IHMC

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Overall Program Summary

Basic Problems:

1. How to make logical content freely useable on the Web.
2. Providing human-useable OWL composing tool

Solution Strategies:

1. Setting S.Web standards with clear semantics, trying to keep them simple.
2. Adapting user-proven IHMC Cmap Tools GUI to OWL

Basic elements:

1. Active involvement with standards process.
2. Applying human-centered computing principles to editor/viewer design.

IHMC:1:Standards activity
Technical Problem and Approach

Work in philosophical logic and set theory during the last decade has relaxed and extended many traditional ideas about logical syntax. Applying these to the RDF semantics made possible a layering of RDF, RDFS, OWL-Full and a natural embedding into Common Logic.

The key *syntactic* idea is *name uniformity*: **every name has the same logical status as every other name**. This maintains the essential simplicity of the 'triples store' concept, and has important computational and expressive advantages.

The key *semantic* idea is that **the only things that are required to exist are those that are indicated by expressions**. This is the central idea that keeps a language essentially first-order, enabling complete rule sets.

These two simple ideas, applied rigorously, lead to a qualitatively different view of logic than traditional textbook presentations, while improving the computational and proof-theoretic properties. They were adopted as guidelines for the design of the RDF/RDFS model-theoretic semantics, which in turn influenced the OWL design and made possible OWL-Full, and are fully expressed in the Common Logic design.

IHMC:1:Standards activity
Technical Problem and Approach

Every name has the same logical status as every other name.

RDF syntax allows the same URI reference to occur in any position. Traditional logical models prohibit relation names occurring in individual position, which makes the natural logical interpretation impossible. (The DAML axiomatic semantics used the artificial translation *rdf_triple(s,p,o)* rather than *p(s,o)* for this reason.) Traditional objection to name uniformity is that it allows self-application eg *rdf:type rdf:type rdf:Property* .

And the semantics would then violate the axiom of foundation. RDF semantics uses *intensional relations* to bypass this: properties are *first-class individuals with an associated extension*, rather than sets.

Intensional interpretations are closer to natural intuitions about linguistic meaning, and have simpler and more efficient inference schemes, realized in the simplicity of the RDFS rule set. RDF+RDFS has an elementary **complete** rule set which supports efficient inference, described in the RDF semantics document.

Intensional rules are intuitively obvious:

If A subClass B *and* X type A *then* X type B

Extensional rules require obscure corner cases:

If subClass subProperty P *and* P range A *then* Class subClass A

(*Recent work by Herman ter Horst develops an intensional semantics for OWL along the same lines, with similar simplifications to inference rules*.)

IHMC:1:Standards activity Technical Problem and Approach

the only things that are required to exist are those that are indicated by expressions.

RDF semantics treats predicates as genuine individuals, but it doesn't require that *all* predicates must exist, only the ones give names to by an ontology. This is the key property that makes complete rule sets possible, i.e. makes the language truly first-order. The same semantic device makes possible the OWL-Full/RDF embedding.

'Wild OWL' Recent work has simplified and extended OWL Full to justify the use of the OWL vocabulary freely in an RDF/ RDFS context (as for example in FOAF), while still retaining an intuitively clear semantics.

Common Logic. A full extended first-order notation based on the same semantic intuitions as used in RDF/RDFS/OWL-Full has been submitted for ISO consideration as a Standard Common Logic (ISO WD 24707). This extends KIF and several other widely used logical standards, and provides a full formal semantics (absent from KIF), a generic XML logical syntax, datatyping, case-role syntax and embeddings from RDF, RDFS, OWL, SWRL and FOL RuleML.

IHMC:2:CODE
Technical Problem and Approach

The challenge we faced was to be able to display OWL ontologies 'intuitively' as concept maps, in a form which makes them easy and natural for SMEs (*not* knowledge engineers) to view, edit and compose, and then be automatically translated into OWL-RDF/XML. This required developing linguistic and stylistic Cmap conventions, and a large number of GUI devices to aid in editing and composition.

OWL constructions do not all have the same intuitive salience: some (*subclassing, domain/range, class/property distinction*) are cognitively more central than others (*transitivity of properties, subproperty relationships, sameAs vs. sameClassAs*). CODE uses a variety of conventions designed to make the most salient features more vivid and easy to construct and recall.

