Training Session on RuleML Technology

Loan Processor Suite: Transforming, Visualizing, and Querying Datalog RuleML Decision Rules

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How to Process a Loan?

“Loans are processed after a credit application is filled out and turned in to the loan officer. This will start the loan processing course, first by pre-qualifying the buyer by reviewing the credit history and debt load of the applicant.”

http://www.ask.com/question/how-to-process-a-loan

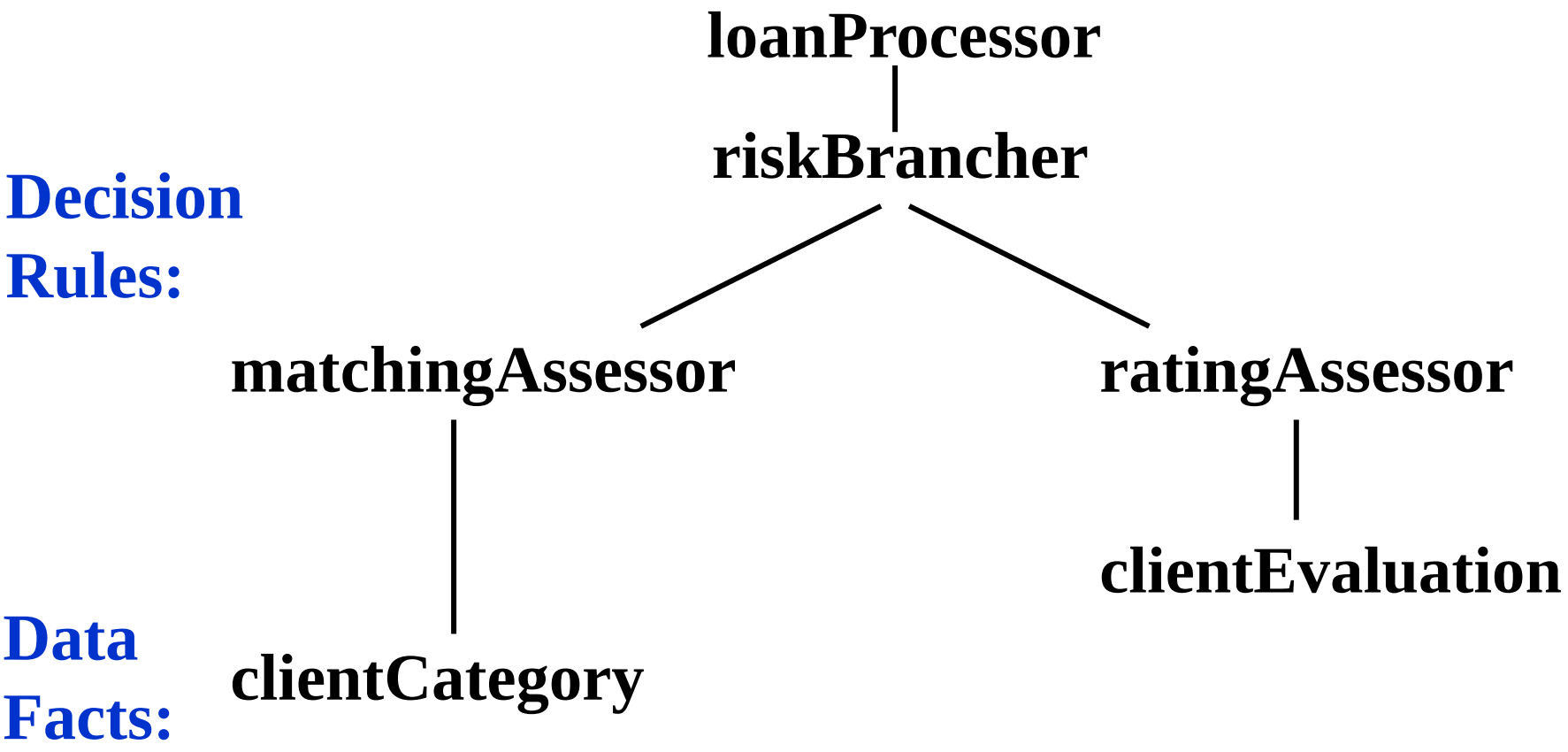
Use Decision Rules and Data Facts!

