Assignment 4

Task 4.1 (Semijoin) (2 Points)
Let $X$ and $Y$ be sets of attributes. $\text{Rel}(X)$ is the set of all relations over $X$.
Let $r \in \text{Rel}(X)$ and $s \in \text{Rel}(Y)$, then $r \bowtie s := \Pi_X(r \bowtie s)$ is called semijoin of $r$ with $s$.

a) Compute for the relations $r$ and $s$ given in exercise 3.4: $r \bowtie s$ and $s \bowtie r$.

b) Prove for $r \in \text{Rel}(X)$ and $s \in \text{Rel}(Y)$:
   i) $r \bowtie s = r \bowtie \Pi_X(r \bowtie s)$
   ii) $r \bowtie s = (r \bowtie s) \bowtie s$
   iii) $\text{Let } r' := r \bowtie s, s' := s \bowtie r$, then holds: $r \bowtie s = r' \bowtie s'$

Task 4.2 (Relational Algebra) (2 Points)
Let $r$ and $s$ be two relations over a common set of attributes $X$ (i.e. $r, s \in \text{Rel}(X)$). Give a proof or counterexample for the following proposition:
There is no expression of relational algebra using only $r, s$ and the operators $\neg, \sigma, \pi$ and $\bowtie$, that is equivalent to $r \cup s$.

Task 4.3 (Relational Algebra and Relational Calculus) (5 Points)
The following relations are given:
- $\text{lives}$ with attributes $\text{person\_name, city and street}$, which contains for every person the location he lives,
- $\text{works}$ with attributes $\text{person\_name, company\_name and salary}$,
- $\text{located}$ with attributes $\text{company\_name and city}$, which contains the locations for every company (i.e. a company can be located in more than one city),
- $\text{boss}$ with attributes $\text{person\_name and manager\_name}$, which contains the persons that are supervised by a manager.

Define the following queries as expressions in relational algebra, tuple relational calculus and domain relational calculus:

a) Find name and city of all persons who work for the company ”Wells Fargo”.

b) Find the names of all persons, who live and work in the same city.

c) Find the names of all persons, who don’t work for ”Wells Fargo”.

\[ \text{i.e. there is no RA-expression } E \text{ such that } E = r \cup s \forall r, s \in \text{Rel}(X) \]
d) Find the names of all managers, whose company is not placed in Munich or Hamburg.

e) Find the names of all companies, that are located in the same city as "Wells Fargo".

Note: Use the following notation to describe the projection of a tuple variable \( t \) onto the attributes \( A \) and \( B \) satisfying \( \delta(t) \) in tuple relational calculus: \( \{ t(A, B) | \delta(t) \} \).

For practical experience with a relational database we offer you the opportunity to access an Oracle DB-server via a web interface. The following exercise (s) will contain tasks that can be solved using this DBMS. If you did not get an access ticket in the tutorial session on 15 November, you can obtain one at our chair office. Use the URL http://robinie.informatik.rwth-aachen.de:7783/isqlplus to enter the username and password of your access ticket. Use "testbas2" as the connection string. After logging in to the iSQL* web frontend of our Oracle test server you can create and query your own tables without disturbing other users by entering appropriate SQL expressions.