Semiotic-Based Ontology Evaluation Tool (S-OntoEval)

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Introduction

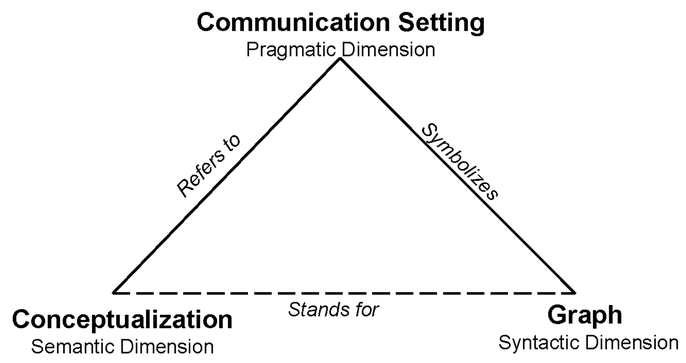
Ontology evaluation is a basis for defining what a good ontology is.

By analyzing the heterogeneous nature of works with respect to the assessment of the ontology, we could note three groups of evaluation methods assessing:

- the graph structure and formal semantics of an ontology (Guarino and Welty, 2002; Yao et al., 2005; Huang and Diao, 2006);
- the ontology's intended use (Maedche and Staab, 2002; Porzel and Malaka, 2004; Daelemans and Reinberger, 2004; Lozano-Tello and Gomez-Perez, 2004); and
- the quality level of the ontology's annotations (Noy, 2004).

These three assessment approaches are directly analogous to a semiotic assessment.

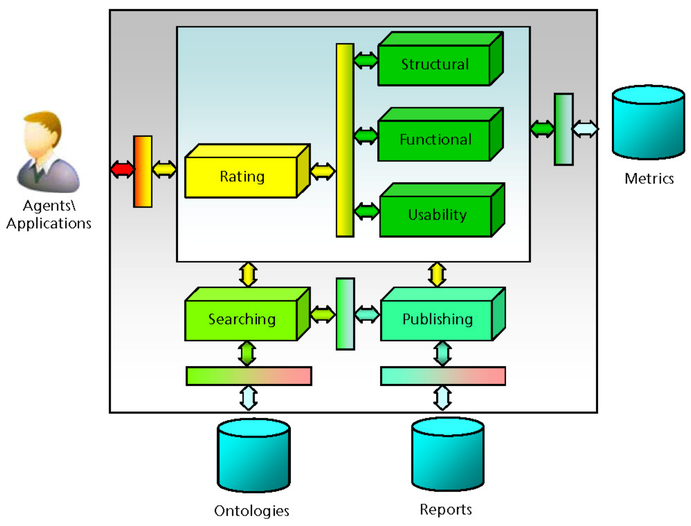
Considering an ontology is a semiotic object (see figure below), the quality of an ontology may be assessed with respect to its **graph** (structure, syntax and formal semantics), its **intended conceptualization** (cognitive semantics), and its **communication setting** (pragmatics).



Evaluation in Semiotic Levels

Our semiotic-based ontology evaluation tool (S-OntoEval) makes use of an unique evaluation framework (Dividino, 2007) which allows to assess the quality of ontologies by drawing upon semiotics.

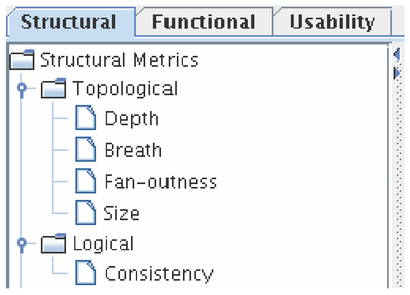
It consists of three main modules (structural, functional and usability) each of them responsible for the assessment of the ontology in one semiotic dimension.



S-OntoEval makes use of a Semantic Web framework (Java/Jena), which provides a programming environment for parsing and interpreting RDF(S) and OWL documents.

S-OntoEval

Basically, the S-OntoEval's GUI is composed of three tab windows for the evaluation at three semiotic levels, respectively.



Each tab presents specific UI components (e.g., trees) for the corresponding evaluation parameters.

Evaluation of SWIntO Use Case

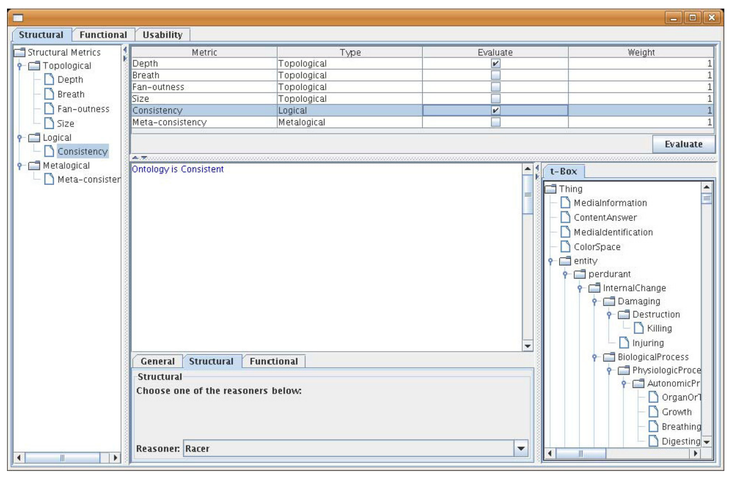
We present the semiotic-based evaluation of the SWIntO ontology (Oberle et al., 2007) developed in the SmartWeb project (Wahlster, 2007).

