RuleML Intro Examples and More Syntax Details

RuleML

Logic

Semantic Web

Harold Boley*, NRC IIT e-Business
http://www.dfki.de/~boley

Benjamin Grosof, MIT Sloan
http://www.mit.edu/~bgrosof

(with help from Bruce Spencer, Steve Ross-Talbot, Said Tabet, and Gerd Wagner)

* On leave from DFKI GmbH

Presentation for
Joint US/EU ad hoc Agent
Markup Language Committee
Meeting of 29 October 2002

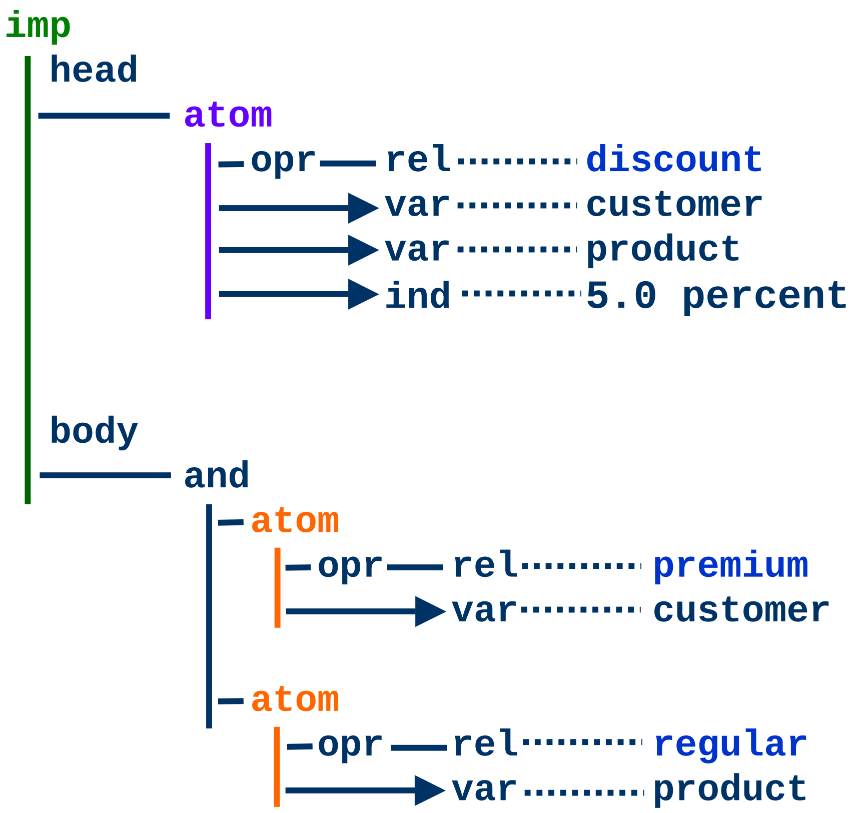
Markup Syntax

RuleML: Markup and Tree

"The **discount** for a *customer* buying a *product* is **5.0 percent**
if the *customer* is **premium** and the *product* is **regular**.',

discount(?customer,?product,“5.0 percent“) ← premium(?customer) /\ regular(?product);

```
<imp>
  <_head>
    <atom>
     <_opr><rel>discount</rel></_opr>
     <tup><var>customer</var>
          <var>product</var>
          <ind>5.0 percent</ind></tup>
    </atom>
  </_head>
  <_body>
    <and>
      <atom>
        <_opr><rel>premium</rel></_opr>
        <tup><var>customer</var></tup>
      </atom>
      <atom>
        <_opr><rel>regular</rel></_opr>
        <tup><var>product</var></tup>
      </atom>
    </and>
  </_body>
</imp>
```



```
imp
 head
      atom
        opr ── rel ........ discount
        ─────→ var ........ customer
        ─────→ var ........ product
        ─────→ ind ........ 5.0 percent

 body
      and
        atom
          opr ── rel ........ premium
          ─────→ var ........ customer
        atom
          opr ── rel ........ regular
          ─────→ var ........ product
```

tup is an ordered tuple.

