CSE–A1200 Databases

Exam May 20th, 2014 **No calculators or extra material allowed**

Students whose mother tongue is not Finnish may use a dictionary, if it does not contain any markings. Those students may also obtain both Finnish and English exam sheet, if they want.

Please write your name, your student ID, the name and the code of this course, the date, and the total number of the papers you submit on top of each paper you submit.

1. a) (8 p) A web-store selling clothes wants to contstruct a database about the products, customers, orders and bills. Construct an E/R diagram based on the following information. Use the notation used in the course text book and underline the key attributes.

   The store sells clothes, which we call products. Each type of product has a product number (unique), description (T-shirt, for example) and a manufacturer. The manufacturer has a name (unique), phone number and an address. The store usually has various sizes and colours of the same product. We call them versions. The various versions of the same product are recognized by using the size and the colour. The different versions of the same product may have different prices, but the manufacturer is always the same for the same product.

   Each customer has a customer number (unique), name, address and e-mail address. The customers make orders. An order can contain several items and even several pieces of the same version of the same product. In addition, the information about an order contains an order number (unique), date, and the status (for example, ordered / packed / posted / delivered). We assume that all items which belong to the same order are delivered together. The same customer may have several orders.

   For each order, the store sends a bill, which has a unique number. The information about the bill also contains its sum, date, due date and status (for example, sent or paid).

   b) (2 p) Convert the E/R diagram from part (a) into relations. Write the relation schemas and underline the names of the key attributes.

2. Consider the following database schema which presents departments, employees, customers and sales of a firm. The job of the employees is to sell various products or services to its customer firms.

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Employee(number, name, salary, departmentId)
Department(id, name, directorNumber)
Customer(customerId, firmName, address)
Sale(EmpoyeeNumber, customerId, date, value, description)
```

   Relation `Employee` tells the number, name and the monthly salary of an employee. It also tells the id of the department at which the person works. Relation `Department` tells the id, name and the employee number of the director of the department. Relation `Customer` tells the customer id, name and address of a customer firm. Relation `Sale` contains information of all sales where the employee of the firm has sold products or services to a customer firm. It tells the number of the employee, id of the customer firm, date of the sale, value of the sale in euros and a short description of the sale. We assume that the same employee can make at most one sale with the same customer firm on a certain day.

   The salaries of the employees and values of the sales are decimal numbers. Other attribute values are strings.You may assume that the tuples of the relations do not contain NULL values.

   Write the following SQL queries:

   a) (2 p) The numbers and names of the employees who work at the department with name `New Games` and whose salary is over 2500 euros.

   b) (2 p) The numbers and names of the employees who have made at least one sale with the firm `TAP007` (customer id), but no sales with the firm `TIR409`.

   c) (2 p) Consider all employees who have made at least one sale with the firm `Loistoteho Oy` (the name of the firm). Find all other firms with which at least one of those employees has made sales. The query should produce the names of these other firms.

   d) (2 p) Find the departments whose total value of sales (the sum of the sales made by all employees of the department) is over 50000 euros. For those departments, the query should produce the department id, name of the department, and the average value (not the sum) of the sales of this department.

Turn the paper!

Write the following queries as expressions of the relational algebra:

e) (2 p) Dates, names of the customer firms, and values of all sales whose value is over 1000 euros and which are made by the employee (or employees if there are several with the same name) with name Tiina Teekkari.

f) (2 p) The numbers and names of those employees who have made sales with exactly one customer firm (not with two or more firms).

3. Consider a relation R with schema $R(A, B, C, D, E)$ and functional dependencies $A \to B$, $B \to DE$ and $C \to E$.

   a) (1 p) Explain why this relation is not in Boyce-Codd normal form (BCNF).

   b) (6 p) Decompose the relation using the BCNF decomposition algorithm taught in this course and in the text book. Give a short justification for each new relation. Continue the decomposition until the final relations are in BCNF. Explain why the final relations are in BCNF.

4. (7 p) What are the four important properties of the transactions in a database managament system? Use a few sentences to explain each of these properties. Just listing the names of the properties and writing 1-2 sentences about each are not enough for 7 points.

5. (4 p) Assume that you have a database consisting of several relations (tables). You are selecting which indexes you should create. How do you judge which indexes are needed? Give a short example to illustrate your answer. (Your example does not have to be complete as long as it shows essential points.)

Please fill the course feedback form before June 6th. The link is given on course Noppa page.