

# Appendices



# A Ontology Metadata

This appendix gives full particulars on the information captured by the metadata model for ontologies. The subsequent example is from the medical domain.

```
<?xml version="1.0"?>

<rdf:RDF
  xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
  xmlns:owl="http://www.w3.org/2002/07/owl#"
  xmlns:meta="http://swpatho.ag-nbi.de/context/meta.owl#"
  xmlns:xsd="http://www.w3.org/2000/10/XMLSchema#"
  xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:dmoz="http://swpatho.ag-nbi.de/context/dmoz_instances.owl#"
>

  <owl:Ontology rdf:about="">
    <owl:imports>
      <owl:Ontology rdf:about="http://swpatho.ag-nbi.de/context/meta.owl"/>
    </owl:imports>
  </owl:Ontology>

  <meta:Thesaurus rdf:ID="Medical_Subject_Headings">
    <meta:describesDomain rdf:resource="dmoz#Medicine"/>
    <meta:isCreatedBy>
      <meta:OntologyAuthor rdf:ID="Author_National_Library_of_Medicine"/>
    </meta:isCreatedBy>
    <meta:hasReadableLabels rdf:datatype="xsd:boolean">
      true
    </meta:hasReadableLabels>
    <meta:hasName rdf:datatype="xsd:string">
      Medical Subject Headings
    </meta:hasName>
    <meta:isImplementedUsingLanguage rdf:resource="meta#asci"/>
    <meta:isImplementedUsingLanguage rdf:resource="meta#marc"/>
    <meta:hasStatus rdf:datatype="xsd:string">
      stable
    </meta:hasStatus>
    <meta:numberOfInheritanceLevels rdf:datatype="xsd:int">
      9
    </meta:numberOfInheritanceLevels>
    <meta:numberOfAxioms rdf:datatype="xsd:int">
      0
    </meta:numberOfAxioms>
    <meta:hasAcronym rdf:datatype="xsd:string">
      MESH
    </meta:hasAcronym>
    <meta:numberOfClasses rdf:datatype="xsd:int">
      22997
```

## A Ontology Metadata

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```
</meta:numberOfClasses>
<meta:numberOfImportedOntologies rdf:datatype="xsd:int">
0
</meta:numberOfImportedOntologies>
<rdfs:comment rdf:datatype="xsd:string">
MESH ist ein kontrolliertes Medizinokabular, das von der
National Library of Medicine in den USA fuer die Katalogisierung
der MEDLINE Archiv entwickelt wurde. Der Thesaurus ist hierarchisch
organisiert. Es gibt 15 Hauptklassen, die fuer die Kategorisierung
der restlichen ueber 170.000 Termini benutzt werden.
Die Termini (descriptors genannt) werden in 2 Kategorien unterteilt:
preferred terms und headings.
</rdfs:comment>
<meta:isUsedForTask rdf:resource="meta#indexing"/>
<meta:hasDocumentation rdf:datatype="xsd:anyURI">
http://www.nlm.nih.gov/mesh/meshhome.html
</meta:hasDocumentation>
<meta:isUsedForTask rdf:resource="meta#search"/>
<meta:hasNaturalLanguage rdf:datatype="xsd:string">
en
</meta:hasNaturalLanguage>
<meta:numberOfInstances rdf:datatype="xsd:int">
0
</meta:numberOfInstances>
<meta:isImplementedUsingLanguage rdf:resource="meta#xml"/>
<meta:numberOfProperties rdf:datatype="xsd:int">
3
</meta:numberOfProperties>
</meta:Thesaurus>

</rdf:RDF>
```

## B Ontology Merging and Integration Metadata

The solution we proposed for the operationalization of merging and integration activities, in particular for the selection of matching tools and techniques which can optimally deal with specific input ontologies, relies on a description of the corresponding services in terms of inputs, outputs and other features. We exemplify this metadata for two composite matchers, LSD [52] and Cupid [130].

### B.1 Description of the Composite Matching Service LSD

```
<?xml version="1.0"?>

<rdf:RDF
  xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
  xmlns:owl="http://www.w3.org/2002/07/owl#"
  xmlns:meta="http://swpatho.ag-nbi.de/context/meta.owl#"
  xmlns:xsd="http://www.w3.org/2000/10/XMLSchema#"
  xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:dmoz="http://swpatho.ag-nbi.de/context/dmoz_instances.owl#"
>

