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Ontology-based Knowledge Management

Ontology Evaluation

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Motivation

- Why ontology evaluation is important?
- Where do we need it?

Ontology Evaluation Approaches

- A typical categorization
 - Based on comparing the ontology to a “golden standard”
 - Based on using the ontology in an application and evaluating the application results
 - Involving comparisons with a source of data about the domain to be covered by the ontology
 - Evaluation is done by humans

Ontology Evaluation Approaches

- These approaches can be applied in different levels
 - Lexical
 - Taxonomy
 - Other semantic relations
 - Syntactic
 - Context and allocation-level
 - Structure, architecture

Ontology Evaluation Perspectives

1. Ontology evaluation in order to make ontology selection possible
 - Ontology ranking
2. Ontology evaluation for increasing the quality of ontologies through conflict/inconsistency detection and removal
3. Ontology evaluation just for evaluation, in order to measure the quality of an ontology
 - For instance to measure how good is an ontology learning algorithm or how good is an ontology mapping algorithm

Ontology Evaluation / perspective 1

- An architecture is proposed for ontology ranking: ACTiveRank
- A prototype of the proposed system is developed

Ontology Evaluation

- The user enters his keywords to search for an appropriate ontology related to those keywords
- The system sends the keywords to SWOOGLE, a search engine for ontologies on the web
- Receives back the search results from SWOOGLE
- Downloads the result ontologie

Ontology Evaluation

- Analyzes each ontology and assigns a ranks to them, using 3 measures
- Based on the ranking, shows the results to the user

Ontology Evaluation

- Measures:
 - CMM: Class Match Measure
 - DEM: Density Measure
 - SSM: Semantic Similarity Measure
 - How close the classes that match the search term are in the ontology
 - BEM: Betweenness Measure

Ontology Evaluation

- Evaluation of the proposed architecture

Ontology Evaluation / perspective 2

- Ontology evaluation for increasing the quality of ontologies through conflict/inconsistency detection and removal

Ontology Evaluation

- OntoClean
- CleanOnto

Ontology Evaluation

- OntoClean
- Rooted in philosophical notions
- Meta-properties
- Expert labels the properties of the ontology with meta-properties
- Based on a set of predefined constraints, it is possible to detect conflicts
 - Subsumption relations and taxonomy checking

Ontology Evaluation

- Meta-properties
 - Essence and Rigidity
 - rigid, semi-rigid, anti-rigid
 - Identity and unity
- It's very hard to assign these labels
- It's a good theoretical framework for arguing about ontologies
 - Cyc developers

Ontology Evaluation

- Essence: a property of an entity is essential to that entity, if it must be true of it in every possible world.
 - Having brain is essential to human
 - Having job is not essential to humena

Ontology Evaluation

- Rigidity: a special form of essentiality
 - A property is rigid if it is essential to all its possible instances
 - An instance of a rigid property cannot stop being an instance of that property in another world
 - Having brain is essential for human
 - Having brain is not essential for scarecrow of the OZ
 - Therefore, having brain is not rigid

Ontology Evaluation

- Rigidity:
 - Rigid
 - Being human is rigid, no human instance can cease being human
 - Semi-rigid
 - Having brain is semi-rigid, some entities that have brain, can cease having brain, but some cannot
 - Anti-rigid
 - Being student is anti-rigid, all student instances can cease being student

Ontology Evaluation

- A constraint sample
 - Anti-rigid properties cannot subsume rigid properties
 - E.g. being student cannot subsume being human
- An example of the conflicts detected by this method
 - “an animal is a physical object” is inconsistent
 - Being alive is essential for animal, but it is not essential for physical object

Ontology Evaluation

- cleanOnto
- Ontoclean is complex
- Assigning labels is tedious and depends on the human
 - 38%
- CleanOnto uses a data-driven approach

Ontology Evaluation

- For each concept of the ontology, it creates a path, using WordNet.
- It analyzes the ontology using these paths and breaks inconsistent links
 - Break a link
 - if one of the nodes is not in the dictionary
 - If it is in conflict with the subsumption definition
- Some orphan nodes and subtrees may be created
- Relinks these orphans to the ontology

Ontology Evaluation

- Based on using the ontology in an application and evaluating the application performance or results
- Drawbacks
 - Ontology is evaluated after it is used in the application.
 - Ontology can be only a small component of the application
 - For comparing different ontologies, they all must be plugged to the same application

Ontology Evaluation

- Multiple-Criteria approaches
 - Different criteria are defined
 - Depth
 - Extension
 - Balance
 - Richness
 - Accuracy
 - ...

Ontology Evaluation

- Conclusion
 - No single best or preferred approach
 - The choice depends on the purpose of evaluation, the application in which the ontology is being used
 - The future work should focus on automated ontology evaluation which is necessary for development of automated ontology processing techniques like ontology learning, ontology population, ...

Ontology Evaluation

- Ontology Evaluation for the Web
- Ph.D. Proposal
- University of Karlsruhe, Germany
- 2006

Ontology Evaluation

- Ontology evaluation will become an important task that must be addressed if ontologies are to be widely adopted, both in the semantic web and in other semantically enabled technologies
- EON 2006 Workshop on Ontology evaluation
- EON: Evaluation of Ontologies for the Web

Ontology Evaluation

- Usage-based evaluation: using the ontology in an application and evaluating the application
- Based on a set of decision criteria
- Based on comparison with a golden standard
 - Useful for the task of automatic learning of ontologies to evaluate the performance of the learning algorithm
- Data-driven approach

Ontology Evaluation

- Logical consistency
 - Track well-defined properties or well-described conceptual mistakes like circulation
- Manual approaches requiring trained human experts

Ontology Evaluation

- most of them do not take the context of the Semantic Web into appropriate consideration.
- What does happen to ontologies, if tools gather them, mash them together, mix them, rip them apart, and push them around? How do ontology evaluation approaches deal with partial, changing, connected, or merged ontologies?

Ontology Evaluation

- The evaluation approaches presented need to be examined with regards to their applicability to the Semantic Web.
- Based on this analysis new approaches need to be developed to extend the existing repertoire.

Ontology Evaluation

- Ontologies will be shared and distributed and will have to fulfill numerous tasks within a multitude of different contexts – e.g. an ontology developed to express social connections could also be used for identity management. Thus ontology evaluation will have to be adaptable to the context of the given task.

Ontology Evaluation

- Capturing context and allowing the evaluation to include contextual information will be necessary to provide a meaningful evaluation. This also allows to take into account dynamic properties of the context that change over time, like the size of the domain, and thus, e.g., efficiency considerations with regards to reasoning.

Ontology Evaluation

- This work will provide both a theoretical framework and a practical implementation for the context-based evaluation of ontologies for the Semantic Web.