CS2102 Database Systems
AY2013/14
Revision Exercises

ER and Relational Models

A chain of pharmacies has offered to give you a free lifetime supply of medicine if you design its database. Given the rising cost of healthcare, you agree. Here is the information that you gather:

- Each pharmaceutical company is identified by name and has a phone number.
- For each drug, the trade name and formula must be recorded. Each drug is manufactured by a pharmaceutical company, and the trade name identifies a drug uniquely from the other products of that company. If a pharmaceutical company is deleted, we need not keep track of its products any more.
- Each pharmacy has a name, address and phone number.
- Each pharmacy sells several drugs and has a price for each. A drug could be sold at several pharmacies, and the price could vary from one pharmacy to another.
- Pharmaceutical companies have long term contracts with pharmacies. A pharmaceutical company can contract with several pharmacies, and a pharmacy can contract with several pharmaceutical companies. For each contract, you have to store a start date, an end date, and the text of the contract.

1. Draw an ER diagram that captures the above information. Identify any constraints not captured by the ER diagram.
2. How would your design change if each drug must be sold at a fixed price by all pharmacies?
3. Translate your ER diagram to a relational schema. Give the SQL DDL statements to create the schema.

Query Languages

Consider the following relations for a parts database.

Part (<u>Pno</u>, Pname, Cost, Sname)
ComplexPart (<u>Pno</u>, LaborCost)
SubPart (<u>Pno, SubPartOf,</u> Qty)

The relation Part contains information about parts. A part could be a basic part (have no subparts) or a complex part (assembled from basic parts or other complex parts). Pno is a numeric key. Pname is the part name. Cost indicates how much the part costs when it is purchased from a supplier. Sname is the supplier name.

The relation ComplexPart contains the parts that are assembled from basic parts and other complex parts. Pno and Pname is the number key and name of the part. LaborCost is the cost of assembling the complex part.

The relation SubPart lists the parts that are subparts of other parts. Pno is a numeric key. SubPartOf is the key of the complex part that contains the subpart. Qty indicates how many of the subpart is needed for assembling the complex part.

Answer the following queries in SQL:

a. List the part numbers and part names of all basic parts whose cost is more than $10.

b. Find all the pairs of complex parts that have the same labor cost.

c. Find the names of the suppliers that supplies at least two parts, with the average cost of these parts.

Answer the following queries in relational algebra:

a. List the names of suppliers who supply all complex parts whose labor cost is more than $100.

b. List the names of suppliers who supply at least two parts.

Answer the following queries in tuple and domain relational calculus:

a. Find the name of the cheapest part.

b. Find the name of the cheapest basic part.

c. List the part numbers that are first and second level subparts of part number p200.

Schema Refinement

Consider a relation R(A, B, C, D, E, G) with the set of functional dependencies
F = { AB$\rightarrow$ C, C $\rightarrow$ A, BC $\rightarrow$ D, ACD $\rightarrow$ B, D $\rightarrow$ E, D $\rightarrow$ G, BE $\rightarrow$ C, CG $\rightarrow$ B,
CG $\rightarrow$ D, CE $\rightarrow$ A, CE $\rightarrow$ G }.

a. Find all the candidate keys of R.

b. Find an extended minimal cover of F. An extended minimal cover is a minimal cover in which we have grouped all dependencies with the same left hand side into one.

c. Is R in BCNF? Justify your answer.

d. Is R in 3NF? Justify your answer.

e. Use the algorithm learned in class and the extended minimal cover obtained, synthesize a 3NF lossless decomposition of R.