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Advanced Databases and Information Systems
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10. Sheet: Conjunctive Queries

Exercise 1 (Evaluation of conjunctive queries)
Consider the following sample instantiation $\mathcal{I}$ of a database.

Sales	*PName*	*SName*	*CName*
	Audi A7	Autohaus Wenz	Meier
	Audi A8	Autohaus Klein	Meier
	Audi A8	Autohaus Wenz	Smith
	Suzuki GSX	Motorsport AG	Hofmann

Part	*PName*	*Type*
	Audi A8	Auto
	Audi A7	Auto
	Suzuki GSX	Motorrad

Cust	*CName*	*CAddr*
	Meier	Freiburg
	Smith	Freiburg
	Hofmann	Mannheim

Supp	*SName*	*SAddr*
	Autohaus Wenz	Freiburg
	Autohaus Klein	Mannheim
	Motorsport AG	Mannheim

Compute the evaluation result of the following queries on instance $\mathcal{I}$ and informally describe their meaning. Note that constants inside the queries are distinguished by *italic* font.

a) q_1: ans(C) ← Sales(P,S,C), Cust(C,*Freiburg*), Supp(S,*Freiburg*)

b) q_2: ans(S,P) ← Sales(P,S,*Meier*), Supp(S,*Mannheim*), Part(P,*Auto*)

c) q_3: ans(S,P) ← Sales(P,S,*Meier*), Supp(S,*Mannheim*), Part(P2,*Auto*)

d) q_4: ans(C1,C2) ← Cust(C1,*Freiburg*), Cust(C2,*Freiburg*), Sales(P1,S1,C1), Sales(P2,S2,C2), Supp(S1,X), Supp(S2,X)

Exercise 2 (Containment)
Consider the following pairs of Conjunctive Queries and decide for each pair q_i, q_i' if $q_i \sqsubseteq q_i'$, $q_i' \sqsubseteq q_i$, and $q_i \equiv q_i'$ holds. If such relationships hold provide the corresponding containment mappings. Otherwise, show that no such mapping exists.

a) q_1: ans(X,Y) ← R(X,Z), R(Z,T), S(T,Y) und q_1': ans(X,Z) ← R(X,X), S(X,Z)

b) q_2: ans(X) ← R(X,Y), S(Y,Z), S(Y',Z') und q_2': ans(Y) ← S(A,B), R(Y,A), R(Y',A)

c) q_3: ans(U,Z) ← R(U,V), R(X,Y), S(Y,Z), S(V,X) und q_3': ans(U,V) ← R(Y,U), R(U,X), S(U,V), S(X,Y)

Exercise 3 (Containment)
Consider the following pairs of Conjunctive Queries and decide if $q_i \sqsubseteq q_i'$, $q_i' \sqsubseteq q_i$, and $q_i \equiv q_i'$ hold using the method of the canonical instance.

a) q_1: ans(X) $\leftarrow$ R(X,Y,X), R(X,Z,Y), S(Y,X) und q_1': ans(X) $\leftarrow$ R(X,Y,Z), S(Y,Z)

b) q_2: ans(X) $\leftarrow$ R(X,Y), R(Y,Z), R(Z,X) und q_2': ans(X) $\leftarrow$ R(X,Y), R(Y,Z), R(Z,U), R(U,V)

Exercise 4 (NP-Completeness)
Prove the Conjunctive Query Containment problem is NP-Complete. To show NP-Hardness, you need to find an NP-Complete problem and make a reduction to the containment problem.