  <owl:Ontology rdf:about="">
    <owl:imports>
      <owl:Ontology rdf:about="http://swpatho.ag-nbi.de/context/meta.owl"/>
    </owl:imports>
  </owl:Ontology>

  <AutomaticCompositionMatcher rdf:ID="lsd">
    <usesMatcher>
      <NameSimilarityMatcher rdf:ID="equalitysynonymmatcher">
        <hasMatcherInput rdf:resource="#InputSchema"/>
      </NameSimilarityMatcher>
    </usesMatcher>
    <hasMatcherInput rdf:resource="#InputSchema"/>
    <supportsCardinality>
      <GlobalCardinality rdf:ID="global1to1"/>
    </supportsCardinality>
    <usesAuxiliaryInformation>
      <AuxiliaryInformation rdf:ID="listofvaliddomainvalues"/>
    </usesAuxiliaryInformation>
    <usesMatcher>
      <InstanceElementLevelLinguisticMatcher rdf:ID="baesianlearners">
        <hasMatcherInput rdf:resource="#InputInstances"/>
      </InstanceElementLevelLinguisticMatcher>
```

```
</usesMatcher>
<supportsRepresentationLanguage rdf:resource="meta#xml"/>
<supportsCardinality>
  <LocalCardinality rdf:ID="local1to1"/>
</supportsCardinality>
<usesMatcher>
  <ValuePatternRangesMatcher rdf:ID="validdomainvalue">
    <hasMatcherInput rdf:resource="#InputInstances"/>
  </ValuePatternRangesMatcher>
</usesMatcher>
<owl:sameAs>
  <AutomaticCompositionMatcher rdf:ID="glue">
    <owl:sameAs rdf:resource="#lsd"/>
    <hasMatcherInput rdf:resource="#InputInstances"/>
    <hasMatcherInput rdf:resource="#InputSchema"/>
  </AutomaticCompositionMatcher>
</owl:sameAs>
<hasMatcherInput rdf:resource="#InputInstances"/>
<usedForContextTask>
  <meta:IntegrationTask rdf:ID="integration"/>
</usedForContextTask>
<usesAuxiliaryInformation>
  <AuxiliaryInformation rdf:ID="trainingmatches"/>
</usesAuxiliaryInformation>
<usesMatcher>
  <NameSimilarityMatcher rdf:ID="equalitynamematcher">
    <hasMatcherInput rdf:resource="#InputSchema"/>
  </NameSimilarityMatcher>
</usesMatcher>
<usesMatcher>
  <SchemaBasedStructureLevelConstraintBasedMatcher
    rdf:ID="xmlclassifier">
    <supportsRepresentationLanguage rdf:resource="meta#xml"/>
    <hasMatcherInput rdf:resource="#InputSchema"/>
  </SchemaBasedStructureLevelConstraintBasedMatcher>
</usesMatcher>
</AutomaticCompositionMatcher>

</rdf:RDF>
```

## B.2 Description of the Hybrid Matching Service Cupid

```
<?xml version="1.0"?>

<rdf:RDF
  xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
  xmlns:owl="http://www.w3.org/2002/07/owl#"
  xmlns:meta="http://swpatho.ag-nbi.de/context/meta.owl#"
  xmlns:xsd="http://www.w3.org/2000/10/XMLSchema#"
  xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:dmoz="http://swpatho.ag-nbi.de/context/dmoz_instances.owl#"
>

  <owl:Ontology rdf:about="">
```

```
<owl:imports>
  <owl:Ontology rdf:about="http://swpatho.ag-nbi.de/context/meta.owl"/>
</owl:imports>
</owl:Ontology>