SWIntO integrates a selection of specific domain and task specific ontologies (navigation, sport, discourse, etc.) with a core ontology.

We evaluated two metrics at the structural level:

- **maximum depth**: provides the number of nodes that lie on the longest path of the ontology's tree.
- **consistency checking**: checks logical adequacy of the ontology model, i.e., lack of contradiction of the ontology (none of the facts deducible from the model contradict one another).

The structural evaluation below follows the **consistency checking** approach.

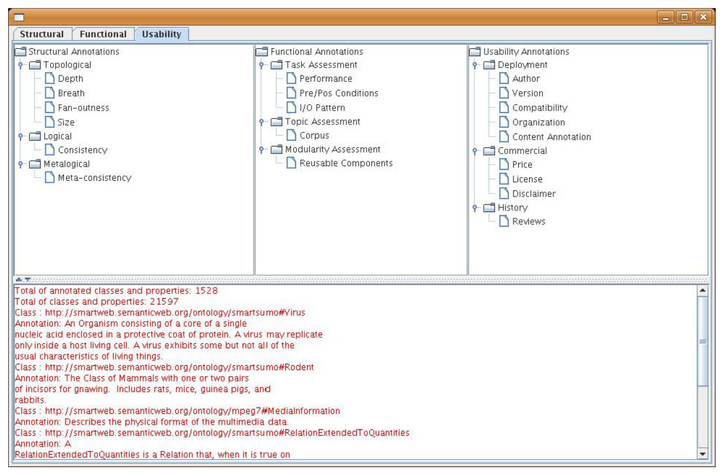


The functional evaluation follows a **task-based** approach.

The task-based approach measures the quality of the ontology with respect to its performance, given a particular task. It deals with measuring the quality of an ontology based on the adequacy of the ontological model of a specific task.

The task-based evaluation approach is a gold standard-based method which involves the creation of a validated corpus of answers for a certain task. The gold standard is used as a reference for checking the performance of an ontology driven system.

At the usability level, S-OntoEval implements the **annotation analysis** metric.



The annotation analysis consists of quantifying the number of ontology elements linked to the tag rdf:comments.

Conclusion

We looked at existing ontology evaluation methods and implemented a semiotic based evaluation tool (S-OntoEval) from the perspective of their integration into a single framework. This is achieved by basically three steps:

- firstly, the quality assessment of **ontology syntax** by making use of methods assessing the ontology's **topological dimension** and formal semantics (logical dimension);
- secondly, the **semantic dimension** by measuring the accuracy of the ontology with respect to its conceptualization (or intended use);
- and finally, its **usability dimension** by adopting approaches addressing the quality level of the set of annotations about the ontology and its elements.

In the evaluation example, we choose four metrics among others (depth, consistency checking, task-based, and annotation analysis) which we believe to be representative in any ontology evaluation process.

The S-OntoEval tool allows to combine different evaluation scores which we plan to extend to more user-specific personalized combinations. After using S-OntoEval on the SWIntO ontology, an optimized version could be deployed for usage in the project THESEUS.

References

N. Guarino and C. Welty. 2002. Evaluating ontological decisions with Ontoclean. Commun. ACM, 45(2):61–65.Yao et al., 2005

N. Huang and S. Diao. 2006. Structure-based ontology evaluation. In ICEBE '06: Proceedings of the IEEE International Conference on e-Business Engineering, pages 132–137, Washington, DC, USA

A. Maedche and S. Staab, 2002. Measuring similarity between ontologies. Springer, Madrid, Spain

R. Porzel and R. Malaka. 2004. A task-based approach for ontology evaluation. In Proceedings of the ECAI 2004 Workshop on Ontology Learning and Population, Valencia, Spain, August

W. Daelemans and M. Reinberger. 2004. Shallow text understanding for ontology content evaluation. IEEE Intelligent Systems, 19(4):1541–1672

A. Lozano-Tello and A. Gomez-Perez. 2004. Ontometric: A method to choose the appropriate ontology. Journal of Database Management, 15:1–18

N. Noy. 2004. Evaluation by ontology consumers. IEEE Intelligent Systems, 19(4):74–81

W. Wahlster, 2007. 40 Jahre Informatikforschung in Deutschland, chapter SmartWeb: Ein multimodales Dialogsystem für das semantische Web. Springer, Heidelberg, Berlin

D. Oberle, et al. 2007. DOLCE ergo SUMO: On Foundational and Domain Models in the Smartweb Integrated Ontology (SWIntO). Web Semant., 5(3):156–174

R. Dividino. 2007. Semiotic-based ontology evaluation tool. Master's thesis, Universität des Saarlandes

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