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Fig. 1

Consistent query answering for inconsistent databases is a running problem...

CCS Concepts: • Information systems → Database design and models; Database query processing.

Additional Key Words and Phrases: Answer Set Programming, Consistent Query Answering

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1 INTRODUCTION

The aim of this article is to present a fair comparison between two methods for solving the problem of CERTAINTY(q). Considering an inconsistent database, a repair is a maximal set of tuples from this database that respects his constraints. The CERTAINTY(q) problem consists in answering the question of knowing if it exists a repair that falsifies the query. Depending on the query, the CERTAINTY(q) problem can be either in first order complexity class, or in NP or co-NP. For the queries that are in first order, we want to compare the efficiency of the generate-and-test method and of the first order rewriting method.

To make a one to one comparison with the results found by Akhil A.Dixit and Phokion G.Kolaitis in their "A SAT-Based System for Consistent Query Answering", we decided to reuse the same FO-rewritable queries they used to prove that the KW-fo rewriting can be more efficient by using ASP instead of SQL.

2 CHOSEN QUERIES

```
q_{1}(z) := \exists x, y, v, w(R_{1}(\underline{x}, y, z) \land R_{2}(\underline{y}, v, w))
q_{2}(z, w) := \exists x, y, v(R_{1}(\underline{x}, y, z) \land R_{2}(\underline{y}, v, w))
q_{3}(z) := \exists x, y, v, u, d(R_{1}(\underline{x}, y, z) \land R_{3}(\underline{y}, v) \land R_{2}(\underline{v}, u, d))
q_{4}(z, d) := \exists x, y, v, u(R_{1}(\underline{x}, y, z) \land R_{3}(\underline{y}, v) \land R_{2}(\underline{v}, u, d))
q_{5}(z) := \exists x, y, v, w(R_{1}(\underline{x}, y, z) \land R_{4}(\underline{y}, v, w))
q_{6}(z) := \exists x, y, x', w, d(R_{1}(\underline{x}, y, z) \land R_{2}(\underline{x'}, y, w)) \land R_{5}(\underline{x}, y, d)
q_{7}(z) := \exists x, y, w, d(R_{1}(\underline{x}, y, z) \land R_{2}(y, x, w) \land R_{5}(\underline{x}, y, d))
```

3 FIRST QUERY

```
certainty (Z): -r1(X,Y,Z), not p0(X,Z), not p1(x).

p0(X,Z): -r1(X,Y,Z1), r1(X,\_,Z), not Z=Z1.

p1(X): -r1(X,Y,Z1), not p2(Y).

p2(Y): -r2(Y,V,W).
```

#show certainty/1.

4 SECOND QUERY

```
\label{eq:certainty} \begin{array}{l} \text{certainty}\,(W,Z)\!:=\!r1\,(X,Y,Z)\,,\,\text{not}\,\,p0\,(Z,X)\,,\,\text{not}\,\,q0\,(W,X)\,,\,\,r2\,(P\,,Q,W)\,.\\ p0\,(Z\,,X)\!:=\!r1\,(X\,,Y\,,Z1)\,,\,\text{not}\,\,Z1\!=\!Z\,,\,r1\,(X\,,_{\,\,\,\,\,\,\,\,},Z)\,.\\ q0\,(W,X)\!:=\!r1\,(X\,,Y\,,Z1)\,,\,\text{not}\,\,q1\,(W,Y)\,,\,\,\,r2\,(P\,,Q,W)\,.\\ q1\,(W,Y)\!:=\!r2\,(Y\,,V\,,W)\,,\,\text{not}\,\,q2\,(W,Y)\,.\\ q2\,(W,Y)\!:=\!r2\,(Y\,,V\,,W1)\,,\,\text{not}\,\,W1\!=\!W,\,r2\,(Y\,,_{\,\,\,\,\,\,},W)\,. \end{array}
```

#show certainty/2.

5 FOURTH QUERY

Generate-and-test method. (Does not work yet).

```
1 \{ rr1(X,Y,Z) : r1(X,Y,Z) \} 1 :- r1(X,\_,\_).
```

```
1 \{ rr4(X,Y,Z) : r4(X,Y,Z) \} 1 :- r4(X,Y,).
197
                                                                                               246
198
                                                                                               247
199
                                                                                               248
     :- rr1(X,Y,Z), rr4(Y,V,W).
200
                                                                                               249
       FO rewriting
201
                                                                                               250
     p(X,Z) := r1(X,Y,Z2), Z2!=Z, r1(X,Y2,Z).
202
                                                                                               251
      t(X) := r1(X,Y,Z), \text{ not } q(Y).
203
204
     q(Y) : - r4(Y, V, W).
                                                                                               253
205
     answer(Z): - r1(X,Y,Z), not p(X,Z), not t(X).
                                                                                               254
206
                                                                                               255
207
                                                                                               256
     #show answer/1.
208
                                                                                               257
209
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     6 SEVENTH QUERY
210
                                                                                               259
     FO rewriting
211
                                                                                               260
      certainty (Z) := \text{not } d1(Z,Y), r2(Y,X,W), r1(X,Y,Z).
212
                                                                                               261
     d1(Z,Y) := not d2(Z,Y,X,W), r2(Y,X,W), r1(X,Y,Z).
213
                                                                                               262
214
     d2(Z, Y, X, W) := not d3(Z, Y, X, W), r2(Y, X, W), r1(X, Y, Z).
                                                                                               263
215
     d3(Z,Y,X,W) := r2(Y,X,W), \text{ not } d4(Z,Y,X,W,P,Q), r1(X,P,Q), r1(X,Y,Z).
     d4(Z,Y,X,W,P,Q) := r1(X,P,Q), P=Y, r2(Y,X,W), Q=Z, d5(Z,Y,X,W).
217
     d5(Z,Y,X,W) := r5(X,Y,D), \text{ not } d6(Z,Y,X,W), r2(Y,X,W), r1(X,Y,Z).
218
                                                                                               267
     d6(Z,Y,X,W) := not d7(Z,Y,X,W,P,D), r2(Y,X,W), r5(X,P,D), r1(X,Y,Z).
219
                                                                                               268
     d7(Z,Y,X,W,P,D) := r2(Y,X,W), r5(X,Z_{5_0},D), r1(X,Y,Z), P=Y.
220
                                                                                               269
221
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     #show certainty/1.
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     ACKNOWLEDGMENTS
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