Course ISE 322: Database Systems
Recitation 3 Exercise

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Hint: You can find the answers to the odd problems from the Ramakrishnan and Gehrke book on the internet.

1 Exercise 2.1

Explain the following terms briefly:

- attribute
- domain
- entity
- relationship
- entity set
- relationship set
- one-to-many relationship
- many-to-many relationship
- participation constraint
- overlap constraint
- covering constraint
- weak entity set
- aggregation
- role indicator

2 Exercise 2.5

Notown Records has decided to store information about musicians who perform on its albums (as well as other company data) in a database. The company has wisely chosen to hire you as a database designer (at your usual consulting fee of $2500/day).

1. Each musician that records at Notown has an SSN, a name, an address, and a phone number. Poorly paid musicians often share the same address, and no address has more than one phone.

2. Each instrument used in songs recorded at Notown has a name (e.g., guitar, synthesizer, flute) and a musical key (e.g., C, B-flat, E-flat).

3. Each album recorded on the Notown label has a title, a copyright date, a format (e.g., CD or MC), and an album identifier.

4. Each song recorded at Notown has a title and an author.

5. Each musician may play several instruments, and a given instrument may be played by several musicians.

6. Each album has a number of songs on it, but no song may appear on more than one album.

7. Each song is performed by one or more musicians, and a musician may perform a number of songs.

8. Each album has exactly one musician who acts as its producer. A musician may produce several albums, of course.

Design' a conceptual schema for Notown and draw an ER diagram for your schema. The preceding information describes the situation that the Notown database must model. Be sure to indicate all key and cardinality constraints and any assumptions you make. Identify any constraints you are unable to capture in the ER diagram and briefly explain why you could not express them.

3 Exercise 2.7

The Prescriptions RX chain of pharmacies has offered to give you a free lifetime supply of medicine if you design its database. Given the rising cost of health care, you agree. Here's the information that you gather:

1. Patients are identified by an SSN, and their names, addresses, and ages must be recorded.

2. Doctors are identified by an SSN. For each doctor, the name, specialty, and years of experience must be recorded.

3. Each pharmaceutical company is identified by name and has a phone number.

4. For each drug, the trade name and formula must be recorded. Each drug is sold by a given pharmaceutical company, and the trade name identifies a drug uniquely from among the products of that company. If a pharmaceutical company is deleted, you need not keep track of its products any longer.

5. Each pharmacy has a name, address, and phone number.

6. Every patient has a primary physician. Every doctor has at least one patient.

7. 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.

8. Doctors prescribe drugs for patients. A doctor could prescribe one or more drugs for several patients, and a patient could obtain prescriptions from several doctors. Each prescription has a date and a quantity associated with it. You can assume that, if a doctor prescribes the same drug for the same patient more than once, only the last such prescription needs to be stored.

9. 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.

10. Pharmacies appoint a supervisor for each contract. There must always be a supervisor for each contract, but the contract supervisor can change over the lifetime of the contract.

1. Draw an ER diagram that captures the preceding 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. How would your design change if the design requirements change as follows: If a doctor prescribes the same drug for the same patient more than once, several such prescriptions may have to be stored.

4 Extra Exercise

In class we discussed the basics of Entity-Relationship Diagrams (ERD). In the recitation we will do two large examples to practice the thinking and design process needed for creating ERDs.

4.1 Example 1: Incremental

We are designing a database for the college library system. The entities we need are as follows: Student, Book, Librarian, Lecturer, Course, Order.

Entities have the following attributes:

Student student id number, a name, and a birthday.

Book a title, an author, an ISBN, and a library index number

Librarian national id, name, hours per week of work

Lecturer national id, name

Course course id, number of students

Order number of books, price, book name

Let us design ERDs for each of the following relationships separately:

1. Lecturers teach courses during a given semester. (simple relationship)
2. Each student may borrow multiple books from the library at a time, but no book may be taken out by two students at the same time. (key constraint from books to students)
3. Books may be put on reserve for courses. One book can be reserved for multiple courses and multiple books may be on reserve for each course. (many to many relationship)
4. Lecturers can request librarians to order books for their courses. Lecturers can place orders for different books, but they can not order the same book in different orders. (weak entity relationship with orders, ternary relationship between lecturer, book, and order)
5. Librarians can order books and must record the purchase price. (attribute for a relationship)
6. Librarians report to a senior librarian. (reflexive librarian).
7. Students and lecturers can also be librarians, but not all librarians are students or lecturers. (inheritance without coverage)
8. Lecturers can also study in the college as students, but not all lecturers are students. (overlap)