Introducing RuleML: Organization, Language, and Technology

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The 7th International Web Rule Symposium: Research Based and Industry Focused (RuleML 2013)

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RuleML Organization

- Has an open **non-profit** structure
- Drives the specification of standard semantic-technology & business rules
-Coordinates rule research & development and holds international meetings
RuleML Standards Effort

- Connects **Web rule** efforts across
  - Academia
  - Standards bodies
  - Industry
- Dovetails with **Web ontology** efforts, e.g. as part of the semantic-technology stack
- Provides a **de facto standard** for Web knowledge representation
RuleML Interoperation

XML-based interchange between (sublanguages of) RIF, CL, SBVR, PRR, N3, Prolog, as well as Rulelog etc.
RuleML Family of Sublanguages (1)
RuleML Family of Sublanguages (2)

- RuleML family covers a wide rule spectrum, from **Deliberation** rules to **Reaction** rules
  - Rule condition part reused across the spectrum
  - Syntactic uniformity enables further reuse
- Family constitutes a deep sublanguage lattice
  - Major sublanguage inclusion path:
    Deliberation ⊇ HOL ⊇ FOL ⊇ Derivation ⊇ Hornlog ⊇ Datalog ⊇ ...
- Naf mix-in customization of Hornlog RuleML (Naf Hornlog RuleML) leads to Logic Programs
Foundational RuleML Technology

- User syntaxes (for knowledge acquisition and querying)
  - Presentation (symbolic): Positional-Slotted Language (POSL), Prova, ...
  - Visualization (graphical): Graph inscribed logic (Grailog), ...
- Serialization syntax (for knowledge exchange): Valid w.r.t. XML schemas
  - In Relax NG (RNG)
    - MYNG Web GUI generates RNG for fine-grained schema customization
  - In XML Schema Definition Language (XSD)
  - RuleML 1.0: RNG and XSD separate. Planned: generate XSD from RNG
- Transformations
  - XSLT normalizers (to the most explicit or most concise RuleML/XML)
  - JAXB unmarshalling of RuleML/XML into Java objects
- Model-theoretic semantics
  - For (Naf-free, OID-slot-free) FOL, Hornlog, Datalog RuleML: Classical
  - For Positional-Slotted Object-Applicative (PSOA) RuleML: RIF-style
- Engines (OO jDREW, Prova, DR-DEVICE, VampirePrime, ...)
Sub...Sublanguage Datalog RuleML from XML Serialization to Grailog Visualization

Grailog KS Viz

```
<Assert mapClosure="universal">
  <Implies>
    <!-- explicit 'And' -->
    <And>
      <Atom>
        <Rel>buy</Rel>
        <Var>person</Var>
        <Var>merchant</Var>
        <Var>object</Var>
      </Atom>
      <Atom>
        <Rel>keep</Rel>
        <Var>person</Var>
        <Var>object</Var>
      </Atom>
      <Atom>
        <Rel>own</Rel>
        <Var>person</Var>
        <Var>object</Var>
      </Atom>
    </And>
  </Implies>
</Assert>
```
RuleML Sublanguages Customized by MYNG as Relax NG Schemas (1)

Selection Form

Instructions

Make a selection from the form below, then click "Refresh Schema" to update the Schema URL. The main module is also displayed below the form. To reset the form to the default (supremum) values, click "Reset Form".

Reset Form  Refresh Schema

Schema URL = http://ruleml.org/1.0/relaxng/schema_rnc.php?backbone=x3f&default=x7&termseq=x7&lng=x1&propo=x3ff&implies=x7&terms=xf3f&quant=x7&expr=xf&serial=xf
RuleML Sublanguages Customized by MYNG as Relax NG Schemas (2)

<table>
<thead>
<tr>
<th>Propositional Options</th>
<th>Implication Options</th>
<th>Term Options</th>
<th>Quantification Options</th>
<th>Expression Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Check Zero or More)</td>
<td>(Check Zero or More)</td>
<td>(Check Zero or More)</td>
<td>(Check Zero or More)</td>
<td>(Check Zero or More)</td>
</tr>
<tr>
<td>✓ IRI</td>
<td>✓ Equivalences</td>
<td>✓ Object Identifiers</td>
<td>✓ Implicit Closure</td>
<td>✓ Generalized Lists</td>
</tr>
<tr>
<td>✓ Rulebases</td>
<td>✓ Inference Direction</td>
<td>✓ Slots</td>
<td>✓ Slotted Rest Variables</td>
<td>✓ Set-valued Expressions</td>
</tr>
<tr>
<td>✓ Entailments</td>
<td>✓ Non-Material</td>
<td>✓ Slot Cardinality</td>
<td>✓ Positional Rest Variables</td>
<td>✓ Interpreted Expressions</td>
</tr>
<tr>
<td>✓ Degree of Uncertainty</td>
<td>✓ Strong Negation</td>
<td>✓ Slot Weight</td>
<td>✓ Equations</td>
<td>✓ In-Place Annotation</td>
</tr>
<tr>
<td>✓ Weak Negation</td>
<td>✓ Weak Negation (Negation as Failure)</td>
<td>✓ Equations</td>
<td>✓ Oriented Equations</td>
<td>✓ Annotation</td>
</tr>
<tr>
<td>✓ Node Identifiers</td>
<td>✓ In-Place</td>
<td>✓ Term Typing</td>
<td>✓ Data Terms</td>
<td>✓ XML base</td>
</tr>
<tr>
<td>✓ In-Place</td>
<td>✓ Annotation</td>
<td>✓ Data Terms</td>
<td>✓ Skolem Constants</td>
<td>✓ XML id</td>
</tr>
<tr>
<td>✓ XML base</td>
<td>✓ XML id</td>
<td>✓ Reified Terms</td>
<td>✓ Reified Terms</td>
<td>✓ Reified Terms</td>
</tr>
</tbody>
</table>
Extended RuleML Technology

