



Knowledge Sharing and Reuse: Ontologies and Applications

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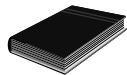
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Outline

- **Cyc Project**
- **Ontologies and KBS**
- **Ontologies used in NLP projects:**
 - **Penman, Komet, TechDoc, AlFresco, GIST, OntoGeneration**
- **Ontologies and Knowledge Management:**
 - **The (KA)2 initiative**
 - **OntoAgent**
- **Comet and Cosmos**
- **Plinius**
- **Enterprise Project**

Why is it difficult to use existing ontologies?

1. **No standardized identifying features that characterize ontologies from the user point of view**
2. **Ontology content formalization differs depending on the server at which it is stored**
3. **Ontologies at the same server are usually described with different detail levels**
4. **No web sites using the same logical organization, presenting relevant information about ontologies**
5. **The search for appropriate ontologies is hard, time-consuming and usually fruitless.**



Arpírez, J; Gómez-Pérez, A.; Lozano, A.; Pinto, S. *(ONTO)2Agent: An ontology-based WWW broker to select Ontologies*
Workshop on Applications of ontologies and Problem Solving Methods. ECAI'98.

Features to characterize and compare ontologies

The kind of questions we are trying to answer are:

- **Which are the languages in which an ontology is available?**
- **Which are the mechanisms for interacting with the ontology?**
- **What is the knowledge representation formalism used?**
- **What is the infrastructure cost needed to use the ontology?**
- **What is the cost of the ontology?**
- **Is the ontology well documented?**
- **Was it evaluated from a technical point of view?**

Uses of Ontologies

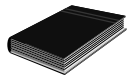
COMMUNICATION between people and organizations

INTER-OPERABILITY between systems:

translation of modeling methods, paradigms, languages and software tools

Systems Engineering

- **Re-usability/sharability:** formal representations are shared in a software system
- **Search:** The ontology is used as meta-data serving as index into a repository of information
- **Reliability:** To perform consistency checking
- **Specification:** To assist the process of identifying requirements for an IT system
- **Knowledge Acquisition**



Uschold, M.; Grüninger, M. *ONTOLOGIES: Principles, Methods, and Applications*.
Knowledge Engineering Review. Vol. 11. N. 2. June. 1996.

Cyc Project

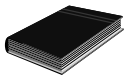


<http://www.cyc.com/>

To construct a foundation of basic common sense knowledge

Modules:

- **Cyc KB** ← **Ontology**
 - organized in microtheories
- **CycL representation language and inference engine**
 - **Declarative**
 - **Expressive**
 - **First-order Predicate Calculus**
 - **Extensions: default reasoning, equality, skolemization, second-order features**
 - **Uses circumscription**
 - **Uses the close world assumption**
- **Knowledge Server Utility**

