Use of multiple background ontologies in ontology matching

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Agenda

• **Intro: ontology matching using background knowledge**
• Case study
• Results, evaluation
• Conclusions
Introduction – ontology matching problem

- Ontology matching is central in Semantic Web
- Solutions are necessary in many applications
- Available automatic solutions:
  - Lexical techniques
  - Structural techniques
  - Instance based techniques
  - Use of background knowledge
Introduction – ontology matching problem

- Ontology matching using background knowledge
  - Step 1: Anchoring
    Connect the matching ontologies to the background knowledge
  - Step 2: Deriving indirect matches
    Find indirect matches using the anchors
Ontology matching using background knowledge

- Background knowledge ontology
- Anchoring
- Deriving relations
- Anchoring
- Source ontology
- Indirect match
- Target ontology
Ontology matching using background knowledge
Introduction – ontology matching problem

Nice idea, but what actually happens in practice?
Agenda

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Case study

- Experiments to match two ontologies: NALT and Agrovoc (OAEI 2005 data)
- Direct matching as a base line
- Indirect matching through six background ontologies
- What is the behavior of matching with multiple background ontologies?
## Case study: Background knowledge

<table>
<thead>
<tr>
<th>Background knowledge ontology</th>
<th>Type of ontology</th>
<th>Size in number of concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>BK₁: Economy</td>
<td>Different domain</td>
<td>323</td>
</tr>
<tr>
<td>BK₂: Mid-level</td>
<td>General knowledge</td>
<td>1773</td>
</tr>
<tr>
<td>BK₃: Sumo</td>
<td>General knowledge</td>
<td>576</td>
</tr>
<tr>
<td>BK₄: Tap</td>
<td>General knowledge</td>
<td>5488</td>
</tr>
<tr>
<td>BK₅: A.Com</td>
<td>Unknown origin</td>
<td>5624</td>
</tr>
<tr>
<td>BK₆: Surrey</td>
<td>Unknown origin</td>
<td>672</td>
</tr>
</tbody>
</table>
Case study: Experiments

• Experiments:
  – **Experiment 1: direct matching**
    • Step 1: Use labels of the matching ontologies
    • Step 2: Use the structure to find additional matches
  – **Experiments 2-7: indirect matching**
    • Step 1: Anchor using lexical method
    • Step 2: Derive indirect matches
  – **Matching result:** concept pairs connected related as
    • Equivalent $\equiv$
    • Broader-than $\supseteq$
    • Narrower-than $\subseteq$
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Results, evaluation

- Direct matching (Exp.1) – base line
  - 6,437 matches in total
  - Comparable with OAEI 2005 results
Results, evaluation

- Indirect matching (Exp.2-7)

<table>
<thead>
<tr>
<th>Background ontology</th>
<th>$BK_i$ size</th>
<th>Indirect matches</th>
<th>Additional matches on top of direct matches</th>
</tr>
</thead>
<tbody>
<tr>
<td>$BK_1$: Economy</td>
<td>323</td>
<td>259</td>
<td>85</td>
</tr>
<tr>
<td>$BK_2$: MidLevel</td>
<td>1773</td>
<td>200</td>
<td>81</td>
</tr>
<tr>
<td>$BK_3$: Sumo</td>
<td>576</td>
<td>115</td>
<td>57</td>
</tr>
<tr>
<td>$BK_4$: Tap</td>
<td>5488</td>
<td>1003</td>
<td>625</td>
</tr>
<tr>
<td>$BK_5$: ACom</td>
<td>5624</td>
<td>87</td>
<td>71</td>
</tr>
<tr>
<td>$BK_6$: Surrey</td>
<td>672</td>
<td>623</td>
<td>543</td>
</tr>
<tr>
<td>Cumulatively all $BK_i$</td>
<td>2183</td>
<td></td>
<td>1428</td>
</tr>
</tbody>
</table>
Results, evaluation

- Evaluation: direct matching
  - Random sample of 10%
  - Manual inspection of correctness
  - Document classification task
Results, evaluation

- Evaluation: indirect matching

<table>
<thead>
<tr>
<th>Matching experiment</th>
<th>Precision indir. matches</th>
<th>Precision addit. matches</th>
<th>ΔRecall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exp.2: BK₁: Economy</td>
<td>84.17%</td>
<td>51.76%</td>
<td>0.68%</td>
</tr>
<tr>
<td>Exp.3: BK₂: Mid-level</td>
<td>97.00%</td>
<td>92.59%</td>
<td>1.17%</td>
</tr>
<tr>
<td>Exp.4: BK₃: Sumo</td>
<td>76.52%</td>
<td>52.63%</td>
<td>0.47%</td>
</tr>
<tr>
<td>Exp.5: BK₄: Tap</td>
<td>57.23%</td>
<td>31.36%</td>
<td>3.04%</td>
</tr>
<tr>
<td>Exp.6: BK₅: A.Com</td>
<td>36.78%</td>
<td>22.54%</td>
<td>0.25%</td>
</tr>
<tr>
<td>Exp.7: BK₆: Surrey</td>
<td>35.63%</td>
<td>26.15%</td>
<td>2.21%</td>
</tr>
<tr>
<td>Cumulatively BK₁-BK₆</td>
<td>57.63%</td>
<td>35.22%</td>
<td>7.81%</td>
</tr>
</tbody>
</table>
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Conclusions

• What background knowledge we use is very important
• Recall increases monotonically - Multiple background ontologies can be used simultaneously
• Precision depends on the quality of background ontology
• Regardless of domain, expert-created background ontologies behave in similar way
Thank you for attention!

Any questions?