfer/Generalisation of assertions ?
- Generalisation as trust – common intention
- How do we transfer/generalise intentions ?

Sociology of agents

- Agents operate in networks
- Agents cluster and herd
- What properties of the group behaviour of agents are important ?

Governance of agents

- Liability and Governance
- Extending
  - the development method
  - the run time system
  - service quality

Conclusion

- The larger vision of the SW is still valid
- It will take a long time to evolve from the web of today into a full SW
- Much research in more abstract areas is required before we will get there
- The opportunities are there for you to take