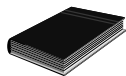
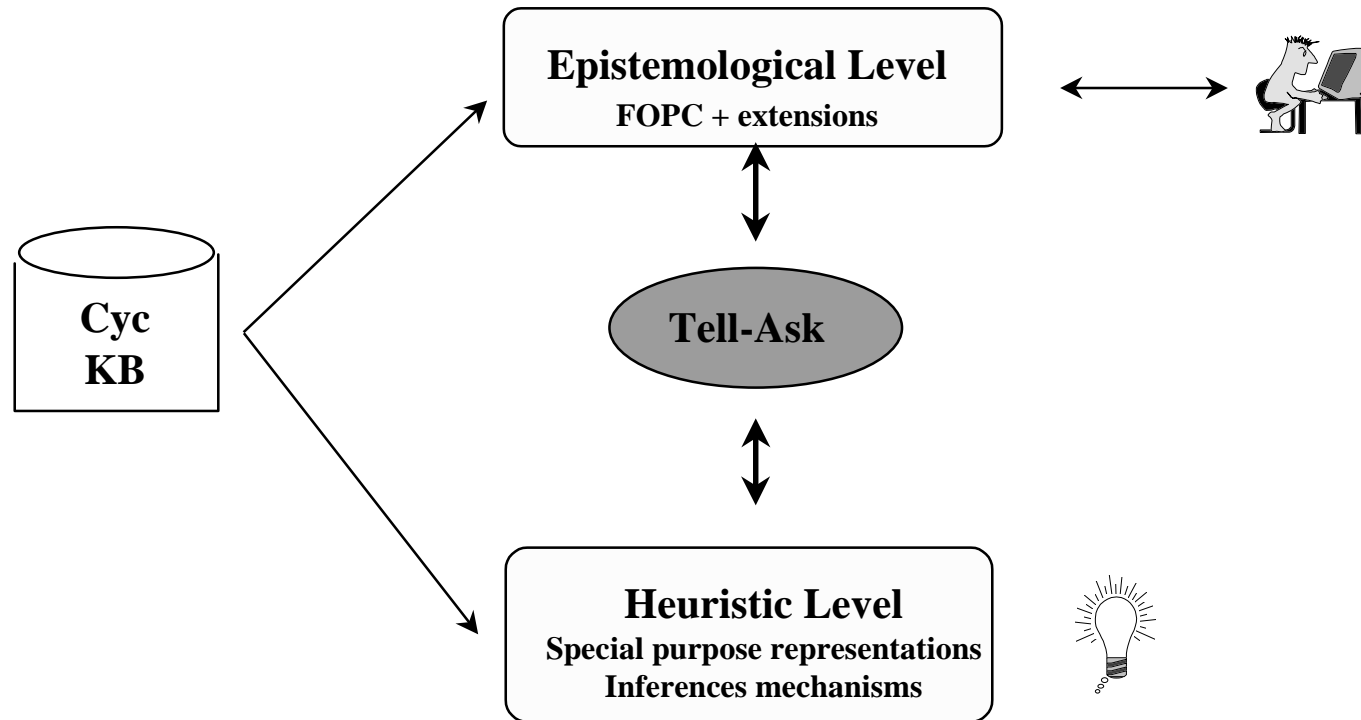


Lenat, D.B., Guha, R.V.; **Building Large Knowledge-Based Systems: Representation and Inference in the Cyc Project.**
Addison-Wesley Publishing Company, Inc. CA. 1990.

Cyc Project



<http://www.cyc.com/>



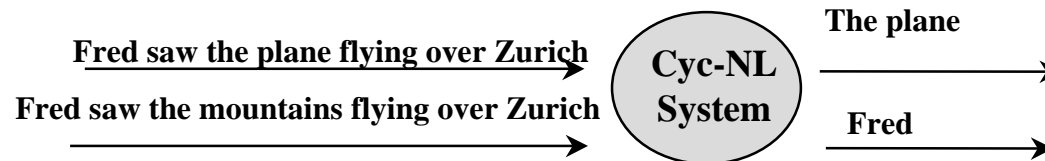
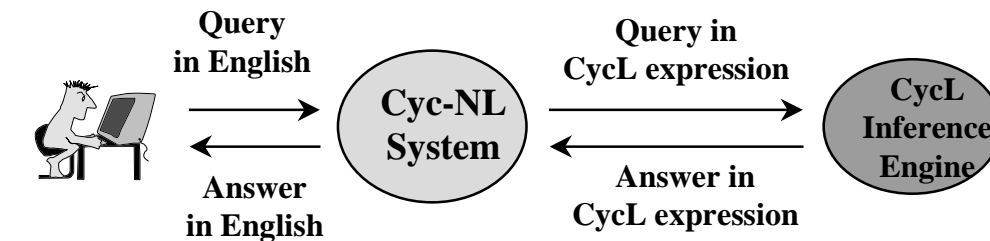
Guha, Lenat D. *Cyc: Towards Programs with Common Sense*. **Communications of the ACM**.
August .Vol 33. N.8. 1990. 32-49.

