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Foundations of Query Languages
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7. Exercise Set: Assorted Topics

Exercise 1
Consider the join expression $BCD \bowtie CDE \bowtie DEG$.

a) Compute the associated hyper graph and apply the *GYO*-algorithm. Provide all intermediate results of the algorithm and finally show that it yields the empty hyper graph.

b) Draw all possible join trees.

c) Show that the following instances are pairwise consistent.

B	C	D
b_1	c_1	d_1
b_1	c_2	d_1

C	D	E
c_1	d_1	e_1
c_2	d_1	e_2

D	E	G
d_1	e_1	g_1
d_1	e_2	g_1

d) Derive the full reducers from the join trees (hint: exploit the fact that the relevant information of the *GYO*-algorithm is implicitly encoded in the join trees) and apply them to the instance above.

e) List the expressions that can be derived from the join trees. Evaluate these expressions on top of the sample instance above and compare the result with $(BCD \bowtie DEG) \bowtie CDE$.

Exercise 2
Show that the database schema $R = \{R_1[AB], R_2[BC], R_3[AC]\}$ has no full reducer.

Exercise 3
Let E(*src*,*dest*) denote the edge relation of a directed graph and consider the following three Conjunctive Queries.

$$Q_1 : \texttt{ans(X,Y)} \text{ :- } \texttt{E(X,Y), E(Y,Z)}$$
$$Q_2 : \texttt{ans(X,Y)} \text{ :- } \texttt{E(X,W), E(W,Y)}$$
$$Q_3 : \texttt{ans(X,Y)} \text{ :- } \texttt{E(X,Y), E(X,U), E(U,Y)}$$

a) Check if $Q_i \sqsubseteq Q_j$ forall $i \neq j$, $1 \leq i \leq 3$, $1 \leq j \leq 3$. Whenever containment does not hold for a pair of queries, provide a sample instance that proves violation.

b) Show that $\{Q_1, Q_2\} \equiv \{Q_1, Q_2, Q_3\}$ holds.

Exercise 4
Consider the infinite sequence of conjunctive queries $Q_1, Q_2, \ldots$, where

$$Q_i\text{: } \texttt{ans(X)} \leftarrow \texttt{arc}(X,Z_1), \texttt{arc}(Z_1,Z_2), \ldots, \texttt{arc}(Z_{i-1},Z_i), \texttt{arc}(Z_i,X)$$

Q_i represents a cycle of length $i + 1$ in a directed graph with edge relation `arc`. Which containment relationships exist between the Q_i? Hint: if a containment relationship does not hold, then you do not need to prove this.

Due by: June 16, 2010 before the tutorial starts.