Pelletheart

A prototype of a hybrid rule reasoner for ontologies.

Description

Integrating classic forward chaining rule reasoning implemented by HeaRT with the Pellet.

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Idea

- **Conceptual level**: Integration of *Attribute Logic with Set Values over Finite Domains (ALSV(FD))* and *Description Logics (DL)* (research paper on integration: read)
- **Implementation level**: Integration of Pellet ontology reasoner and HeaRT rule inference engine (research paper on architecture proposal: read, poster:

See LNCS/LNAI 6359/2010 Paper: Pellet-HeaRT – Proposal of an Architecture for Ontology Systems with Rules (2010).

It is based on the DAAL concept, see Springer SCI vol. 244/2009 Paper: Proposal of a New Rule-Based Inference Scheme for the Semantic Web Applications (2009) and TCCI II, LNCS/LNAI 6450/2010 Paper: Integration Proposal for Description Logic and Attributive Logic – Towards Semantic Web Rules (2010).

Integration Proposal

- Attributes in AL correspond to Concepts in DL
- model of a system stored in HeaRT, rule conditions checked by Pellet, execution of rules by HeaRT
- communication: DIG or command line

Implementation

Top-down overview

There are 2 aspects of the integration of Pellet and HeaRT:

1. Communication channel
    1. command line
        1. sending RDF/XML (dedicated translators from HML/R to RDF/XML)
    2. DIG interface
        1. sending DIG message (dedicated translators HML/R to DIG)

2. Inference scenario
    1. rule precondition checked with *consistency checking* DL task
    2. rule precondition checked with *realisation* DL task

What has been done

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% Reasoning with HeaRT-Pellet:                                      %
%  1. Build TBox: definitions of types and attributes               %
%    a) build additional statements: 'allDifferent' for individuals %
%  2. Call any inference mode you wish (GDI, TDI etc.)              %
%  3. In each state build an ABox representing this state           %
%  4. Whenever you check a rule preconditions:                      %
%    a) build rule axioms (temporary TBox),                         %
%    b) ontology = definitions TBox + rule axioms TBox + state ABox %
%    c) send the ontology to Pellet to check its consistency        %
%  5. Interpret the result, carry on as usual                       %
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% Reasoning with HeaRT-Pellet - Alternative version:                %
%                                                                   %
%  1. Build TBox: definitions of types and attributes               %
%    a) build additional statements: 'allDifferent' for individuals %
%  2. Call any inference mode you wish                              %
%  3. In each state build an ABox representing this state           %
%  4. Whenever you check a rule preconditions:                      %
%    a) build rule axioms (ABox statements)                         %
%    b) definitions TBox + rule axioms aBox + state ABox            %
%    c) send to Pellet to check realization the rule conditions     %
%  5. Interpret the result, carry on as usual                       %
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

Following the inference scenario:

1. HeaRT can be started with additional parameter in the gox predicate:

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% gox(StateIn,T,Mode,ExternalReasoner)                                  %
%   ExternalReasoner - the one used to check the rules preconditions    %
%                                                                       %
% Augmented version of Heart - additional variable for an ext.reasoner  %
%                                                                       %
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

2. Translating parts of the HMR model to RDF/XML

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% DAAL prototype translator.
% --------------------------
```

```
%
% Translates attributes into concepts,
%  attribute values into instances and
%  rule preconditions into T-Box like axioms.
%
% Supported operators: 'in', 'eq'.
% Supported attributes: 'symbolic'.
%
% Basic predicates:
%   owl_xml_gen/0 - translate HMR file into DAAL representation (ontology).
%   owl_xml_gen/1 - translate HMR file into DAAL representation (ontology)
%                   and write it to the file given as the argument.
%   owl_xml_attr_gen/0 - translate the attribute definitions
%   owl_rulp_gen/0 - translate the rules preconditions
%   owl_rulp_gen/1 - translate the given rule preconditions
%   owl_stat_gen/0 - translate the states statements
%   owl_stat_gen/1 - translate the given state statement
%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

3. Sending partial ontologies from HeaRT to Pellet

1. predicates for sending the ontologies 🔧 Fix Me!

4. Interpreting the Pellet answers by HeaRT 🔧 Fix Me!

Technically

- `heart-pellet.pl` - Extended version of HeaRT (works with the standard HeaRT distribution): additional parameter in gox predicates for the external reasoner to use
- `heart-daal-translator.pl` - predicates

Papers

- G.J. Nalepa, W.T. Furmańska: Proposal of a New Rule-Based Inference Scheme for the Semantic Web Applications, New Challenges in Computational Collective Intelligence. Studies in Computational Intelligence, 2009, Vol. 244/2009, 15-26.
- G.J. Nalepa, W.T. Furmańska: Pellet-HeaRT – Proposal of an Architecture for Ontology Systems with Rules, KI 2010: Advances in Artificial Intelligence. LNCS, Vol. 6359/2010, 143-150.
- G.J. Nalepa, W.T. Furmańska: Integration Proposal for Description Logic and Attributive Logic – Towards Semantic Web Rules, TRANSACTIONS ON COMPUTATIONAL COLLECTIVE INTELLIGENCE II, LNCS, Vol. 6450/2010, 1-23.

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