<HybridMatcher rdf:ID="cupid">
  <usesAuxiliaryInformation rdf:resource="#useracronyms"/>
  <usedForContextTask>
    <TranslationTask rdf:ID="translation"/>
  </usedForContextTask>
  <usesMatcher rdf:resource="#abbreviationmatcher"/>
  <usesMatcher>
    <SchemaBasedElementLevelConstraintBasedMatcher
      rdf:ID="referentialconstrains">
      <hasMatcherInput rdf:resource="#InputSchema"/>
    </SchemaBasedElementLevelConstraintBasedMatcher>
  </usesMatcher>
  <usesMatcher>
    <NameSimilarityMatcher rdf:ID="substringsimilaritymatcher">
      <hasMatcherInput rdf:resource="#InputSchema"/>
    </NameSimilarityMatcher>
  </usesMatcher>
  <usesMatcher rdf:resource="#equalityhypernymmatcher"/>
  <usesMatcher rdf:resource="#equalityhomonymmatcher"/>
  <usesAuxiliaryInformation>
    <UserInputInformation rdf:ID="usersynonyms"/>
  </usesAuxiliaryInformation>
  <usesMatcher rdf:resource="#equalitysynonymmatcher"/>
  <usesMatcher rdf:resource="#equalitynamematcher"/>
  <hasMatcherInput rdf:resource="#InputSchema"/>
  <usesMatcher>
    <GraphMatcher rdf:ID="subtree">
      <hasMatcherInput rdf:resource="#InputSchema"/>
    </GraphMatcher>
  </usesMatcher>
  <supportsRepresentationLanguage
    rdf:resource="meta#relationaldb"/>
    <supportsCardinality rdf:resource="#local1to1"/>
  <usesAuxiliaryInformation>
    <AuxiliaryInformation rdf:ID="thesauri"/>
  </usesAuxiliaryInformation>
  <supportsRepresentationLanguage rdf:resource="meta#xml"/>
  <usesMatcher>
    <TypeSimilarityMatcher rdf:ID="datatypecriteria">
      <hasMatcherInput rdf:resource="#InputSchema"/>
    </TypeSimilarityMatcher>
  </usesMatcher>
  <usesAuxiliaryInformation>
    <UserInputInformation rdf:ID="userabbreviations"/>
  </usesAuxiliaryInformation>
  <usesMatcher>
    <SchemaBasedElementLevelLinguisticMatcher
      rdf:ID="linguisticmatcher">
      <hasMatcherInput rdf:resource="#InputSchema"/>
    </SchemaBasedElementLevelLinguisticMatcher>
```

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```
</usesMatcher>
<supportsCardinality rdf:resource="#global1to1"/>
<usesAuxiliaryInformation>
  <AuxiliaryInformation rdf:ID="glossaries"/>
</usesAuxiliaryInformation>
</HybridMatcher>

</rdf:RDF>
```



## C Contextual Dependencies for Matcher Selections

In this appendix we present several comprehensive examples about how contextual dependency rules for the selection of appropriate matching services for ontologies can be formalized and applied. For each example we show the results of applying the corresponding rules to the knowledge base —containing ontology and service descriptions—as returned by the Sesame-based SWRL engine. The result is a list of matchers, modelled as instances of the matching metadata ontology, which fulfill the query defining the properties of the ontologies to be processed.

### C.1 Rule for Semi-formal Ontologies

**Use only linguistic matchers for semi-formal ontologies.**

```
<swrl:Imp rdf:ID="SemiFormalOntologyRule">
  <swrl:body>
    <swrl:AtomList>
      <rdf:rest>
        <swrl:AtomList>
          <rdf:first>
            <swrl:DatavaluedPropertyAtom>
              <swrl:argument1 rdf:resource="#y"/>
              <swrl:argument2 rdf:resource="meta#semiformal"/>
              <swrl:propertyPredicate
                rdf:resource="meta#hasFormalityLevel"/>
            </swrl:DatavaluedPropertyAtom>
          </rdf:first>
          <rdf:rest>
            <swrl:AtomList>
              <rdf:first>
                <swrl:ClassAtom>
                  <swrl:argument1 rdf:resource="#y"/>
                  <swrl:classPredicate rdf:resource="#w"/>
                </swrl:ClassAtom>
              </rdf:first>
              <rdf:rest rdf:resource="...rdf-syntax-ns#nil"/>
            </swrl:AtomList>
          </rdf:rest>
        </swrl:AtomList>
      </rdf:rest>
    </swrl:AtomList>
  </rdf:rest>
  <rdf:first>
    <swrl:IndividualPropertyAtom>
      <swrl:argument1 rdf:resource="#x"/>
    </swrl:IndividualPropertyAtom>
  </rdf:first>
</swrl:Imp>
```

```

        <swrl:propertyPredicate rdf:resource="#hasMatcherInput"/>
        <swrl:argument2 rdf:resource="#w"/>
    </swrl:IndividualPropertyAtom>
    </rdf:first>
</swrl:AtomList>
</swrl:body>

<swrl:head>
  <swrl:AtomList>
    <rdf:first>
      <swrl:ClassAtom>
        <swrl:argument1 rdf:resource="#x"/>
        <swrl:classPredicate
          rdf:resource="#SchemaBasedElementLevelLinguisticMatcher"/>
        </swrl:ClassAtom>
      </rdf:first>
      <rdf:rest rdf:resource="...rdf-syntax-ns:nil"/>
    </swrl:AtomList>
  </swrl:head>
</swrl:Imp>

```

The results of applying this rule on the matching knowledge base using the SWRL rule engine [141, 171] are depicted in Figure C.1.