The Loan Processor Suite is a series of formal documents for testing and learning ***Graph inscribed logic (Grailog), RuleML, SVG, XSLT, POSL, OO jDREW, etc.***
They exemplify Datalog RuleML decision rules and data facts that are being transformed, visualized, and queried

See: http://ruleml.org/papers/Primer

http://wiki.ruleml.org/index.php/Grailog#Test_Suites

Decision Rule / Data Fact Architecture



See: http://www.cs.unb.ca/~boley/Grailog/LoanProcessor/LoanProcessor.txt

Joint Agile Development of Decision Rules and Data Facts

The predicate **loanProcessor** considers requests with ?AmountAsk in (0 500000],

also fixing ?RiskLevel = 1000 and ?RatiMin = 0.8 in a call to **riskBrancher**:

Its "**<**" rule invokes **matchingAssessor**, hence **clientCategory**, for table lookup.

Its "**>=**" rule uses **ratingAssessor**, hence **clientEvaluation**, for deep analysis.

Possible outcomes are either failure, without ?AmountGrant binding, or success,

with ?AmountGrant bound to the loan.

Predicate definitions can **flexibly combine rules and facts** using Prolog/Datalog-like **POSL** syntax (e.g., "**:-**" as the "**IF**" infix):
http://ojs.academypublisher.com/index.php/jetwi/article/view/0204343353

Decision Rule: loanProcessor

```
loanProcessor(?Client,?AmountAsk,?AmountGrant) :-
                                        % loanProcessor(In,In,Out)

  greaterThan(?AmountAsk,0),
                                        % Positive loan request

  lessThanOrEqual(?AmountAsk,500000),
                                        % up to half a million.

  riskBrancher(?Client,?AmountAsk,?AmountGrant,1000,0.8).
                                        % ...,?RiskLevel,?RatiMin).
```

Decision Rules: riskBrancher

```
riskBrancher(?Client,?AmountAsk,?AmountGrant,
                                    ?RiskLevel,?RatiMin) :-
 lessThan(?AmountAsk,?RiskLevel),
                                    % Deterministic ...
 matchingAssessor(?Client,?AmountAsk,?AmountGrant).


riskBrancher(?Client,?AmountAsk,?AmountGrant,
                                    ?RiskLevel,?RatiMin ) :-
 greaterThanOrEqual(?AmountAsk,?RiskLevel),
                                    % ... branch
 ratingAssessor(?Client,?AmountAsk,?AmountGrant,
                                    ?RatiMin).
```

Decision Rules: matchingAssessor

matchingAssessor(?Client,?AmountAsk,?AmountGrant) **:-**

clientCategory(?Client,gold),
% ?Client fact matches gold category

multiply(?AmountGrant,?AmountAsk,0.75).
*% ?AmountGrant = ?AmountAsk * 0.75*

matchingAssessor(?Client,?Amount,?Amount) **:-**
% ?Amount = ?AmountGrant = ?AmountAsk ***IF***

clientCategory(?Client,platinum).
% ?Client fact matches platinum category

Decision Rule: ratingAssessor

ratingAssessor(?Client,?AmountAsk,?AmountGrant,
?RatiMin) **:-**

clientEvaluation(?Client,?AmountAsk,?Rating),
% Data analysis binds ?Rating in [0,1].

greaterThanOrEqual(?Rating,?RatiMin),
% For ?Rating < ?RatiMin: not approved

multiply(?AmountGrant,?AmountAsk,?Rating).
*% ?AmountGrant = ?AmountAsk * ?Rating*

Data Facts: clientCategory

Facts store database table
which captures qualitative categories
of previous quantitative analysis

clientCategory(nilper,silver).

clientCategory(bold,gold).

clientCategory(claritum,platinum).