Applications that use Cyc

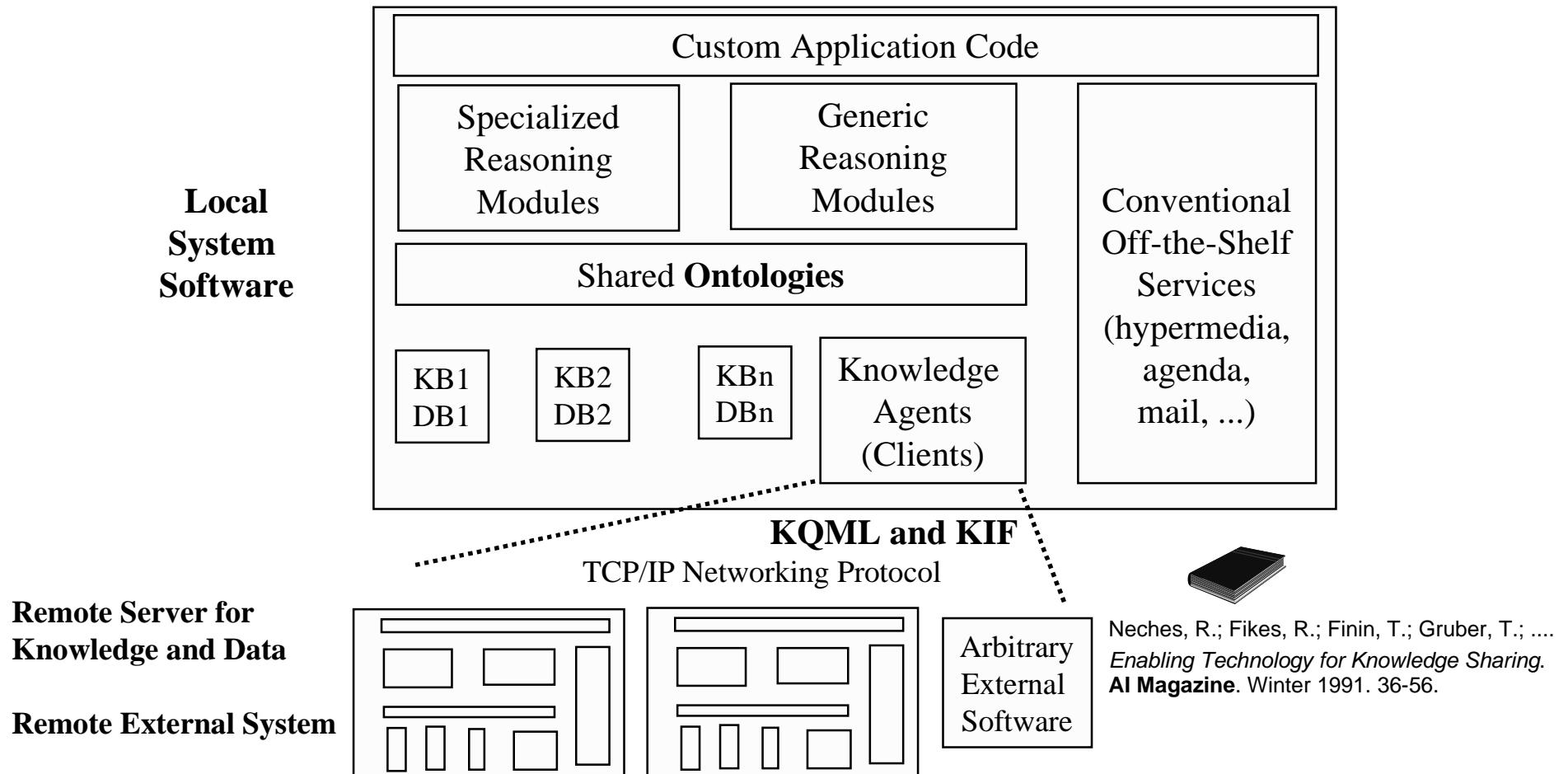
To construct a foundation of basic ~~common~~ common sense knowledge

- Data Mining
- Integration of Heterogeneous DB
- Image Retrieval
- Text Retrieval
- Natural Language Processing

