Substance of the Semantic Web

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Outline

• Background and Technical Details
• Selected Technical Benefits of the Semantic Web
Semantic Web Perspectives

- The Semantic Web means different things to different people. It is multi-dimensional
  - Distributed data access
  - Inference
  - Data Integration
  - Logic
  - Services
  - Search
  - Configuration
  - Agents
  - ...

- Different users value these dimensions differently

- Theme: Machine-operational declarative specification of the meaning of terms
Semantic Web Layering

- Self-desc. doc.
- Data
- RDF + rdfschema
- XML + NS + xmschema
- Unicode
- URI
- Ontology vocabulary
- Logic
- Proof
- Trust
- Digital Signature

From: Berners-Lee XML 2000
The Semantic Web is made up of individual statements. The subject and predicate are Uniform Resource Identifiers (URIs) – the object can be a URI or an optionally typed literal value.
Selected Technical Benefits

1. Integrating Multiple Data Sources
2. Semantic Drill Down / Focused Perusal
3. Statements about Statements
4. Inference
5. Translation
6. Smart (Focused) Search
7. Smarter Search … Configuration
8. Proof
1: Integrating Multiple Data Sources

- The Semantic Web lets us merge statements from different sources.
- The RDF Graph Model allows programs to use data uniformly regardless of the source.
- Figuring out where to find such data is a motivator for Semantic Web Services.

Different line & text colors represent different data sources.
2: Drill Down /Focused Perusal

- The Semantic Web uses Uniform Resource Identifiers (URIs) to name things.
- These can typically be resolved to get more information about the resource.
- This essentially creates a web of data analogous to the web of text created by the World Wide Web.
- Ontologies are represented using the same structure as content:
  - We can resolve class and property URIs to learn about the ontology.
3: Statements about Statements

• The Semantic Web allows us to make statements about statements
  – Timestamps
  – Provenance / Lineage
  – Authoritativeness / Probability / Uncertainty
  – Security classification
  – ...

• This is an unsung virtue of the Semantic Web particularly relevant to the Intelligence Community

From CIA World Factbook
4: Inference

- The formal foundations of the Semantic Web allow us to infer additional (implicit) statements that are not explicitly made.
- Unambiguous semantics allow question answerers to infer that objects are the same, objects are related, objects have certain restrictions, …
- SWRL allows us to make additional inferences beyond those provided by the ontology.
5: Translation

• While encouraging sharing, the Semantic Web allows multiple URIs to refer to the same thing
• There are multiple levels of mapping
  – Classes
  – Properties
  – Instances
  – Ontologies
• OWL supports equivalence and specialization; SWRL allows more complex mappings
6: Smart (Focused) Search

• The Semantic Web associates 1 or more classes with each object

• We can use ontologies to enhance search by:
  – Query expansion
  – Sense disambiguation
  – Type with restrictions
  – ….
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7: Smarter Search / Configuration

Course Type: NON-SPICY-RED-MEAT

"Pairs well with dry red varieties. Medium-bodied wines match especially well."

The local knowledge base particularly recommends the following:

- MOUNTADAM PINOT NOIR
- FORMAN CABERNET SAUVIGNON
- SAUCELITO CANTON ZINFANDEL
  - GARY FARRELL MERLOT
  - MARIETTA OLD VINES RED
- PAGE MILL WINERY CABERNET SAUVIGNON
  - CHIANTI CLASSICO
  - MARIETTA PETITE SYRAH
- WHITENALL LANE CABERNET FRANC
- MARIETTA CABERNET SAUVIGNON
  - MARIETTA ZINFANDEL
  - KATHRYN KENNEDY LATERAL

The recommended wines can be found below, along with some comparable selections.

Web Inventory Search

Alternatively, the following varieties include many suitable matches:

- PINOT NOIR
- MERLOT
8: Proof

- The logical foundations of the Semantic Web allow us to construct proofs that can be used to improve transparency, understanding, and trust.
- Proof and Trust are ongoing research areas for the Semantic Web: e.g., See PML and Inference Web.

“Employees of member companies can access W3C’s content.”
Selected Technical Benefits

1. Integrating Multiple Data Sources
2. Drill Down / Focused Perusal
3. Statements about Statements
4. Inference
5. Translation
6. Smart (Focused) Search
7. Smarter Search … Configuration
8. Proof and Trust
Resources

**Selected Papers:**

**Selected Tutorials:**

**Languages, Environments, Software:**
- OWL - [http://www.w3.org/TR/owl-features/][1], [http://www.w3.org/TR/owl-guide/][2]
- Inference Web - [http://www.ksl.stanford.edu/software/iw/][3]
- Chimaera - [http://www.ksl.stanford.edu/software/chimaera/][5]
- TAP - [http://tap.stanford.edu/][7]
- OWL-QL - [http://www.ksl.stanford.edu/projects/owl-ql/][8]
- Network Inference - [http://www.networkinference.com][9]
- Sandpiper Software - [http://www.sandsoft.com][10]