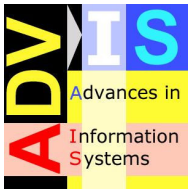

Inferencing for the Semantic Web: A Concise Overview

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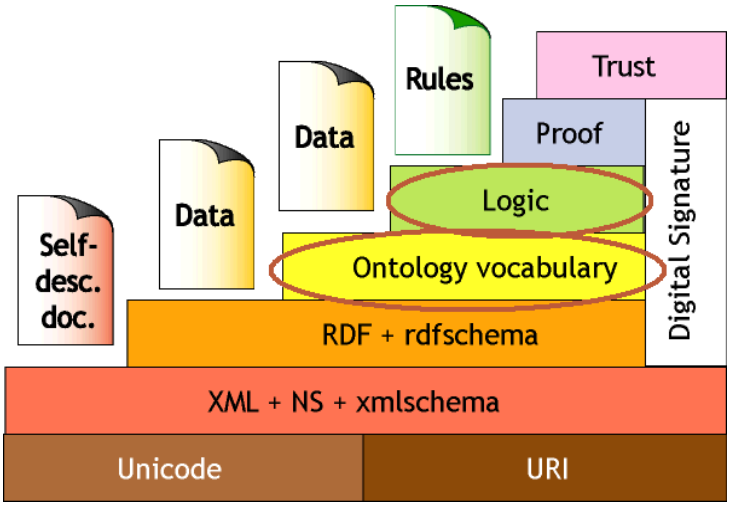
Structure of This Presentation

- General features of inferencing for the Web
- Inferencing languages
- Survey of basic tools to support inferencing on the Web

Where Does Inferencing Fit into the SW Layered Architecture?



http://www.w3.org/2000/Talks/1206-xml2k-tbl/slide10-0.html

Why Does the Semantic Web Need Inferencing?

- There are a lot of useful facts on the Web
- Some facts are explicit, others are implicit
- If automated processing can only deal with explicit facts, then it becomes too inflexible to perform sophisticated tasks
- Example: Nick is a father. A father is a kind of parent. Therefore, Nick is a parent.

Characteristics of Inferencing on the Web

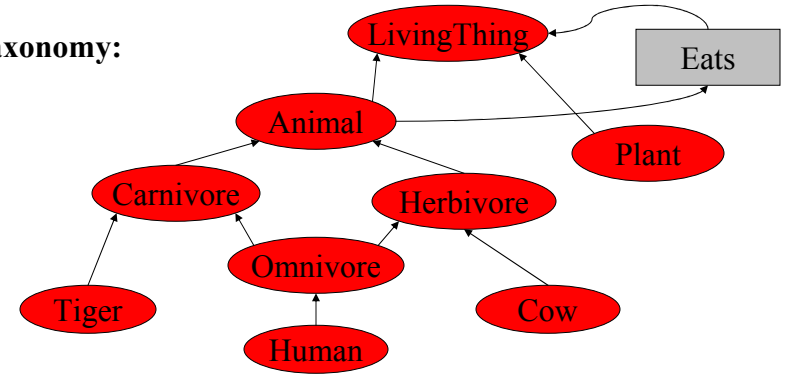
- Generally involves multiple sources of data
  - Data from different sources may be in different formats
  - Data from different sources may contradict each other
- For efficiency, facts must be expressed in machine-readable format (because NLP is expensive)
- Trade-off between expressivity and computational complexity

What Are Ontologies?

- Tim BL: "document that formally defines the relations among terms"
- Has a hierarchical taxonomy and a set of inference rules
- Used to describe objects and the relationships among objects

Example of an Ontology

Taxonomy:



Inference Rules:

If x is an animal and x eats animals, then x is a carnivore.
If x is an animal and x eats plants, then x is an herbivore.
If x is both a carnivore and an herbivore, then x is an omnivore.
…

Inferencing Languages

Two major types for the Web:

- Description Logics (DL)
- Frame Logics (F-logic)

Inferencing Languages: Description Logics (1)

- Evolved from work on semantic networks
- Has a nice set theory interpretation
- Can easily be translated into a subset of first order logic

Inferencing Languages: Description Logics (2)

Current DL languages for the Web:

- DAML+OIL – fusion of DAML-ONT and OIL
- OWL – successor to DAML+OIL, W3C initiative

Inferencing Languages: Description Logics (3)

Interactive demo of building an ontology using:

OilEd (University of Manchester)

http://oiled.man.ac.uk

- Open source, Java, GUI-based ontology editor
- Supports DAML+OIL, can be linked to external DL inference engine
- Useful, but does not support development of large-scale ontologies

Inferencing Languages: Frame Logics (1)

- Evolved from object-oriented paradigm
- Can be translated into Horn logic (a subset of first order logic)
- Syntax is similar to first order predicate calculus

Inferencing Languages: Frame Logics (2)

Current F-logic languages for the Web:

- Ontobroker – works with commercial tool suite sold by ontoprise GmbH
- TRIPLE – open source sibling of Ontobroker

Inferencing Languages: Frame Logics (3)

Demo using:

OntoEdit (ontoprise GmbH)

http://www.ontoprise.de/products/ontoedit_en

- Commercial, Java, ontology editor
- Supports DAML+OIL, uses F-logic inferencing
- Free version is limited to 50 concepts

Description Logics Vs. Frame Logics

- Standardization: DLs are more standardized (OWL is W3C initiative)
- Computation: No clear winner
- Querying: F-logics are better equipped to handle basic querying
- Tools: DLs currently have more

Basic Tools for Inferencing

- Jena
- KAON
- TRIPLE
- FaCT
- RACER
- Cerebra
- Protégé 2000

Jena (HP)

http://www.hpl.hp.com/semweb/jena.htm

- Open source, Java, tool suite
- DAML API, OWL API, inference engine, basic querying*
- RDF parsing, RDBMS persistence, web publishing, browsing

*Inference engine and OWL support planned for version 2.0, not officially released yet

KAON (University of Karlsruhe)

http://kaon.semanticweb.org/

- Open source, Java ontology management framework
- KAON API, OI-Modeler (ontology creation & evolution tool), TextToOnto (semi-automatic ontology creation through text mining), KAON Server (SW application server)
- RDF parsing, RDBMS persistence

TRIPLE

http://triple.semanticweb.org

- Open source, Java, F-logic system
- TRIPLE language is based on RDF, not RDFS (unlike DAML+OIL)
- Can use DL inference engines as external modules

FaCT

http://www.cs.man.ac.uk/~horrocks/FaCT

- Free, Lisp, DL inference engine
- Interface for CORBA
- Works with OilEd

RACER

http://www.cs.concordia.ca/~faculty/haarslev/racer/

- Free/commercial, Lisp, DL inference engine
- Interfaces for XML, Java, C++
- Support for querying
- Works with OilEd

Cerebra

http://www.networkinference.com/products.asp

- Commercial, C++, DL inference engine
- Interfaces for SOAP, COM, CORBA
- Works with OilEd

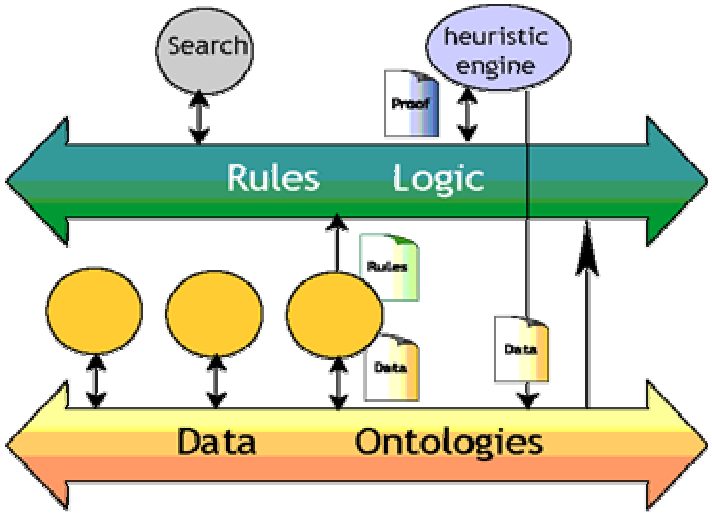
Protégé 2000

http://protege.stanford.edu

- Open source, Java, ontology editor for frame-based systems
- Basic support for DAML
- Heavily influenced OilEd's GUI

What Comes After Inferencing?

The Proof layer lies directly above the Logic layer:



http://www.w3.org/2000/Talks/1206-xml2k-tbl/slide14-0.html

Conclusion

- The Ontology and Logic layers are essential parts of the SW Layered Architecture
- There are two types of inferencing languages for the SW, Description Logics and F-logics; neither one is dominant.
- Using free tools, you can now develop your own inference-capable SW applications.