**Query results:**

x
http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#equalityhomonymmatcher
http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#equalitysynonymmatcher
http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#equalitynamematcher
http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#abbreviationmatcher
http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#equalityhypernymmatcher
http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#keywordsextractingmatcher
http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#substringsimilaritymatcher
http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#linguisticmatcher
http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#equalitynamerepresentationmatcher

9 results found in 6 ms.

Figure C.1: Results of Applying the Rule: “Use only linguistic matchers for semi-formal ontologies”

## C.2 Rule for Ontologies Using Different Natural Languages

Use structure-based matchers for ontologies with different natural languages.

```

<swrl:Imp rdf:ID="DifferentNaturalLanguagesRule">
  <swrl:body>
    <swrl:AtomList>
      <rdf:first>
        <swrl:IndividualPropertyAtom>

```

```

<swrl:propertyPredicate rdf:resource="#hasMatcherInput"/>
<swrl:argument1 rdf:resource="#x"/>
<swrl:argument2 rdf:resource="#p"/>
</swrl:IndividualPropertyAtom>
</rdf:first>
<rdf:rest>
<swrl:AtomList>
<rdf:rest>
<swrl:AtomList>
<rdf:first>
<swrl:ClassAtom>
<swrl:classPredicate rdf:resource="#p"/>
<swrl:argument1 rdf:resource="#y"/>
</swrl:ClassAtom>
</rdf:first>
<rdf:rest>
<swrl:AtomList>
<rdf:first>
<swrl:ClassAtom>
<swrl:classPredicate rdf:resource="#q"/>
<swrl:argument1 rdf:resource="#z"/>
</swrl:ClassAtom>
</rdf:first>
<rdf:rest>
<swrl:AtomList>
<rdf:rest>
<swrl:AtomList>
<rdf:rest>
<swrl:AtomList>
<rdf:first>
<swrl:DifferentIndividualsAtom>
<swrl:argument1 rdf:resource="#u"/>
<swrl:argument2 rdf:resource="#t"/>
</swrl:DifferentIndividualsAtom>
</rdf:first>
<rdf:rest rdf:resource="...rdf-syntax-ns#nil"/>
</swrl:AtomList>
</rdf:rest>
<rdf:first>
<swrl:DatavaluedPropertyAtom>
<swrl:argument1 rdf:resource="#z"/>
<swrl:argument2 rdf:resource="#t"/>
<swrl:propertyPredicate
  rdf:resource="meta#hasNaturalLanguage"/>
</swrl:DatavaluedPropertyAtom>
</rdf:first>
</swrl:AtomList>
</rdf:rest>
<rdf:first>
<swrl:DatavaluedPropertyAtom>
<swrl:argument1 rdf:resource="#y"/>
<swrl:argument2 rdf:resource="#u"/>
<swrl:propertyPredicate
  rdf:resource="meta#hasNaturalLanguage"/>
</swrl:DatavaluedPropertyAtom>

```

```
        </rdf:first>
        </swrl:AtomList>
    </rdf:rest>
    </swrl:AtomList>
</rdf:rest>
</swrl:AtomList>
</rdf:rest>
<rdf:first>
    <swrl:IndividualPropertyAtom>
        <swrl:argument2 rdf:resource="#q"/>
        <swrl:argument1 rdf:resource="#x"/>
        <swrl:propertyPredicate rdf:resource="#hasMatcherInput"/>
    </swrl:IndividualPropertyAtom>
</rdf:first>
</swrl:AtomList>
</rdf:rest>
</swrl:AtomList>
</swrl:body>
<swrl:head>
    <swrl:AtomList>
        <rdf:rest rdf:resource="...rdf-syntax-ns#nil"/>
        <rdf:first>
            <swrl:ClassAtom>
                <swrl:classPredicate
                    rdf:resource="#SchemaBasedStructureLevelMatcher"/>
                <swrl:argument1 rdf:resource="#x"/>
            </swrl:ClassAtom>
        </rdf:first>
    </swrl:AtomList>
</swrl:head>
</swrl:Imp>
```

The results of applying this rule are showed in Figure C.2.