Non-Positional RuleML Via the Name-Giving Metarole _r (I)

The minimal 'metarole' (_r) representation of the non-positional, RDF-like Jess fact

(automobile (make Ford) (model Explorer) (year 1999))

in RuleML 0.82 with user roles named (n) by XML attributes:

```
<fact>
  <_head>
    <atom>
      <_opr><rel>automobile</rel></_opr>
      <_r n="make"><ind>Ford</ind></_r>
      <_r n="model"><ind>Explorer</ind></_r>
      <_r n="year"><ind>1999</ind></_r>
    </atom>
  </_head>
</fact>
```

Non-Positional RuleML Via the Name-Giving Metarole _r (II)

This 'non-positional RuleML' notation corresponds to the 'positionalized' ruleml-datalog notation

```
<fact>
  <_head>
    <atom>
      <_opr><rel>automobile</rel></_opr>
      <ind>Ford</ind>
      <ind>Explorer</ind>
      <ind>1999</ind>
    </atom>
  </_head>
</fact>
```

if the 'roles' of the make, model, and year positions are remembered somewhere else (signature declaration)

From Limited Natural Language to Horn Logic

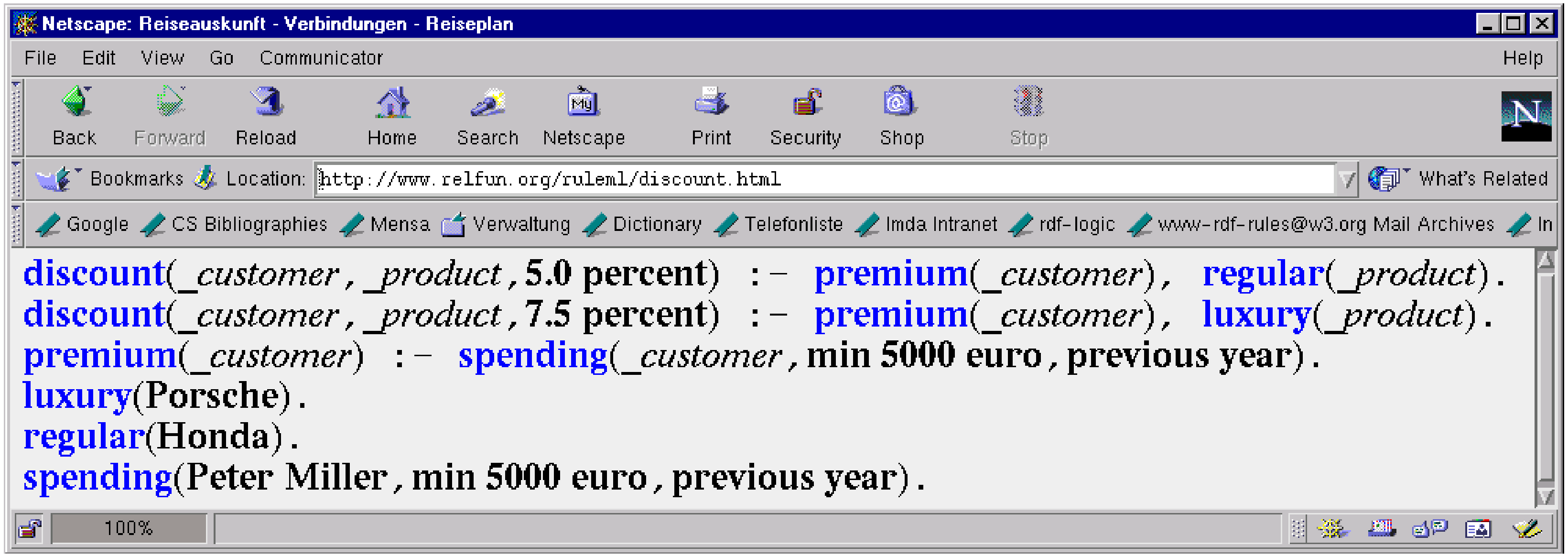
English-subset Business Rules:

"The **discount** for a *customer* buying a *product* is **5.0 percent** if the *customer* is **premium** and the *product* is **regular**."

"The **discount** for a *customer* buying a *product* is **7.5 percent** if the *customer* is **premium** and the *product* is **luxury**."

. . .

Prolog-like formalization (syntax generated from XML):



```
discount(_customer, _product, 5.0 percent)  :-  premium(_customer),  regular(_product).
discount(_customer, _product, 7.5 percent)  :-  premium(_customer),  luxury(_product).
premium(_customer)  :-  spending(_customer, min 5000 euro, previous year).
luxury(Porsche).
regular(Honda).
spending(Peter Miller, min 5000 euro, previous year).
```

Structure of the RuleML DTD Hierarchy

- Our system of DTDs (current version: 0.8) uses a modularization approach similar to XHTML in order to **accomodate** the various **rule subcommunities**
- The evolving hierarchy of RuleML DTDs forms a *partial order* with **ruleml** as the greatest element (a **ruleml**-rooted DAG) -- many ‘smallest’ elements
- Each DTD node in the hierarchy (conformance “lattice”) corresponds to a specific RuleML sublanguage, **syntactically and semantically**:
  - ‘Union’ (*join*) of sublanguages reached via outgoing links: to smaller or equal nodes below
  - ‘Intersection’ (*meet*) of sublanguages via incoming links: from greater or equal nodes above

