

Handling Cyclic Conjunctive Queries

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Query containment for conjunctive queries is the problem of checking whether a query q is contained in another query q' with respect to a given Description Logic schema \mathcal{S} . It is known that query containment can also be used to answer queries. Query containment is important in many areas, including information integration, query optimisation, and reasoning about Entity-Relationship diagrams, while query languages that allow the use of variables and individuals in a query, such as conjunctive queries, become a more and more important topic in the area of ontology development and the Semantic Web.

We analyse an existing conjunctive query containment algorithm [1] for \mathcal{DLR}_{reg} and highlight cases, where cyclic queries are not handled correctly. The suggested improvements for \mathcal{DLR} [2] are not enough for \mathcal{DLR}_{reg} . The main problem is that the algorithm depends on a strict tree-model property, which can be disturbed by transitivity, inverse roles or the role hierarchy. E.g., consider the boolean query $q: \langle \rangle \leftarrow \mathbf{a}: \exists[\$1]\mathbf{s}$, with \mathbf{a} a constant and the cyclic boolean query $q': \langle \rangle \leftarrow \mathbf{s}(\langle \mathbf{x}, \mathbf{y} \rangle) \wedge \mathbf{t}_{\$2, \$1}(\langle \mathbf{y}, \mathbf{x} \rangle)$ with \mathbf{x} and \mathbf{y} existentially quantified variables and let \mathcal{S} be $\{\mathbf{s} \sqsubseteq \mathbf{t}\}$ for \mathbf{s}, \mathbf{t} roles of arity 2. Since \mathbf{x} and \mathbf{y} are only existentially quantified, $\mathcal{K} \models q \sqsubseteq q'$. However, Calvanese et al. argue that cycles cannot be expressed in the schema itself and therefore the variables in q' have to be replaced by constants or variables from q , i.e., \mathbf{a} here. As a result, the algorithm answers $\mathcal{K} \not\models q \sqsubseteq q'$. There are more examples, e.g., for transitivity, to support this claim.

References

- [1] D. Calvanese, G. De Giacomo, and M. Lenzerini. On the decidability of query containment under constraints. In *17th ACM SIGACT-SIGMOD-SIGART Symposium on Principles of Database Systems*, 1998.
- [2] I. Horrocks, U. Sattler, S. Tessaris, and S. Tobies. How to decide query containment under constraints using a description logic. In *7th Int. Conf. on Logic for Programming and Automated Reasoning*, 2000.

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