RuleML Overview and Position Statement

The RuleML Initiative

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http://www.ruleml.org
The Web Rule Language in its Context
RuleML, WSML, SWSL View

- FOL++
- Rules
- OWL
- RDF(S)
- XML
- Unicode
- URI
Introduction

• The RuleML Initiative was formed in 2000 to provide a neutral platform for semantic interoperation of rules, across the Web, between commercially important rule systems:
  – Production rules
  – Relational databases
  – Prolog
  – Event-Condition-Action rules

• ... → Enable rule-based Semantic Web Services

• Pioneered webized representation of a modular family of rule sublanguages, catering to a variety of needs on the Web
RuleML is ...

An open *semantic* standard for

- *Semantics* founded on logical knowledge representation

1. **Rule Modeling:**
   - Data model integrates
     - Ordered XML trees
     - Labeled RDF graphs
   - Abstract syntax uses MOF
     - Mappings for OMG PRR [53] and SBVR [85]

2. **Rule Classification:** Modular Family of
   - XML Schemas and associated
   - (Model-Theoretic, Well-Founded) Semantics
RuleML is ...

An open semantic standard for Rule

3. **Serialization**: XML, RDF, Presentation
4. **Distributedness**: Fully webized, cf. N3 [94]
5. **Interoperation**:
   - Mature experience with RDF/RuleML [93] and OWL: SWRL [81]; also with F-logic: SWSL [124]
   - Adapt Sublanguages, write XSLT, ... Translators, or establish APIs such as JSR94 [107]
6. **Execution**: Mandarax, jDREW [49], Jess, XSB ...
7. **Tools**: SweetRules V2.1, IW Editor, ...
RuleML Identifies ...

• Expressive **sublanguages**
  – for Web rules
  – explored mostly with
    • *Derivation* rules: to derive beliefs
    • *Reaction* rules: to perform actions
  – empowering their **subcommunities**
SWRL FOL, SWSL-Rules in RuleML Family

RuleML
  - Derivation rules
  - Reaction rules
    - FOL RuleML
    - SWSL-Rules
      - Courteous LP
      - Situated LP
    - SCLP RuleML
    - ECA
    - PR RuleML

- Hornlog
- Datalog
- Unary/Binary Datalog
- Description LP

OWL-DL

Datalog

SWRL FOL
RuleML Specification & Interoperation

- Rule Family specified via XML Schemas
  - All sublanguages, pre-release: RuleML 0.89
    - First Order Logic, cf. SCL [103]: FOL RuleML 0.9
    - With Ontology language, cf. [81]: SWRL 0.7
      - A Semantic Web Rule Language combining OWL and RuleML
    - With Services language, cf. [124]: SWSL 0.91

- Rule Translators in & out (e.g. Jess, XSB)
  - Interoperation between many commercially important rule systems
(FOL) RuleML Has N-ary Relations & Functions, Extending SWRL (FOL)

- N-ary relations (predicate symbols)
  - Extends SWRL, which is unary/binary
- N-ary constructors (function symbols)
  - Extends SWRL, which uses individuals as 0-ary constructors (function-free)
FOL RuleML: Syntax and Semantics


- **Modular** combination of syntactically characterized new sublanguages with:
  - Explicit quantifiers
  - Head disjunctions
  - Equivalence and Negation

- Semantics is FOL model theory
- (Pragmatics via performatives)
Business Rule: Positional

"The discount for a customer buying a product is 5 percent if the customer is premium and the product is regular."

Serialization:

```xml
<Implies>
  <head>
    <Atom>
      <Rel>discount</Rel>
      <Var>customer</Var>
      <Var>product</Var>
      <Ind>5.0</Ind>
    </Atom>
  </head>
  <body>
    <And>
      <Atom>
        <Rel>premium</Rel>
        <Var>customer</Var>
      </Atom>
      <Atom>
        <Rel>regular</Rel>
        <Var>product</Var>
      </Atom>
    </And>
  </body>
</Implies>
```
DTD for Recursive FO Formulas

<!ENTITY % foformula "(Atom | And | Or | Neg | Implies | Equivalent | Forall | Exists)">
<!ELEMENT Atom (Rel, (Ind | Var | Cterm)*)>
<!ELEMENT Cterm (Ctor, (Ind | Var | Cterm)*)>
<!ELEMENT And (%foformula;*)>
<!ELEMENT Or (%foformula;*)>
<!ELEMENT Neg (%foformula;)
<!ELEMENT Implies (%foformula;, %foformula;)
<!ELEMENT Equivalent (%foformula;, %foformula;)
<!ELEMENT Forall (Var+, %foformula;)
<!ELEMENT Exists (Var+, %foformula;)
<!ELEMENT Ind (#PCDATA)>
<!ELEMENT Var (#PCDATA)>
<!ELEMENT Rel (#PCDATA)>
<!ELEMENT Ctor (#PCDATA)>

