

Tutorial on Port Clearance Rules in PSOA RuleML: From Controlled-English Regulation to Object-Relational Logic

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Introduction: Tutorial Goals

- Bridge between RuleML, Fact-Based Modeling, and Decision Management
- Explain rules for a harbor security use case, leading to Cyber Physical Systems
- Exemplify the Pragmatic Semantic Web by prohibiting certain ships to enter a harbor
- Provide a hands-on demo with audience-driven queries of the Object-Relational Decision Model
- Recommend models using generalized rule (and ontology) expressivity in PSOA RuleML

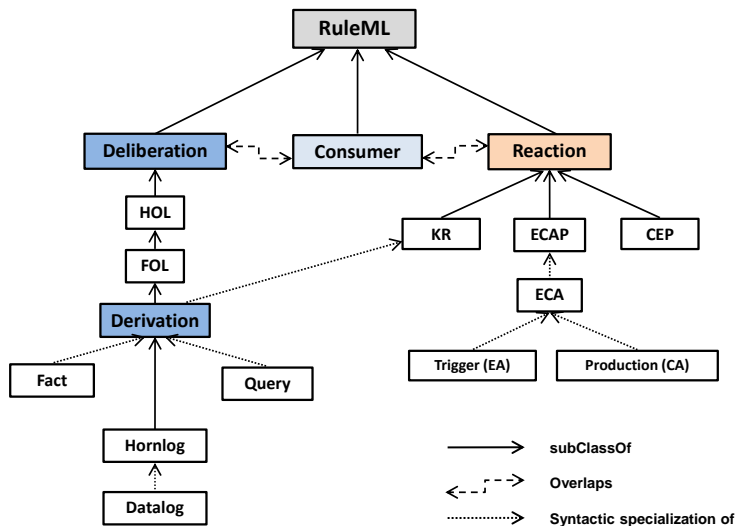
- 1 This Introduction (Gen Zou, Harold Boley)
- 2 RuleML Update (Harold Boley)
- 3 Fact-Based Model in PSOA RuleML
(Harold Boley)
- 4 Port Clearance Rules in PSOA
RuleML (Gen Zou, Harold Boley,
Dylan Wood, Kieran Lea):

<http://ruleml.org/talks/PortClearanceRulesPSOARuleML-talk.pdf>

- 5 Port Clearance Demonstration
(Gen Zou)

- RuleML models data and knowledge
 - Visualization and (here) presentation syntaxes for logics (facts+taxonomies+rules)
 - XML syntax uniform across logics, platforms, and tools
 - Translators for (multi-paradigm/model) interchange of logics
- Current spec release is RuleML 1.02
 - Includes Deliberation (e.g., Horn logic) and Reaction (e.g., event-processing) RuleML families
 - Integrated via Consumer RuleML family
 - Part of OASIS LegalRuleML Core 1.0
 - See more: <http://ruleml.org>

RuleML Update: Version 1.02 Families



- PSOA RuleML is a novel subfamily of **object-relational integrations** that started with OO RuleML and Datalog/Hornlog RuleML
- PSOA constructs extend to all of Deliberation RuleML as well as to Consumer and Reaction RuleML
- PSOA use cases include Port Clearance Rules, supporting future physical (sensor-based) constraints
- See more: http://wiki.ruleml.org/index.php/PSOA_RuleML

Fact-Based Model in PSOA RuleML: Mapping

- Conceptual schemas / fact-based models can be mapped to deductive databases
- PSOA RuleML can be seen as an object-relational deductive database
- Facts and rules (incl. “fact types” / constraints) of fact-based models can be mapped to relational or object-centered fragments of PSOA (in simplified presentation syntax)
- This will be sketched with the **Illustrative Example** of “Fact-Based Modelling Metamodel (version WD08): Exchanging Fact-Based Conceptual Data Models”, pp. 2-6 (<http://www.factbasedmodeling.org/Data/Sites/1/media/FBM1002WD08.pdf>, Fig. 1-1 ff)

Fact-Based Model in PSOA RuleML (Relations): Facts

```
name(:101 "Ann Jones")    % Relationships as facts
title(:101 Dr)            % (happen to be binary)
gender(:101 F)
manages(:101 :102)       % Global IDs get ":" prefix
manages(:101 :103)
```

```
name(:102 "Sue Wong")
title(:102 Mrs)
gender(:102 F)
reportsTo(:102 :101)
manages(:102 :104)
manages(:102 :105)
```

```
name(:103 "John Smith")
title(:103 Dr)
gender(:103 M)
reportsTo(:103 :101)
```


Fact-Based Model in PSOA RuleML (Objects): Facts

```
:101#Employee(name->"Ann Jones"    % Frames as facts
              title->Dr              % (OIDs & slots)
              gender->F
              manages->:102          % "#" for 'member of'
              manages->:103)
```

```
:102#Employee(name->"Sue Wong"
              title->Mrs
              gender->F
              reportsTo->:101
              manages->:104
              manages->:105)
```

```
:103#Employee(name->"John Smith"
              title->Dr
              gender->M
              reportsTo->:101)
```

Fact-Based Model in PSOA RuleML (Relations): Rule/Constraint (Uniqueness)

“Each Employee reports to at most one Employee.”

```
forall ?e1 ?e2 ?e3 (      % Explicit quantifiers
  ?e1 = ?e2 :-            % Prolog-like 'if'
    And(reportsTo(?e3 ?e1) % Prefix-"And"
        reportsTo(?e3 ?e2)
    )
)
```

Fact-Based Model in PSOA RuleML (Objects): Rule/Constraint (Uniqueness)

“Each Employee reports to at most one Employee.”

```
forall ?id1 ?id2 ?id3 ( % "#" for 'member of'  
  ?id1#Employee = ?id2#Employee :-  
    ?id3#Employee(reportsTo->?id1#Employee  
                  reportsTo->?id2#Employee)  
)
```

Fact-Based Model in PSOA RuleML (Relations): Rule/Derivation (Recursive Subordination)

“If employee e1 reports either to employee e2 or to some employee e3 who ultimately (via a chain of one or more intermediate managers) reports to e2 then e1 is a subordinate of e2.”

```
forall ?e1 ?e2 ?e3 (  
  subordinateOf(?e1 ?e2) :-  
    Or(reportsTo(?e1 ?e2)  
      And(reportsTo(?e1 ?e3)  
          subordinateOf(?e3 ?e2)  
      )  
    )  
)
```

Fact-Based Model in PSOA RuleML (Objects): Rule/Derivation (Recursive Subordination)

“If employee id1 reports either to employee id2 or to some employee id3 who ultimately (via a chain of one or more intermediate managers) reports to id2 then id1 is a subordinate of id2.”

```
forall ?id1 ?id2 ?id3 (  
  ?id1#Employee(subordinateOf->?id2#Employee) :-  
  Or(?id1#Employee(reportsTo->?id2#Employee)  
    And(?id1#Employee(reportsTo->?id3#Employee)  
        ?id3#Employee(subordinateOf->?id2#Employee)  
    )  
  )  
)
```

Fact-Based Model in PSOA RuleML: Towards an FBM PSOA

- Elaborate this sketch of Fact-Based Modeling in PSOA RuleML for an FBM PSOA:
 - Make FBM's fact types available as a new PSOA signature level
 - Make PSOA's translators available to reach new FBM target engines