### C.3 Rule for Formal Axiomatized Ontologies without Instances

**Use constraints-based matchers only for formal ontologies without instances and only if ontologies contain axioms.**

```
<swrl:Imp rdf:ID="FormalWithAxiomsWithoutInstancesOntologyRule">

    <swrl:head>
        <swrl:AtomList>
            <rdf:first>
                <swrl:ClassAtom>
                    <swrl:argument1 rdf:resource="#x"/>
                    <swrl:classPredicate
                        rdf:resource="#SchemaBasedElementLevelConstraintBasedMatcher"/>
                </swrl:ClassAtom>
            </rdf:first>
            <rdf:rest rdf:resource="...rdf-syntax-ns#nil"/>
        </swrl:AtomList>
    </swrl:head>
```

## Query results:

x
<a href="http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#xmlclassifier">http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#xmlclassifier</a>
<a href="http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#cardinalitiesmatcher">http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#cardinalitiesmatcher</a>
<a href="http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#sahierarhiesmatcher">http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#sahierarhiesmatcher</a>
<a href="http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#tree">http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#tree</a>
<a href="http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#relatedelements">http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#relatedelements</a>
<a href="http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#subtree">http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#subtree</a>
<a href="http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#sat">http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#sat</a>
<a href="http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#ntom">http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#ntom</a>
<a href="http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#structureschemamatcher">http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#structureschemamatcher</a>
<a href="http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#milestone">http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#milestone</a>
<a href="http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#ntoone">http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#ntoone</a>
<a href="http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#similarityflooding">http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#similarityflooding</a>
<a href="http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#s-match">http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#s-match</a>
<a href="http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#neighbornhood">http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#neighbornhood</a>
<a href="http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#onetone">http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#onetone</a>
<a href="http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#oneton">http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#oneton</a>

16 results found in 5 ms.

Figure C.2: Results of Applying the Rule: “Use structure-based matchers for ontologies with different natural languages”

```

<swrl:body>
  <swrl:AtomList>

    <rdf:first>
      <swrl:IndividualPropertyAtom>
        <swrl:propertyPredicate rdf:resource="#hasMatcherInput"/>
        <swrl:argument2 rdf:resource="#w"/>
        <swrl:argument1 rdf:resource="#x"/>
      </swrl:IndividualPropertyAtom>
    </rdf:first>

    <rdf:rest>
      <swrl:AtomList>
        <rdf:first>
          <swrl:ClassAtom>
            <swrl:classPredicate rdf:resource="#w"/>
            <swrl:argument1 rdf:resource="#y"/>
          </swrl:ClassAtom>
        </rdf:first>
        <rdf:rest>
          <swrl:AtomList>
            <rdf:first>
              <swrl:IndividualPropertyAtom>
                <swrl:argument2 rdf:resource="#r"/>
                <swrl:propertyPredicate

```

```
        rdf:resource="meta#supportsOntologicalPrimitive"/>
    <swrl:argument1 rdf:resource="#y"/>
</swrl:IndividualPropertyAtom>
</rdf:first>
<rdf:rest>
    <swrl:AtomList>
        <rdf:first>
            <swrl:ClassAtom>
                <swrl:classPredicate rdf:resource="meta#Restriction"/>
                <swrl:argument1 rdf:resource="#r"/>
            </swrl:ClassAtom>
        </rdf:first>
        <rdf:rest>
            <swrl:AtomList>
                <rdf:first>
                    <swrl:ClassAtom>
                        <swrl:classPredicate
                            rdf:resource="#OntologyWithoutInstances"/>
                        <swrl:argument1 rdf:resource="#y"/>
                    </swrl:ClassAtom>
                </rdf:first>
                <rdf:rest>
                    <swrl:AtomList>
                        <rdf:first>
                            <swrl:DatavaluedPropertyAtom>
                                <swrl:argument1 rdf:resource="#y"/>
                                <swrl:argument2 rdf:resource="meta#formal"/>
                                <swrl:propertyPredicate
                                    rdf:resource="meta#hasFormalityLevel"/>
                            </swrl:DatavaluedPropertyAtom>
                        </rdf:first>
                        <rdf:rest rdf:resource="...rdf-syntax-ns#nil"/>
                    </swrl:AtomList>
                </rdf:rest>
            </swrl:AtomList>
        </rdf:rest>
    </swrl:AtomList>
</rdf:rest>
</swrl:AtomList>
</rdf:rest>
</swrl:AtomList>
</swrl:AtomList>
</swrl:body>
</swrl:Imp>
```