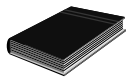
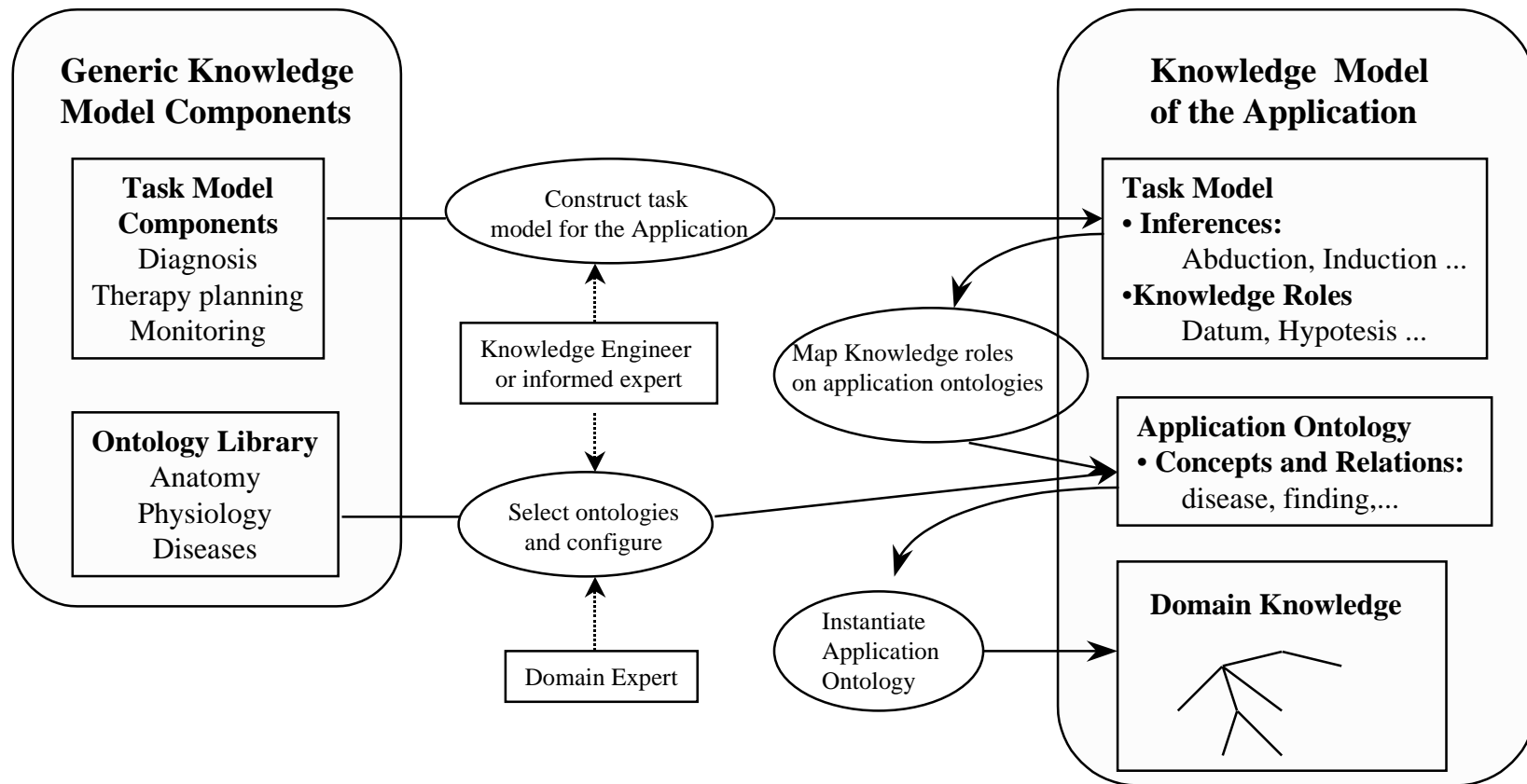
The Cyc Ontology resolves ambiguities and provides Semantic Level Knowledge



Ontologies and KBS



Ontologies and KBS

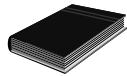


Van Heist, G.; Schreiber, T.; Wielinga, B. *Using Explicit Ontologies in KBS*
International Journal of Human-Computer Studies. Vol. 46. (2/3). 183-292. 1997

Applications that use the GUM

Natural Language Processing Applications

Penman: Generator of text in different domains



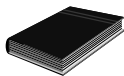
J. Bateman; R. Kasper; J. Moore; R. Whitney.
A General Organization of Knowledge for Natural Language Processing: The Penman Upper Model.
Technical Report , USC/ISI. Marina del Rey, CA. 1990

Komet: Generate texts in English, German and Dutch



<http://www.darmstad.gmd.de/publish/komet/>

TechDoc: Multilingual generation of technical texts



D. Rösner *Generating Multilingual Documents from a Knowledge Base: The TECHDOC Project.*
Technical Report FAW. FAW Ulm, Ulm (Germany). 1994.