Data Facts: clientEvaluation

(Non-ground) facts cache ratings
from deep client data analysis,
which could be made conditional
on (currently free) ?AmountAsk

clientEvaluation(nilper,?AmountAsk,0.77).

clientEvaluation(bold,?AmountAsk,0.79).

clientEvaluation(claritum,?AmountAsk,0.91).

clientEvaluation(ralcitum,?AmountAsk,0.91).

Query Rules: negTest

negTest(1,?AG) :- **loanProcessor**(nilper,200,?AG).
% Failure since 200 < 1000 and
% no silver match

negTest(2,?AG) :- **loanProcessor**(nilper,1100,?AG).
% Failure since 1100 > 1000 and
% 0.77 < 0.8

negTest(3,?AG) :- **loanProcessor**(bold,1100,?AG).
% Failure since 1100 > 1000 and
% 0.79 < 0.8

negTest(4,?AG) :- **loanProcessor**(ralcitum,200,?AG).
% Failure since 200 < 1000 and
% no category

Query Rule: posTest

```
posTest(?AG1,?AG2,?AG3,?AG4) :-
  loanProcessor(bold,200,?AG1),
            % Success with ?AG1 = 150  since 200 < 1000 and
            %                                  gold match
  loanProcessor(claritum,200,?AG2),
            % Success with ?AG2 = 200  since 200 < 1000 and
            %                                  platinum match
  loanProcessor(claritum,400000,?AG3),
            % Success with ?AG3 = 364k since 400k > 1k and
            %                                  0.91 > 0.8
  loanProcessor(ralcitum,500000,?AG4).
            % Success with ?AG4 = 455k since 500k > 1k and
            %                                  0.91 > 0.8
```

Transforming POSL to RuleML/XML

```
loanProcessor(?Client,?AmountAsk,?AmountGrant) :-
                                    % loanProcessor(In,In,Out)
  greaterThan(?AmountAsk,0),
                                    % Positive loan request
  lessThanOrEqual(?AmountAsk,500000),
                                    % up to half a million.
  riskBrancher(?Client,?AmountAsk,?AmountGrant,1000,0.8).
                                    % ...,?RiskLevel,?RatiMin).
```