- Editors ([Mandarax](http://www.mandarax.com), [S2REd](http://www.s2red.org), [Rawe](http://rawe.csl.sri.com))
- Translators (interchange/interoperation tools)
  - RuleML ↔ POSL
  - PSOA → TPTP
  - Attempto Controlled English (ACE) → RuleML
  - Translators between RuleML and Prolog, Jess, N3, ...
- APIs ([Rulestore API](http://rulestore.org), [API4KB](http://api4kb.sourceforge.net))
- Multi-agent frameworks ([Rule Responder](http://ruleml.org/RRE/), [EMERALD](http://emerald-project.org))
- More tools
RuleML as Basis for other Languages

- Semantic Web Rule Language (SWRL)
  - Uses RuleML Version 0.89
- Semantic Web Services Language (SWSL)
  - Uses RuleML Version 0.89
- LegalRuleML
  - Uses RuleML Version 1.0
RuleML Uses

- Specific use cases ([http://ruleml.org/usecases](http://ruleml.org/usecases))
  - ChemXelem (Chemical XML Elements)
  - WineOnto (Wine Ontology)
  - NBBizKB (New Brunswick Business Knowledge Base)
  - FindXpRT (Find an eXpert via Rules and Taxonomies)
  - eTourPlan (eTourism Route and Activity Planner)
  - ...
- Rule Responder instantiations ([http://responder.ruleml.org](http://responder.ruleml.org))
  - SymposiumPlanner (formalizing RuleML 20xy in RuleML)
  - WellnessRules, PatientSupporter
- Uses as basis for other languages (see above)
RuleML Version Roadmap

- RuleML 1.0 is expanding by *sublanguage augmentation*, including for Modal RuleML 1.0 and Reaction RuleML 1.0
- RuleML 1.05 is in preparation, with focus on *feature improvement*
- RuleML 1.1 is being designed, with focus on *feature addition*
RuleML Meetings

- **International Web Rule Symposium** (starting in 2002 as a Workshop)
- Special Tracks
  - 2013: **Human Language Technology**
  - 2014 (planned):
    - Human Language Technology
    - Rules and Machine Learning
    - Building and Querying Large Knowledge Bases
- **International Rule Challenge** (since 2007)
- **RuleML Doctoral Consortium** (since 2011)
- Birds-of-a-Feather Sessions
  - Controlled Language
  - Reaction RuleML
  - Common Logic
RuleML Online Community

- RuleML MediaWiki ([http://wiki.ruleml.org](http://wiki.ruleml.org))
- Mailing lists ([http://ruleml.org/mailman/listinfo](http://ruleml.org/mailman/listinfo))
  - Uncertainty Reasoning
  - Defeasible Logic
  - Reaction Rules
  - Multi-Agent Systems
  - ...
- RuleML sources are hosted on Github ([https://github.com/RuleML](https://github.com/RuleML))
RuleML and You: Getting Involved

- Participate in meetings
- Contribute online to the wiki and in mailing lists
- Give feedback on existing specifications
  - [http://ruleml.org/1.0](http://ruleml.org/1.0)
- Give input on emerging specifications
RuleML Partners

- The RuleML *symposium series* is grateful to its annual Sponsors and Partners
- The RuleML *non-profit organization* acknowledges its long-term Partners
- The RuleML Symposium and Organization Co-Chairs can be contacted about Sponsoring or Partnering
- Cf. [http://ruleml.org](http://ruleml.org)
Further Reading

- RuleML wiki page corresponding to this talk (
- RuleML 1.0: The Overarching Specification of Web Rules
  - Paper ([http://link.springer.com/chapter/10.1007%2F978-3-642-16289-3_15](http://link.springer.com/chapter/10.1007%2F978-3-642-16289-3_15))
- Reaction RuleML 1.0: Standardized Semantic Reaction Rules
  - Talk ([http://www.slideshare.net/swadpasc/reaction-ruleml-ruleml2012paschketutorial](http://www.slideshare.net/swadpasc/reaction-ruleml-ruleml2012paschketutorial))
- Grailog 1.0: Graph-Logic Visualization of Ontologies and Rules
  - Paper ([http://link.springer.com/content/pdf/10.1007%2F978-3-642-39617-5_9](http://link.springer.com/content/pdf/10.1007%2F978-3-642-39617-5_9))