→ Translated to XML Schema since RuleML 0.88
Slotted (FOL) RuleML Extension

- N-ary relations and constructors can contain set of slots (‘user-labeled arcs’)
  - Enables Object Oriented modeling:
    - `rdf:Descriptions` (rather than triples)
    - RDFS and OWL class descriptions
  - Positional logic Frame logic (F-logic)
- Serialization of SWSL-Rules
Business Rule: Slotted (for OO)

"The **discount** for a *customer* buying a *product* is 5 percent if the *customer* is **premium** and the *product* is **regular**."
Some RuleML Use Cases

- **RACSA, RALOCA, RACOFI**: Rule Applying Agents for Comparison Shopping, Learning Object Comparison, and COllaborative FIltering (led to inDiscover.net)
- **NBBizKB**: New Brunswick Business Knowledge Base uses OO RuleML for data validation and integration
- **AgentMatcher**: e-Learning metadata interchanged in Weighted OO RuleML
- **Teclantic**: Startup project descriptions for Atlantic technology transfer in Weighted OO RuleML
- Regulatory guidelines for financial services in the US, Can, and UK by Inference Web Inc.
- **MITRE Convoy Mission** [28]
SweetRules & MIT RuleML Use Cases

• Contracts/negotiation, advertising/discovery
  – E-procurement, E-selling
  – Pricing, terms & conditions, supplier qualification, ...

• Monitoring:
  – Exception handling, e.g., of contract violations
    • Late delivery, refunds, cancellation, notifications
  – Notifications, personal messaging, and other workflow

• Trust Policies: authorization, confidentiality & privacy, security, access control
  – E.g., financial services, health care
    • Extensive analysis of business case/value

• Semantic mediation: rule-based ontology translation, context-based information integration

• Object-oriented process ontologies: MIT Process Handbook
  – With default inheritance
Lessons from RuleML Experience

- Rule standardization process requires
  - Long-term vision
  - Engaging with all stakeholders
  - Full understanding of needs of various communities

- Each sublanguage also requires very strict and explicit scope to guarantee delivery of mature results in a phased fashion

- Focussing on certain sublanguages will be necessary for planned W3C Working Group
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Position Based on Experience

• Since 2000 the RuleML Initiative has engaged/collaborated with:
  – Large variety of use cases: finance, insurance, e-commerce, supply-chain, security & trust, biomed, ...
  – RDF, N3, TRIPLE
  – OWL, DL, Joint Committee
  – Semantic Web Services, SWSI, WSMO
  – Development of dozens of tools

• Pioneered webized representation of modular family of rule sublanguages, catering to a variety of needs on the Web
Position: Proposed Scope of WG (1)

First Phase (ca. 9 months):

• Start with LP expressiveness including Datalog Horn + NAF, then add logical functions

• Enable use of RDF and of OWL-DL [81]

• Draw especially on:
  – Use cases
  – RuleML, SWSL [124], WSML [44, 128], N3 [94], TRIPLE [98], SCL/KIF [103]
Position: Proposed Scope of WG (2)

First Phase (cont’d):

- Add some subset of following ten features:
  - Slotted/Frame syntax; webized OIDs/labels
  - Datatyping; lists
  - Signature declarations
  - Lloyd-Topor: syntactic sugar for enriched connectives
  - Integrity constraints, mutual exclusions, functional dependency
  - Prioritized conflict handling, cf. Courteous
  - Procedural attachments, cf. Situated:
    - built-ins/tests/sensors
    - actions/effectors
    - events/time
  - Hilog: syntactic sugar for restricted higher-order
  - User-defined head equality and functions
  - Reification
Position: Proposed Scope of WG (3)

**Second Phase** (additional ca. 6-9 months):

- Extend for more expressiveness as required by more use cases and doable in that period
  - Vote now for your top k out of 10 😊
Upcoming Events

• Workshop on Protégé with Rules
  • Will be held in conjunction with 8th Intl. Protégé Conference, on 18 July 2005
  • Deadline for paper or abstract submissions: 1 June 2005
  • http://www.med.univ-rennes1.fr/~cgolb/Protege2005/ProtegeWithRulesCFP.htm

• RuleML-2005: International Conference on Rules and Rule Markup Languages for the Semantic Web
  • Will be held in conjunction with ISWC-2005, on 10-11 November 2005
  • Deadline for paper submissions: 1 July 2005
  • http://2005.ruleml.org