Evaluating Ontology Matching Tools

Christian Meilicke
Chair of Artificial Intelligence
School of Business Informatics and Mathematics
University of Mannheim, Germany
christian@informatik.uni-mannheim.de
Outline

• **Background on Ontology Matching**
• Metrics for Evaluating Matching Systems
• OAEI Datasets and Scenarios
• Webbased & Platformbased Evaluation
• Usage of Testclient / Tool Wrapping
• Plans for OAEI 2011 & References
Ontology Matching

[Diagram showing relationships between concepts like Person, Human, Chairman, ConferenceMember, Author, Reviewer, Paper, SubjectArea, Committee member, Chair, Conference contributor, Active participant, Regular author, and Topic, with specific properties such as email, gender, and assignment relationships.]
Terminology

- **Correspondence**
- Alignment
- Reference Alignment
- Matching System (Matcher)
- OAEI (Ontology Alignment Evaluation Initiative)
Terminology

- Correspondence
- **Alignment**
- Reference Alignment
- Matching System (Matcher)
- OAEI (Ontology Alignment Evaluation Initiative)
Terminology

- Correspondence
- Alignment
- Reference Alignment
- Matching System (Matcher)
- OAEI (Ontology Alignment Evaluation Initiative)
Terminology

• Correspondence
• Alignment
• Reference Alignment
• **Matching System (Matcher)**
• OAEI (Ontology Alignment Evaluation Initiative)
Terminology

- Correspondence
- Alignment
- Reference Alignment
- Matching System (Matcher)
- OAEI (Ontology Alignment Evaluation Initiative)
OAEI

• Annual evaluation campaign at ISWC ontology matching workshop
  – Comparing performance of matching systems
  – Support to improve ontology matching
• Divided in several tracks, track = dataset + evaluation methods
• Each track conducted by a different group of researchers
  • Until 2009: Alignments generated by tool developers and submitted to organizers for evaluation
  • Evaluation of submitted alignments and generation of results often script-based + spreadsheets + …
  • 2010 & 2011 with SEALS support
Outline

• Background on Ontology Matching
• **Metrics for Evaluating Matching Systems**
• OAEI Datasets and Scenarios (Tracks)
• Webbased & Platformbased Evaluation
• Usage of Testclient / Tool Wrapping
• Plans for OAEI 2011 & References
Compliance-based Metrics

• Based on comparing generated alignment $A$ against reference alignment $R$

• Precision, recall, and f-measure (harmonic mean of precision and recall)

$$P(A, R) = \frac{|A \cap R|}{|A|} \quad R(A, R) = \frac{|A \cap R|}{|R|}$$

Person = Person
writtenBy = hasWritten
FirstAuthor < Author

Person = Person
FirstAuthor < Author
Paper = Article
Document = Contribution

$P(A, R) = 2/3 = 0.66$
$R(A, R) = 2/4 = 0.5$
Other Metrics

• Variants of Precision & Recall
  – Semantic Precision and Recall
  – Manual labeling / sampling

• Efficiency and Scalability
  – Runtime and memory consumption

• Conformance to standards
  – Alignment API, format of input ontologies, ...

• Coherence of alignments
  – Unsatisfiability as a result of using the alignment
Outline

• Background on Ontology Matching
• Metrics for Evaluating Matching Systems
• **OAEI Datasets and Scenarios (Tracks)**
• Webbased & Platformbased Evaluation
• Usage of Testclient / Tool Wrapping
• Plans for OAEI 2011 & References
Important Datasets from OAEI

• Benchmark
  – More than 50 testcases; one ontology (33 named classes, 24 object properties, 40 data properties) has to be matched on systematic, artificially generated variations

• Anatomy
  – Two ontologies from biomedical domain (approx. 3000 classes, more than 1000 correspondences in R)

• Conference
  – Several ontologies from conference domain (30-200 classes), reference alignment between all pairs from a subset of 7 ontologies
Benchmark (#249-2)
Anatomy (human)
Conference (CMT)
Metrics applied in the past

- Precision, recall, f-measure
- Conformance
- Coherency
- Runtime measurements (Efficiency/Scalability)
- Deployability

- Important aspect on meta-level:
  - Reproducibility of results!
Results OAEI 2010

• 15 participants / 13 participants for tracks in SEALS modality
• Benchmark (11)
  – ASMOV and RiMOM ahead, with AgrMaker as close follower
  – SOBOM, GeRMeSMB and Ef2Match achieve intermediary results
• Anatomy (9)
  – AgrMaker (prec. 90%, recall 85%) ahead, followed by Ef2Match, NBJLM and SOBOM
• Conference (8)
  – CODI ahead (prec. 88%, recall 52%), with Falcon, Ef2Match and ASMOV as follower
  – most alignments are highly incoherent
Results over last years
Outline

• Background on Ontology Matching
• Metrics for Evaluating Matching Systems
• OAEI Datasets and Scenarios (Tracks)
• Webbased & Platformbased Evaluation
• Usage of Testclient / Tool Wrapping
• Plans for OAEI 2011 & References
Two Approaches

SEALS Repositories
- Test Data
- Tools
- Evaluations
- Results

SEALS Platform
- Evaluation Runtime
- Service Manager
- SEALS Repositories
  - Test Data
  - Tools
  - Evaluation Description
  - Results

