Theory I - Exercise sheet 6

Submission due **Tuesday, July 21**

Exercise 1: (4 points) Conjunctive Query Containment
Consider the following conjunctive queries Q and Q':

- $Q : ans(X, Y) \leftarrow R(X, Z), R(Z, T), S(T, Y)$

- $Q' : ans(X, Z) \leftarrow R(X, X), S(X, Z)$

Is Q contained in Q'? Is Q' contained in Q? Please prove or contradict these two claims with a containment mapping.

Exercise 2: (4 points) Conjunctive Query Containment
Consider the following conjunctive queries Q and Q':

- $Q : ans(X) \leftarrow R(X, Y, X), R(X, Z, Y), S(Y, X)$

- $Q' : ans(X) \leftarrow R(X, Y, Z), S(Y, Z)$

Use the method of canonic instances to prove, that Q is contained in Q'.

Exercise 3: (6 points) Serializability of Schedules
Consider the following schedule S:

$$
S : \quad
\begin{array}{llllllll}
T_1 : & & & R(X) & & W(Y) & & \\
T_2 : & & & & R(Y) & & W(Y) & \\
T_3 : & R(Z) & W(Y) & & & & &
\end{array}
$$

a) Show, that S is not conflict-serializable.

b) Use the serial schedule $T_1 T_3 T_2$ to show, that S is serializable.

c) Show, that there are serializable schedules which become non-serializable if a transaction is removed.

Exercise 4: (4 points) Synchronization of Transactions
Multi-user-methods guarantee serializability for arbitrary semantics of the transactions. We assume that the semantic of the running transactions is known. We consider to following two scenarios:

a) The transactions realize the operations *search*, *insert* and *delete* of a key from a B-tree.

b) The transactions run sequences of *Increment-* and *Decrement*-operations on counters.

Sketch synchronizing methods for both cases, which guarantee serializability inside the respecting scenarios and which allows more schedules than would be allowed by a 2-phase-lock mechanism.