Applications that use the GUM

AlFresco: Information retrieval in the domain of italian art history



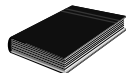
<http://ecate.itc.it:1024/projects/alfresco.html>

GIST: Multilingual system for generating bureaucratic texts in English, German and italian



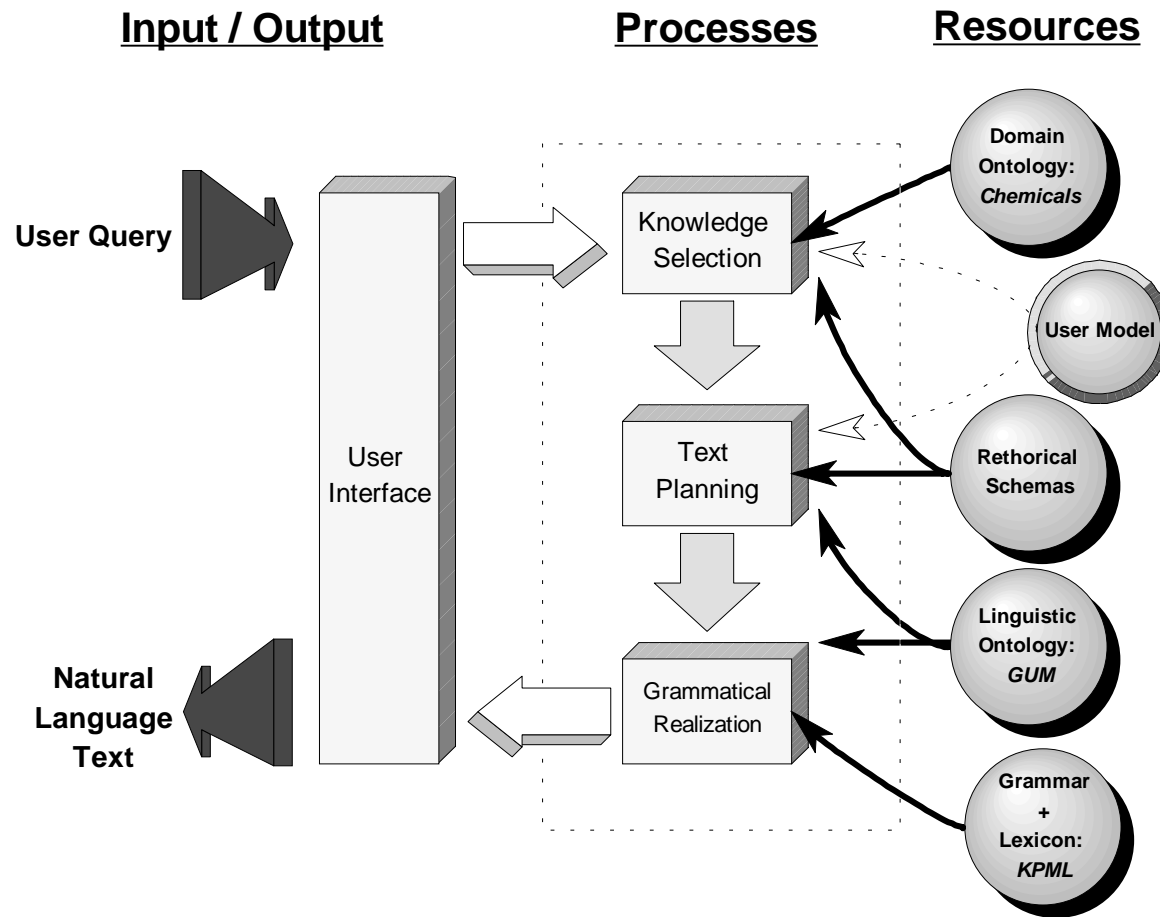
<http://ecate.itc.it:1024/projects/gist.html>

OntoGeneration: Information query and retrieval system by generating texts in Spanish using linguistic and domain ontologies

