

Practical Reasoning with OWL and Rules

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So what is reasoning?



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Reasoning is . . .

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⇒ essential background technology for semantic knowledge
representation

Main tasks for backends in semantic systems:

- ontology management
- inferencing
- query answering



KAON2: OWL reasoner **and** ontology management API

- Reasoner optimised for large ABoxes
- API for ontology manipulation and serialisation
- Database bindings
- DIG and SPARQL interfaces

Binaries available from <http://kaon2.semanticweb.org>

Reasoning Support in KAON2

- Supported language: OWL DL without *enumerated classes* (nominals) but with *qualified cardinality restrictions*.
- Algorithm not based on tableau method
- Using first-order resolution calculus

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KAON2 computes inferences in two processing steps:

OWL DL ABox

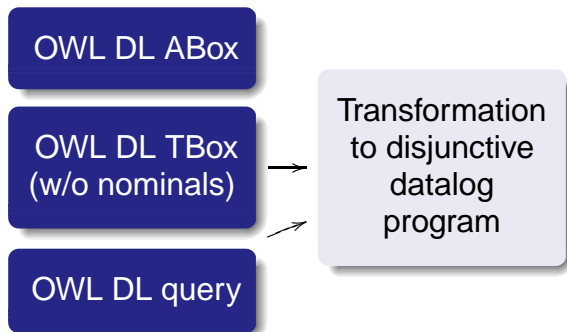
OWL DL TBox
(w/o nominals)

OWL DL query

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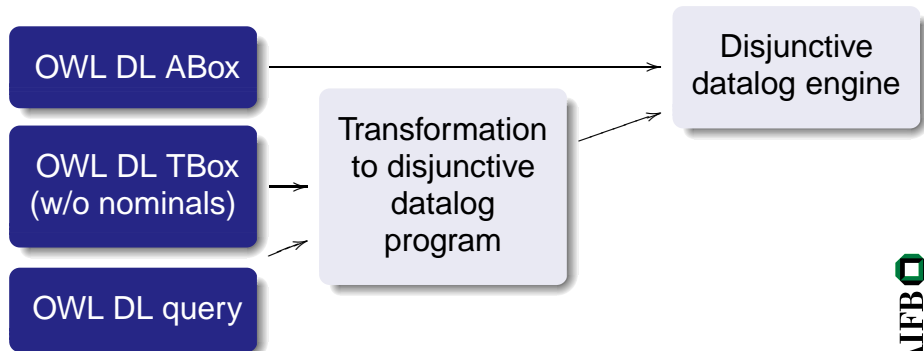
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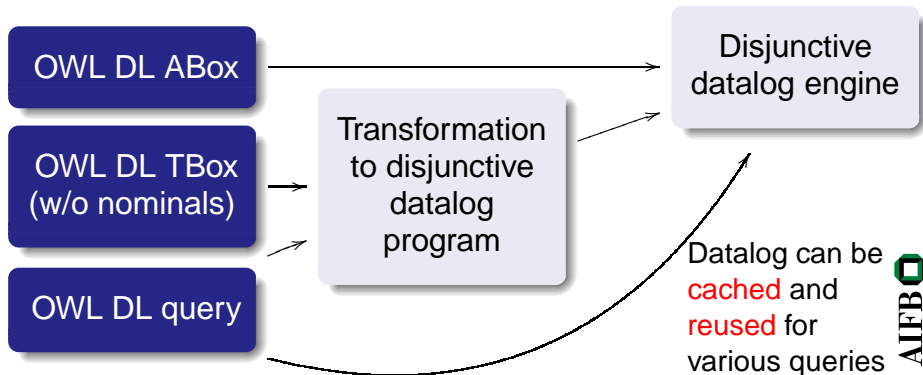
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KAON2 computes inferences in two processing steps:



Recall: $P \subseteq NP$

Recall: $P \subseteq NP \subseteq PSPACE$

Recall: $P \subseteq NP \subseteq PSPACE \subseteq EXPTIME$

KAON2 Complexity and Performance

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- 1 Process query and TBox to obtain disjunctive datalog $\rightsquigarrow EXPTIME$
- 2 Add ABox
- 3 Use Datalog reasoner for query answering $\rightsquigarrow NP$ (w.r.t. ABox)