## C.4 Rule for Formal Ontologies without Instances

### Use schema based matcher if no instance data is available

```

<swrl:Imp rdf:ID="FormalWithAxiomsWithoutInstancesOntologyRule2">

  <swrl:head>
    <swrl:AtomList> <rdf:rest rdf:resource="...ns#nil"/>
      <rdf:first>
        <swrl:ClassAtom>
          <swrl:classPredicate
            rdf:resource="#SchemaBasedStructureLevel
              ConstraintBasedMatcher"/>
          <swrl:argument1>
            <swrl:Variable rdf:ID="x"/>
          </swrl:argument1>
        </swrl:ClassAtom>
      </rdf:first>
    </swrl:AtomList>
  </swrl:head>

  <swrl:body>
    <swrl:AtomList>
      <rdf:rest>
        <swrl:AtomList>
          <rdf:rest>
            <swrl:AtomList>
              <rdf:rest>
                <swrl:AtomList>
                  <rdf:rest rdf:resource="...ns#nil"/>
                  <rdf:first>
                    <swrl:ClassAtom>
                      <swrl:argument1 rdf:resource="#y"/>
                      <swrl:classPredicate
                        rdf:resource="#OntologyWithoutInstances"/>
                    </swrl:ClassAtom>
                  </rdf:first>
                </swrl:AtomList>
              </rdf:rest>
            </swrl:AtomList>
          </rdf:rest>
        <rdf:first>
          <swrl:ClassAtom>
            <swrl:argument1 rdf:resource="#y"/>
            <swrl:classPredicate
              rdf:resource="#OntologyWithAxioms"/>
          </swrl:ClassAtom>
        </rdf:first>
      </swrl:AtomList>
    </rdf:rest>
  <rdf:first>
    <swrl:ClassAtom>
      <swrl:argument1 rdf:resource="#y"/>
      <swrl:classPredicate rdf:resource="#FormalOntology"/>
    </swrl:ClassAtom>
  </rdf:first>
</swrl:AtomList>

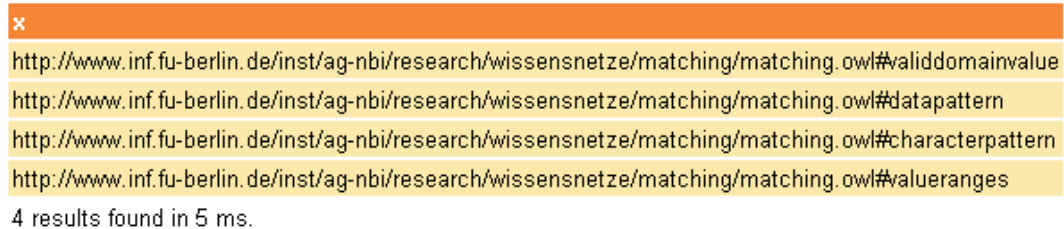
```

```
</rdf:rest>
<rdf:first>
  <swrl:IndividualPropertyAtom>
    <swrl:propertyPredicate rdf:resource="#hasMatcherInput"/>
    <swrl:argument2 rdf:resource="#y"/>
    <swrl:argument1 rdf:resource="#x"/>
  </swrl:IndividualPropertyAtom>
</rdf:first>
</swrl:AtomList>
</swrl:body>

</swrl:Imp>
```

Figure C.3 shows an excerpt of results returned by applying the last two rules.

### Query results:



x

- <http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#validdomainvalue>
- <http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#datapattern>
- <http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#characterpattern>
- <http://www.inf.fu-berlin.de/inst/ag-nbi/research/wissensnetze/matching/matching.owl#valueranges>

4 results found in 5 ms.

Figure C.3: Results of Applying the Rule: *‘Use constraints-based matchers only for formal ontologies without instances and only if ontologies contain axioms’*