OO jDREW 1.0 POSL/RuleML Translator

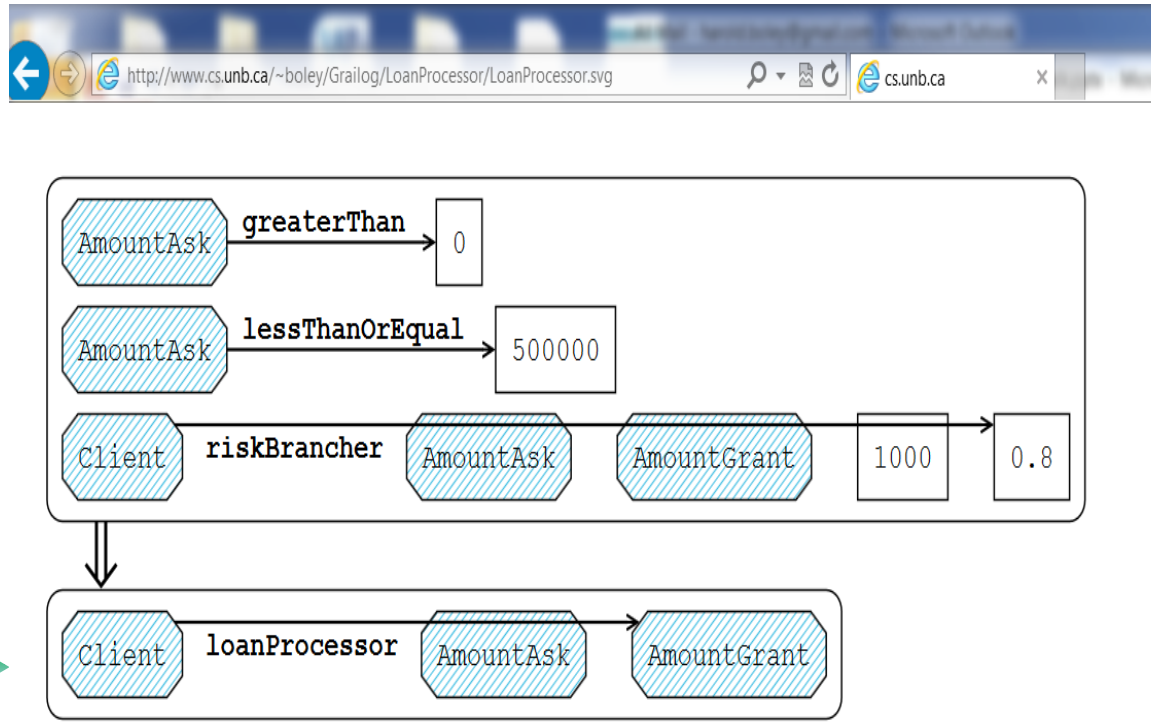
```
<Implies>
  <And>
    <Atom>
      <Rel>greaterThan</Rel>
      <Var>AmountAsk</Var>
      <Ind>0</Ind>
    </Atom>
    <Atom>
      <Rel>lessThanOrEqual</Rel>
      <Var>AmountAsk</Var>
      <Ind>500000</Ind>
    </Atom>
    <Atom>
      <Rel>riskBrancher</Rel>
      <Var>Client</Var>
      <Var>AmountAsk</Var>
      <Var>AmountGrant</Var>
      <Ind>1000</Ind>
      <Ind>0.8</Ind>
    </Atom>
  </And>
  <Atom>
    <Rel>loanProcessor</Rel>
    <Var>Client</Var>
    <Var>AmountAsk</Var>
    <Var>AmountGrant</Var>
  </Atom>
</Implies>
```

Complete: http://www.cs.unb.ca/~boley/Grailog/LoanProcessor/LoanProcessor.xml
(View Page Source)