Features

- TBox translation not necessary for every query
- Datalog-reasoning exploits well-known optimisation strategies (e.g. *magic sets*)
- Data complexity is NP
- Overall algorithm is worst-case optimal (EXPTIME)

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↪ Investigation of **tractable fragments** of OWL

- OWL Lite is not suitable (EXPTIME)
- Proposed languages: DL Lite (LOGSPACE), \mathcal{EL}^{++} (PTIME), Horn-*SHIQ* (PTIME for instance data)
- KAON2 supports Horn-*SHIQ*: precompile ontology to Datalog program (no disjunctions)
↪ suitable for non-trivial ontologies with large ABoxes

Various proposals for Semantic Web rule languages:

- First-Order Logic: SWRL
- Logic Programming: F-Logic, Prolog, WRL, ...

↔ partially reconciled in various approaches

Tutorial tomorrow: **“Answer-Set Programming for the Semantic Web”**

↔ rule interchange format under development (W3C RIF)

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Rules in KAON2

- support for decidable fragment of SWRL: **DL-safe rules**
- intuition: restrict SWRL rules to *known individuals*
- no increase of reasoning complexity

Ontology engineering environment – www.neon-toolkit.org

- Supports the lifecycle of networked ontologies
 - Modeling
 - Collaboration
 - Integration/modularization of ontologies
 - Verification/testing
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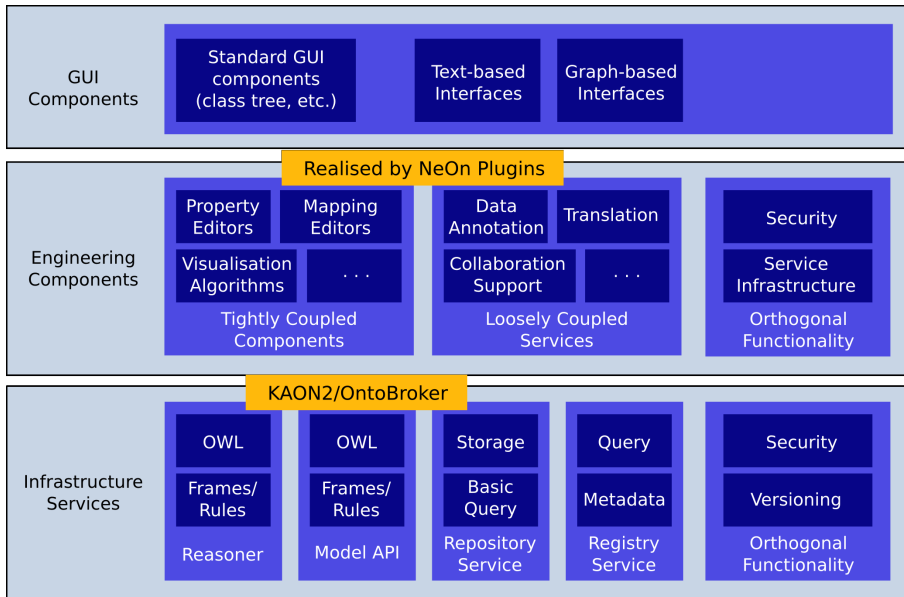


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- Dual language approach
 - Frame-like modeling with FLogic rules
 - OWL DL modeling



NeOn Toolkit Architecture



Querying Ontologies

How to query OWL ontologies?

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Conjunctive queries

The knowledge base can be queried for conjunctions of

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KAON2 support: conjunctive queries for *known* individuals

↪ similar to DL-safe rules

Conjunctive queries for OWL DL and OWL 1.1: current research



KAON2

- Ontology management and reasoning for (part of) OWL
- Partial support for *SWRL rules* and *conjunctive queries*
- Free for non-commercial use – commercial support by *ontoprise*

<http://kaon2.semanticweb.org>

NeOn Toolkit

- Novel ontology engineering environment
- **Official launch: next week at ESWC!**

4th June 2007, 18:20

Congress Center Innsbruck, Freiburg Hall, 3rd floor

<http://www.neon-toolkit.org>

Future work

- Tractable OWL variants
- Improved querying for OWL
- OWL 1.1