Each DTD/XSD is fairly short – a few pages --   e.g., Situated Courteous (from SweetRules v1)

```
<!-- SCLP RuleML DTD, Monolith Uncommented version v13 of 2001-12 -->
<!ENTITY % URI "CDATA">
<!ENTITY % bool "yes|no">
<!ELEMENT rulebase ( (_rbaselab, (imp | fact | mutex | sens | effe)*)   | (imp | fact | mutex | sens | effe)+, _rbaselab?) )>
<!ATTLIST rulebase direction  (forward | backward | bidirectional)  "bidirectional">
<!ELEMENT _rbaselab (ind | cterm)>
<!ELEMENT imp ( (_head, ((_body,_rlab?) | (_rlab,_body?))? ) | (_body, ((_head,_rlab?) | (_rlab,_head)))  | (_rlab,((_head,_body?) |
 (_body,_head))) )>
<!ELEMENT _rlab (ind | cterm) >
<!ELEMENT fact ( (_rlab,_head) | (_head,_rlab?) )>
<!ELEMENT _head (clit | atom | andh)>
<!ELEMENT _body (fclit | atom | clit | flit | andb | orb | and)>
<!ELEMENT andb ((fclit | atom | clit | flit | andb | orb)*)>
<!ELEMENT orb ((fclit | atom | clit | flit | andb | orb),  (fclit | atom | clit | flit | andb | orb)+)>
<!ELEMENT andh ((clit | atom | andh), (clit | atom | andh)+)>
<!ELEMENT and ((atom | and)*)>
<!ELEMENT clit ((_opr, (ind | var | cterm)*) | ((ind | var | cterm)+, _opr))>
<!ATTLIST clit cneg (%bool;) #IMPLIED>
<!ELEMENT fclit ((_opr, (ind | var | cterm)*) | ((ind | var | cterm)+, _opr))>
<!ATTLIST fclit cneg (%bool;) #IMPLIED>
<!ATTLIST fclit fneg (%bool;) #IMPLIED>
<!ELEMENT flit ((_opr, (ind | var | cterm)*) | ((ind | var | cterm)+, _opr))>
<!ATTLIST flit fneg (%bool;) #IMPLIED>
<!ELEMENT atom ((_opr, (ind | var | cterm)*) | ((ind | var | cterm)+, _opr))>
<!ELEMENT _opr (rel)>
<!ELEMENT rel  (#PCDATA)>
<!ATTLIST rel href %URI; #IMPLIED>
<!ELEMENT var  (#PCDATA)>
<!ELEMENT ind  (#PCDATA)>
<!ATTLIST ind href %URI; #IMPLIED>
<!ELEMENT cterm ((_opc, (ind | var | cterm)*) | ((ind | var | cterm)+, _opc))>
<!ELEMENT _opc (ctor)>
<!ELEMENT ctor (#PCDATA)>
<!ATTLIST ctor href %URI; #IMPLIED>
```

Situated Courteous DTD, cont’d

```
<!-- syntax for courteous and situated follows --->

<!ELEMENT mutex ((_oppo, _mgiv?) | (_mgiv, _oppo))>
<!ELEMENT _oppo (ando)>
<!ELEMENT _mgiv (fclit | andb | orb)>
<!ELEMENT ando (clit, clit)>

<!ENTITY % bind "bound|free">
<!ELEMENT sens ((_opr, ((_aproc, _modli?) | (_modli,_aproc))) | (_aproc, ((_opr,_modli?) | (_modli,_opr))) | (_modli,((_aproc,_opr) |
 (_opr,_aproc))) )>
<!ELEMENT effe ((_opr, _aproc) | (_aproc, _opr))>
<!ELEMENT _aproc (jproc | uproc)>
<!ELEMENT uproc (#PCDATA)>
<!ATTLIST uproc href %URI; #IMPLIED>
<!ELEMENT jproc ((clas, ((meth, path?) | (path, meth))) | (meth, ((clas, path?) | (path, clas)))  |
(path, ((meth, clas) | (clas, meth))))>
<!ELEMENT path (#PCDATA)>
<!ATTLIST path href %URI; #IMPLIED>
<!ELEMENT clas (#PCDATA)>
<!ATTLIST clas href %URI; #IMPLIED>
<!ELEMENT meth (#PCDATA)>
<!ATTLIST meth href %URI; #IMPLIED>
<!ELEMENT _modli ((bmode)*)>
<!ELEMENT bmode EMPTY>
<!ATTLIST bmode val (%bind;) "free">
```

More: Pointers

- RuleML DTD 0.8, a system of DTDs, is available at http://www.dfki.de/ruleml/indtd0.8.html; sample rulebases at http://www.dfki.de/ruleml/0.8/exa, use cases at http://www.dfki.de/ruleml/library