From $\mathcal{EL}$ to Tractable Existential Rules with Complex Role Inclusions

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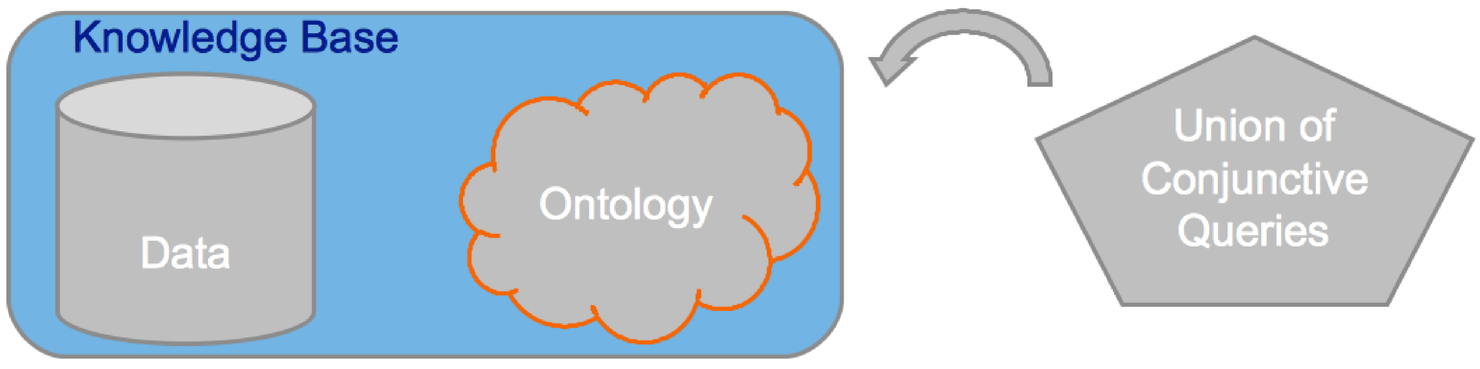
Ontology-Based Data Access (OBDA)



Representing Ontologies

- Description Logics: disjunction, negation,. . .

$$\exists R.C \sqsubseteq B$$

- **Existential Rules:** any arity, cyclic dependencies on variables

$$\forall x\, \forall y\, r(x, y) \wedge c(y) \rightarrow b(x)$$

Decidable Classes for Existential Rules

AC_0 NLOGSPACE	P NP	P 2-EXPTIME
DL-Lite$_{\text{core}}$	$\mathcal{EL}$	Horn-$\mathcal{SROIQ}$
Linear TGDs	Frontier-1	General Rules
AC_0 PSPACE	P 2-EXPTIME	Undecidable

Contribution

A class of existential rules "tightly" covering $\mathcal{EL}$ (namely, *orientable rules*)

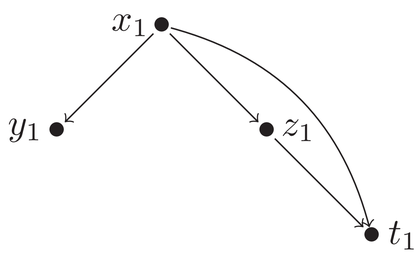
A worst-case optimal adaptation of the algorithm of [KR12] for that class

A generalization with complex role inclusions

An Example of Orientable Rules

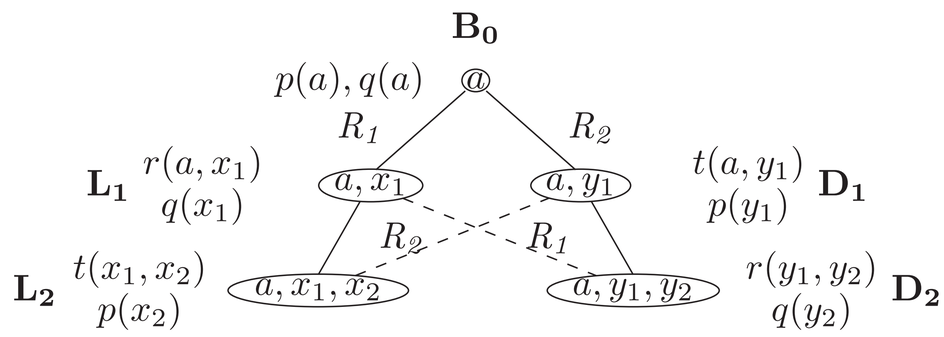
Let $\mathcal{R} = \{R_1, R_2\}$ with:

- $R_1 = \forall x_1 \forall y_1\ (r(x_1, y_1) \wedge p(y_1) \rightarrow \exists z_1 \exists t_1\ q(x_1, z_1, t_1) \wedge s(z_1, t_1))$
- $R_2 = \forall x_2 \forall y_2 \forall z\ (q(x_2, y_2, z_2) \wedge s(y_2, z_2) \rightarrow \exists t_2\ v(x_2, t_2) \wedge r(t_2, t_2) \wedge p(t_2))$



Or any set of so-called $\mathcal{EL}$-rules.

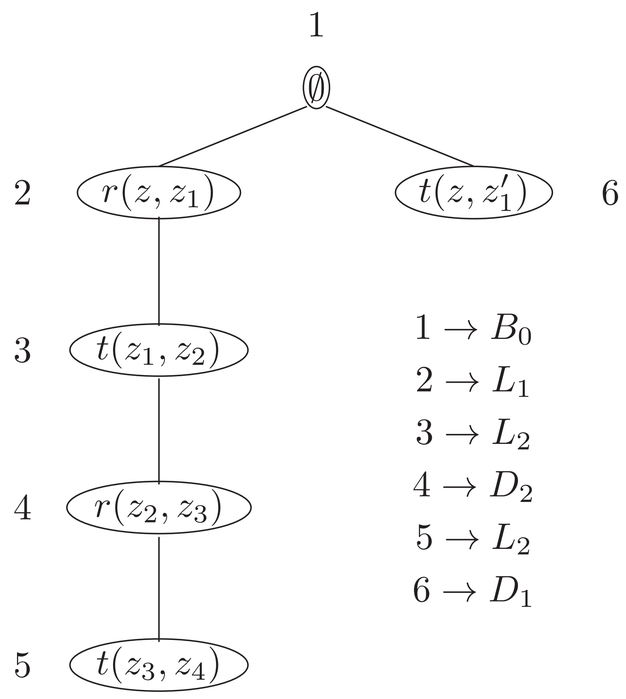
A Finite Representation of an Infinite Tree Decomposition



We have taken $F = \{p(a), q(a)\}$ and the following $\mathcal{EL}$-rules:

- $p(x) \rightarrow r(x, y) \wedge q(y)$
- $q(x) \rightarrow t(x, y) \wedge p(y)$

The Querying Operation: $*$-homomorphism



Adding Complex Role Inclusion

Modification of the $*$-homomorphism to take complex role inclusions into account

Similar regularity condition as in $\mathcal{SROIQ}$

Synthetic map