University of Helsinki, Department of Computer Science,
Introduction to Databases, exam 7.3.2001

1. Let's consider the relations $A(\underline{a},b,c)$ (cardinality n>0 tuples), $B(\underline{a \rightarrow A, d},e)$ (cardinality m>0 tuples) and $C(\underline{a \rightarrow A},d,e)$ (cardinality p>0 tuples). Notations: $\cap$ intersect, π projection, $\times$ Cartesian product, $|\times|$ join, σ selection, * natural join and $|\times[$ right outer join. An arrow indicates a foreign key and the relation it refers to.

a) Is it possible that the cardinality of $\pi_a(A)$ is less than the cardinality of $\pi_a(B)$?

b) Is it possible that the cardinality of $B \cap C$ is less than the cardinality of $B * C$?

c) What is the cardinality of $A |\times|_{A.a=B.a} B$?

d) Is it possible that the cardinality of $A |\times[_{A.a=C.a} C$ differs from the cardinality of $C|\times[_{C.a=.A.a} A$?

e) Is $B - C$ empty, if $\pi_a(B) - \pi_a(C)$ is empty?

f) Is it true, that if the cardinality of $\pi_b(A)$ is x and the cardinality of $\pi_c(A)$ is y and $x>y$, then the cardinality of $\pi_{a,b}(A)$ is bigger than the cardinality of $\pi_{a,c}(A)$? *(2 points each)*

Let's considet the following tables
```
chain(chain_id, chain_name)
cabin(cabin_id, region, size, address, chain→chain)
facilities(cabin_id, facility)
hobby_potential(cabin_id→ cabin, hobby_name, range_km)
customer(customer_id, name, address, phone)
reservation(cabin_id→cabin, year, week_number, customer_id→customer,
   date_reserved)
prices(cabin_id→cabin, year, season, price_for_week)
```
   (season= winter, spring, summer, autumn)

2. Express the following queries in SQL. Specify a proper order for the results.
a) Make a list of cabins in Heinola region the weekly price of which is less than 1200 FIM in summer 2001.
b) Make a list of unoccupied cabins in Lammi region on week 27 of year 2001.
c) Make a list of cabins in Heinola region that provide both a sauna and a barbecue and the potential for swimming within the range of 100 meters.
d) Produce the statistics of the amount of cabins in each region.
e) Which region has the most of cabins?
f) Summer season contains the weeks 22 to 33. Produce a list of cabins that are occupied for more than 80% of the summer season. *(4 points for each)*

3. The chain 'Star' has decided to equip with a fridge all their cabins that have electricity but no fridge. This is to take place before the beginning of the summer season 2001. The weekly price for the improved cabins will be increased by 50 FIM starting from the beginning of the summer season 2001. Use SQL to make the required changes in the database *(6 points)*

4. Explain the concept database transaction. Include examples in your answer. *(8 points)*

5. *NOTE: This task should be answered **only by the attendants of the final exam and by the students who want to substitute their practice points** with the point of this task (28 practice tasks, done in schedule, give the maximum of 10 points, and below that each point corresponds to about 2,5 tasks (rounded)).*

Let's consider the relation
```
Student(student_id, name, major_id, major_name, credits_achieved)
```
What is the meaning of the functional dependencies
```
major_id→major_name and major_name→major_id?
```
In this relation `student_id` determines functionally all the attributes of the relation. Is the relation in Boyce-Codd normal form? Justify your answer. *(10 points)*