Uncertain Reasoning for Creating Ontology Mapping on the Semantic Web

Miklos Nagy, Maria Vargas-Vera and Enrico Motta
Outline

- Introduction and context
- Motivation: Question Answering (QA)
- Belief for uncertain similarities
- Evaluation
- Conclusions
Introduction and context

Ontology mapping on the Semantic Web:

- Need for efficient and effective mapping
- Meaningful similarity combination
- Independent from domain specific parameters
Motivation: Question Answering (QA)
Belief for Uncertain Similarities

Assumptions:

• Similarity measures based on unreliable and inconsistent information

• Agents’ background knowledge depends on their perspective

• Knowledge over similarity measure is subjective and context dependent
Uncertainty with Dempster-Shafer

- Uncertain information in a numerical way
- Missing data also can be modeled
- Probabilities are assessed by combining pieces of evidences
- Evidences from two or more sources can be combined using Dempster’s rule of combination
**Frame of discernment (\(\Theta\))**: Represent the space of hypotheses

**Evidence**: available fact as a result of the observation

**Belief mass function (\(m\))**: finite amount of support for the particular evidence

**Belief**: sum of all evidence that supports a particular proposition

**Dempster’s rule of combination:**

\[
m_{ij}(A) = m_i \oplus m_j = \sum_{E_k \cap E_k} m_i(E_k) \ast m_j(E_k)
\]
Evaluation

- Experiments with the existing benchmarks of the 2006 and 2007 Ontology Alignment Evaluation Initiative
- Bibliographic references Ontology (different classifications of publications) contained 33 named classes, 24 object properties, 40 data properties
- Reference Ontology + systematically generated test ontologies starting from the reference ontology and discarding a number of information (data types, properties, instances, class hierarchies)
Sample ontologies from the benchmark

- Ontology Nr. 103: Language generalisation (OWL Lite)
- Ontology Nr. 204: Different naming conventions
- Ontology Nr. 205: Synonyms
- Ontology Nr. 221: No hierarchy
- Ontology Nr. 222: Flattened hierarchy
- Ontology Nr. 221: Expanded hierarchy
- Ontology Nr. 301: Real ontology – BibTex(MIT)
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**DSSim:** uses beliefs for managing uncertainty for similarity combination.

**SimpleSim:** combines different similarities producing an average measure.
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**DSSim**: uses beliefs for managing uncertainty for similarity combination.

**SimpleSim**: combines different similarities producing an average measure.
Comparison of different algorithms based on OAEI 2007 benchmarks(*)

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Position of the systems considering Precision/Recall(*)

DSSim Pros and cons

✓ Our method is not heavily dependent on subclass, sub property, disjointness or equivalency relationships among classes and properties

✓ Query terms are extended with their synonyms from WordNet so the uncertainty can be distributed sufficiently

✗ Dempser’s combination rule is computationally expensive therefore optimalisation is necessary

✗ WordNet terms are not domain specific
Conclusions

- Proposed a solution for the problem of inconsistency and incompleteness during ontology mapping
- Increased the mapping precision with utilizing uncertainty
- Proved that uncertainty handling with Dempster-Shafer theory is a promising alternative to traditional Bayesian solutions
Thank You!