Visualizing RuleML/XML as Grailog/SVG

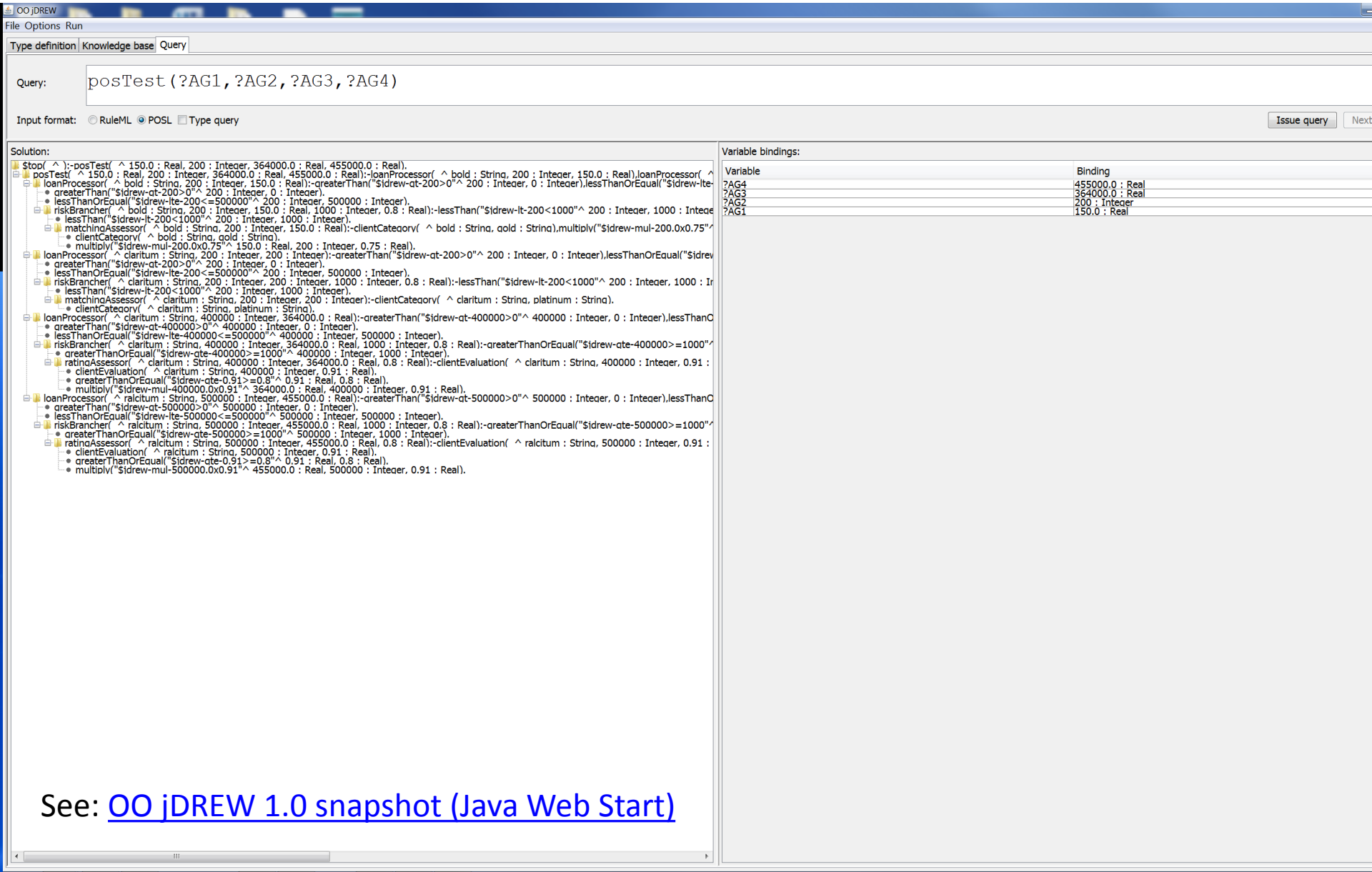
```
<Implies>
  <And>
    <Atom>
      <Rel>greaterThan</Rel>
      <Var>AmountAsk</Var>
      <Ind>0</Ind>
    </Atom>
    <Atom>
      <Rel>lessThanOrEqual</Rel>
      <Var>AmountAsk</Var>
      <Ind>500000</Ind>
    </Atom>
    <Atom>
      <Rel>riskBrancher</Rel>
      <Var>Client</Var>
      <Var>AmountAsk</Var>
      <Var>AmountGrant</Var>
      <Ind>1000</Ind>
      <Ind>0.8</Ind>
    </Atom>
  </And>
  <Atom>
    <Rel>loanProcessor</Rel>
    <Var>Client</Var>
    <Var>AmountAsk</Var>
    <Var>AmountGrant</Var>
  </Atom>
</Implies>
```

Grailog KS Viz



Complete: http://www.cs.unb.ca/~boley/Grailog/LoanProcessor/LoanProcessor.svg
(View Page Source)

Querying with OO jDREW



See: [OO jDREW 1.0 snapshot (Java Web Start)]

Exercises

1) Give client ralcitum the category platinum and explain what will happen for the positive and negative tests
2) Augment the decision rules so that clients of category silver (e.g., client nilper) will obtain half of the amount asked. Hint: Model category silver in analogy to category gold
3) Update the entire LP Suite (transformation, visualization, and querying) using 1) and 2)