SEALS
Semantic Evaluation at Large Scale
Pros and Cons

Webbased approach

- Used in OAEI 2010
- Low barrier of usage
- Configuration/modifications can be tested on the fly
- No reproducibility of results
- No efficiency measurement possible

Platformbased approach

- Will be used in OAEI 2011
- Requires to upload tool
- Harder to test different configurations/modifications
- Results are attached to a certain version, can be reproduced any time
- Runtime measurements possible
Solving the problem

Testclient

• To be used in preliminary testing for OAEI 2011
• Low barrier of usage
• Configuration/modifications can be tested on the fly
• No reproducibility of results
• No efficiency measurement possible

Platformbased approach

• Will be used in OAEI 2011
• Requires to upload tool
• Harder to test different configurations/modifications
• Results are attached to a certain version, can be reproduced any time
• Runtime measurements possible
Outline

• Background on Ontology Matching
• Metrics for evaluating Matching Systems
• OAEI Datasets and Scenarios (Tracks)
• Webbased & Platformbased Evaluation
• **Usage of Testclient / Tool Wrapping**
• Plans for OAEI 2011 & References
Wrap your Tool (1)

- bin/
- lib/
  - demomatcher.jar
  - owlapi.jar
  - simmetrics.jar
  - demomatcher-bridge.jar
- deploy.bat (or *.sh on linux)
- start.bat
- stop.bat
- undeploy.bat
- conf/
  - configuration/
    - threshold.txt
- lib/
  - (empty)
  - descriptor.xml

- Your tool in a jar
- Libraries required by your tool
- One class that acts as bridge
- Configuration files required at runtime
- Metainformation and references to content
Wrap your Tool (2)

```java
/**
 * Aligns two ontologies specified via their URL and returns the
 * URL of the resulting alignment, which should be stored locally.
 */
public URL align(URL source, URL target) throws ToolBridgeException, ToolException {
    DemoMatcher demoMatcher;
    try {
        demoMatcher = new DemoMatcher();
        try {
            String alignmentString = demoMatcher.align(source.toURI(), target.toURI());
            try {
                File alignmentFile = File.createTempFile("alignment", ".rdf");
                FileWriter fw = new FileWriter(alignmentFile);
            }
        }
    }
}
```

Using the Alignment API?
- No need to write the Bridge, we offer mechanism to build a package that includes the Bridge (available soon).
Execute your Tool

Microsoft Windows [Version 6.0.6002]
Copyright (c) 2006 Microsoft Corporation. Alle Rechte vorbehalten.
C:\Users\Christian>a:
A:\>cd seals/sealshome
A:\seals\sealshome>SET SEALSHOME=a:\seals\sealshome
A:\seals\sealshome>java -jar A:/seals/innsbruck/demo/seals-omt-client.
jar A:/seals/temp/demomatcher-package
Syntax (simple test): <packageLocation> {<t>}
Or (full test): <packageLocation> {-e} <testsuite> <output>
Or (for local test): <packageLocation> {-o} <ontologyURL1> <ontologyURL2>
Replace <testsuite> with one of Anatomy2010, Benchmark2010, Conference2010, or MLConference
A:\seals\sealshome>
Results of Local Evaluation Run

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>101</td>
<td>1.0</td>
<td>0.873</td>
<td>file:/C:/....</td>
</tr>
<tr>
<td>103</td>
<td>1.0</td>
<td>0.873</td>
<td>file:/C:/....</td>
</tr>
<tr>
<td>104</td>
<td>1.0</td>
<td>0.873</td>
<td>file:/C:/....</td>
</tr>
<tr>
<td>201</td>
<td>0.010</td>
<td>0.066</td>
<td>file:/C:/....</td>
</tr>
<tr>
<td>201-2</td>
<td>0.793</td>
<td>0.631</td>
<td>file:/C:/....</td>
</tr>
<tr>
<td>201-4</td>
<td>0.597</td>
<td>0.604</td>
<td>file:/C:/....</td>
</tr>
</tbody>
</table>
Outline

• Background on Ontology Matching
• Metrics for Evaluating Matching Systems
• OAEI Datasets and Scenarios (Tracks)
• Webbased & Platformbased Evaluation
• Usage of Testclient / Tool Wrapping
• Plans for OAEI 2011 & References
Plans for 2nd SEALS campaign

• OAEI 2011 at OM-workshop (ISWC 2011)
• Support preliminary tests and finally run tools on platform
  – Online evaluation service for preliminary testing
  – Client for running test and complete evaluation locally
  – We run tools on platform for generating final results
  – Use experiences for a fully automated approach in 2012
• More datasets under SEALS?
  – OAEI Directory track
  – Instance Matching Track
  – Track on Matching Linked Open Data Schemas
References

• Webpages:
    tutorial for wrapping a matcher to be executed on the platform,
    still partially under construction
  – http://www.seals-project.eu/ontology-matching-evaluation-ui
    user interface of the online evaluation service

• Publications:
  – Euzenat et al.: Results of the ontology alignment evaluation
    initiative 2010, OM-2010
    comprehensive overview on OAEI 2010 results
  – Trojahn et al.: Automating OAEI Campaigns (First Report),
    IWEST-2010
    about using the online evaluation service in OAEI 2010
Contact me!

• Ontology Matching in SEALS-Booth
  – Mon 18:00-18:30
  – Tue 10:30-11:00
  – Tue 13:30-14:00

• It’s for free!

• Email:
  – christian@informatik.uni-mannheim.de
Thanks!

Any Questions?