Warmup #1  (Textbook Problem 6.5)

Let the following relational schemas be given:

\[ R = (A, B, C) \]
\[ S = (D, E, F) \]

Let relations \( r(R) \) and \( s(S) \) be given. Give an expression in the tuple relational calculus that is equivalent to each of the following:

a. \( \Pi_A(r) \)

b. \( \sigma_{B=17}(r) \)

c. \( r \times s \)

d. \( \Pi_{A,F}(\sigma_{C=D}(r \times s)) \)

Warmup #2

Consider the following database:

employee = \((\text{person name}, \text{street}, \text{city})\)
works = \((\text{person name}, \text{company name}, \text{salary})\)
company = \((\text{company name}, \text{city})\)
manages = \((\text{company name}, \text{manager name})\)

Give expressions in tuple relational calculus for each of the following queries:

a. Find the names of all employees who work for First Bank Corporation.

b. Find the names and cities of residence of all employees who work for First Bank Corporation.

c. Find the names, cities of residence, and street address of all employees who work for First Bank Corporation and earn more than $10,000.

d. Find the names of all employees in this database who live in the same city as that in which the company for which they work is located.
Warmup #3  (Textbook Problem 7.20)

Consider the E-R diagram in Figure 7.29, which models an online bookstore.

a List the entity sets and their primary keys.

b Suppose the bookstore adds Blu-ray discs and downloadable video to its collection. The same item may be present in one or both formats, with differing prices. Extend the E-R diagram to model this addition, ignoring the effect on shopping baskets.

c Now extend the E-R diagram, using generalization, to model the case where a shopping basket may contain any combination of books, Blu-ray discs, or downloadable video.

Problem 4 (To Be Graded)

In this problem you are going to design a relational database for a retailer. The retailer has the following requirements:

- The retailer has a number of regions, which represent different distribution points. Every region has a unique id, name and address (containing street, city, state and zip code).

- Every region serves a number of customers. Every customer has a unique id, first and last name, address (street, city, state and zip code) and account balance. Every customer belongs to a single region.

- Customers can make multiple orders. Every order has a unique id, date, status (“Processing”, “Paid”, “Delivered”, etc.).

- Every order contains one or more items, where each item represents something that every region sells. Each item has a unique id, name and price. An order can contain more than one of the same item. At this point you can assume that items are the same for every region.

1. Assuming the requirements above construct an E-R diagram and a relational schema for the database.

The retailer decided to change requirements as follows:

- Every region can have different items for sale now. The basic properties of the items remain the same (unique id, name, price), but now every region has its own listing of items and different regions might have different quantities for the same item in stock. Different items from the same order might be fulfilled by different regions.

- For customer service purposes the retailer decides to keep customer review records about every item. Every review contains information about the item, the customer, the order, how many stars the item was awarded (0-5), and the review comments. Each review has be related to an order to make sure customers are reviewing the items they have bought.

2. Describe the changes you have to make to the E-R diagram and the schema to accommodate the new requirements.

Note: As always, multiple designs are possible, but you should try to come up with a “better” one in a general sense. For instance, it is a better practice to avoid information duplication in a relation. Thus, putting all information about an order, including all its items, in a single relation is a bad idea.
Problem 5 (To Be Graded)

Following is the simplified schema for the database of Rhode Island State Police Highway Patrol Unit:

- Person(SSN, name, address)
- Car(license, year, model)
- Accident(license, accident_date_time, driver_ssn, damage_amount)
- Owns(SSN, license)

Where:
- Each car in an accident has a separate accident report.
- A car cannot be in multiple accidents at a given time.
- A driver_ssn can be in an accident with a car another person owns. (i.e. The driver_ssn in an accident is not always the car’s owner.)

For each of the following queries give the equivalent TRC (tuple-relational calculus) queries.

1. Find all the license plate numbers of Toyota (model) cars that have been in an accident in 2015.

2. Find all the accident reports (license plate and time) where driver is not the car owner.

3. Find the name and address of people who have been involved in an accident (as a driver) where the damages are more than $1,000.