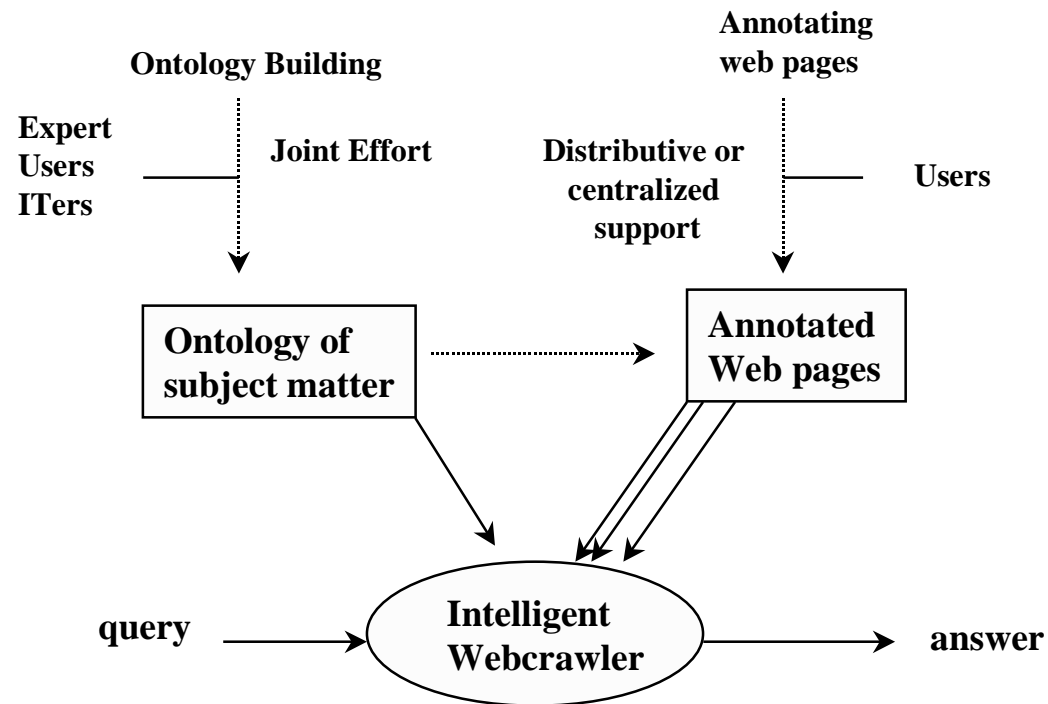


G. Aguado; A. Bañón; S. Bernardos; A. Gómez-Pérez; E. Nieto; A. Olalla; R. Romera; A. Sánchez
OntoGen: Ontologies and Natural Language Generation
Facultad de Informática. UPM. 1998.