As a side-effect, it is easy to **recognize** a familiar ontology and **directly see** certain errors or omissions (*missing domain/range, classes with no content, unconnected properties, loops or disconnects in the subclass hierarchies*).

CODE is written in Java as extension to the IHMC Cmap Tools suite (c. 20,000 downloads in use), runs on most platforms. Tested on all OWL ontologies listed on SchemaWeb.

CODE includes concept search through locally stored ontologies, web-server support, and a customized interface to the Pragati MVP-CA concept clustering process.

CODE is freely available for non-commercial use, but is not open source.

Future support and development is predicated on acquisition of further funding, which is uncertain at present.

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Technical Progress

- What technical problems?

1. The main problems in setting standards are social, not technical. This doesn't make them any the less real, however. The chief *technical* issues arose from trying to reconcile clashing views of how best to 'layer' SWeb languages without breaking the semantics.
2. The chief technical problems in building CODE were the design of the 'semi-formal' Cmap conventions, and translating them back into correct OWL/XML

- Did you meet your original or revised programmatic goals?

1. Yes and no. We met all the local goals, but globally I feel that we could have done better. The SWeb has gotten started, but the current emphasis on DLs, with built-in syntax restrictions to ensure deductive efficiency, has imposed an artificially limiting framework and already has led to unnecessary multiple efforts and clashing standards. I think that the intensional logic foundation used for RDF/RDFS and fully expressed in Common Logic will provide a better basis for future standards work.
2. Yes. CODE performs better than we expected it would, particularly at laying out complex ontologies 'readably'. We think it will be the tool of choice for many beginners and SMEs when building and viewing OWL ontologies.

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Milestones and Accomplishments

- year-by-year:
  - **2000**. Member of DAML Joint Committee, contributing to DAML+OIL design.
  - **2001**. Member (Invited Expert) of W3C RDF Core WG. Drafted first RDF semantics. Member (Invited Expert) of W3C Webont WG. Developed L_{w1w} semantics for Common Logic.
  - **2002**. Continuing WG and JC activity. Liaison between the WG semantics designs (RDF and OWL).
  - Convened and chaired the SCL group, taking up the Common Logic design effort.
  - **2003**. Basic design of IHMC-CODE Cmap-based OWL editor realized. Common Logic standardization process initiated as ISO WD 24707. Reconciled OWL and RDF semantic models, justifying OWL-Full design.
  - **2004**. Authored RDF/RDFS semantics Recommendation document (with complete inference rule set), co-authored OWL semantics Recommendation document. Formulated 'web logic' principles, applied to Common Logic design. Published translation of RDF/RDFS/OWL into Common Logic. First IHMC-CODE release.
- Talks, etc.
- Invited talks on Semantic Web at IWCS-5 (Netherlands), COMSO-04 (Colombia).

IHMC Transition/Handoff

- Where are the results of your work available?
  - RDF Semantics recommendation http://www.w3.org/TR/2004/REC-rdf-mt-20040210/
  - OWL Semantics (with Patel-Schneider and Horrocks)
  - http://www.w3.org/TR/owl-semantics/
  - SCL initiative (web site http://cl.tamu.edu/ working document http://www.ihmc.us/users/phayes/CL/SCL2004.html)
  - IHMC-CODE release (will be on ontology central before end of 2004)

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Remaining Issues

Issue	Remediation
What principles should guide the design of a true Web logic?	Paper in preparation attempts to formulate a first list of these and link them to the Common Logic design.
How to design a truly great ontology editor?	Work together with psychologists, educators and GUI designers on improving the IHMC-CODE GUI; immediate improvements include (1) dividing large ontologies into meaningful parts for display (2) integrating ontology and markup content into hyperlinked Cmaps.
What principles should underlie a truly useful Web *reasoner*?	Watch what happens; the answer must depend on how SWeb markup actually gets used in practice. We theoreticians and semantics experts need to be more humble in deciding how the world will use our tools.

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Summary

- What is the take-away message from your program?
  - Respect the utility and power of the tools and formal techniques we have developed; but respect the size, scope and pragmatism of the actual planet's users more. The Semantic Web will not be traditional ontology development writ large: it will be something entirely new. We will need to keep on our toes in order to not be left behind as an irrelevance.

(Program Name)
Backup