ONTOGENERATION architecture



The (KA)² Initiative

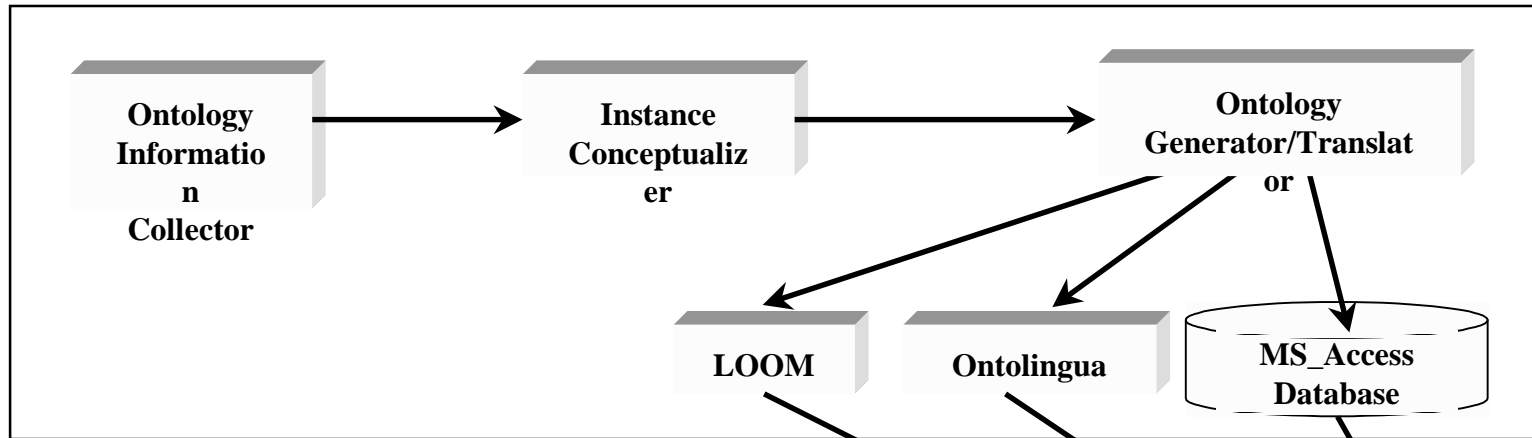


<http://www.aifb.uni-karlsruhe.de/WBS/broker/>

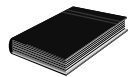
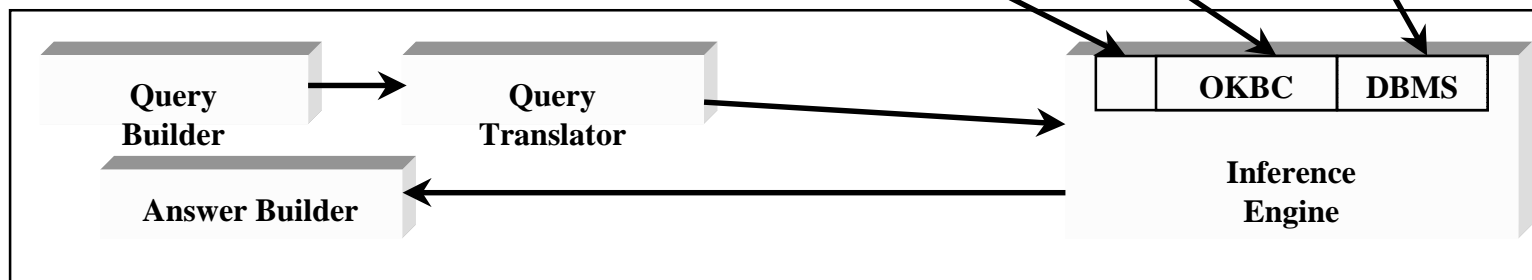
Benjamins, R.; Fensel, D.; Gómez-Pérez, A. *Knowledge Management through Ontologies*.

(Onto)²Agent Architecture

Domain Model Builder Broker



WWW Domain Model Retrieval Broker

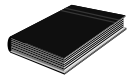


Arpírez, J; Gómez-Pérez, A.; Lozano, A.; Pinto, S. *(ONTO)2Agent: An ontology-based WWW broker to select Ontologies* Workshop on Applications of ontologies and Problem Solving Methods. ECAI'98.

Other applications

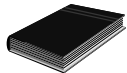
COMET supports design of software using the ontological commitment principle

COSMOS supports engineering negotiation using the ontological commitment principle



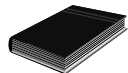
Mark, W.; Dukes-Schlossberg, J.; Kerber, R. *Ontological Commitment and Domain-Specific Architectures: Experience with Comet and Cosmos*. **Towards Very Large Knowledge Bases**. Ed. by N. Mars. IOS Press. Amsterdam. 1995. PP: 33-45

Enterprise Project for enterprise modeling



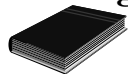
Uschold, M.; Grüninger, M. *ONTOLOGIES: Principles, Methods and Applications*. **Knowledge Engineering Review**. Vol. 11; N. 2; June 1996.

Plinius is a semi-automatic acquisition system from NL text in the domain of ceramic materials



Vet, P.; Speel, P.; Mars, N. *Ontologies for Very Large Knowledge Bases in Material Science: a Case Study*. **Towards Very Large Knowledge Bases**. Ed. by N. Mars. IOS Press. Amsterdam. 1995. PP. 73-83.

Ontologies as a semantic gateway between database schema



Dowell, M.; Stephens, L.; Bonnell, R. *Using a Domain Knowledge Ontology as a Semantic Gateway among Databases*. **IJCAI Workshop on Basic Ontological Issues in Knowledge Sharing**. Montreal, Quebec, Canada. 1995.

Conclusion

- 1. Theoretical Foundations**
- 2. Most Relevant Ontologies**
- 3. Methodologies to build Ontologies**
- 4. Tools**
- 5. Applications**

Future Trends

Theoretical Foundation

- **Criteria to measure ontologies**
- **Libraries of ontologies**

Development of ontologies

- **Use of methodologies**
- **Development of meta-ontologies**
- **Integration of meta-ontologies with domain ontologies**
- **Evaluation of ontologies**
- **Methods for integrating ontologies**
- **Methods for merging ontologies**

Tools

- **Design of ontologies**
- **Evaluation of ontologies**

Ontologies and applications