

Additional Relational Algebra Exercises

Exercise 1

Consider the following simple banking schema:

account(acct_num, branch_name, balance)

The account relation stores the account number, the branch name and the balance (the amount of money in the account). Account numbers are unique across branches.

branch(branch_name, branch_city, assets)

The branch relation stores data about the location of a given branch of the bank and its assets, i.e., the amount of cash it can use.

customer(cstmr_name, cstmr_street, cstmr_city)

The customer relation stores data about customers, their name and address.

depositor(cstmr_name, acct_num)

The depositor relation stores the relationship between customers and account numbers.

Note that a customer might have several accounts.

loan(loan_num, branch_name, amount)

The loan relation stores the loans given by a given branch (identified by its name). Loans are identified by the loan number, and are associated to a loaned amount.

borrower(cstmr_name, loan_num)

The borrower relation stores the relationship between customers and loans.

Note that a customer might have multiple loans.

Express the following queries in relational algebra:

1. Find the customers who do not have loans in the bank where they have an account
2. Find the customers who have exactly one account and one loan
3. Find the customers that have loaned an amount lower than their balance (hint: do not forget customers without loans, i.e., customers whose loaned amount is zero)
4. Find the branch(es) with the lowest assets.

For each query, you should give concise explanations of how you obtain your result. That will help me see how much you have understood even if your answer is not correct.

Exercise 2

Consider the following schema for an hotel reservation application (the key for each relation is underlined):

city(zip int, name string, state string)

customer(cno int, firstname string, name string, zip int, address string)

hotel(hno int, name string, zip int, address string)

room(hno int, type string, price int)

reservation(rno int, cno int, hno int, type string, arrival date, departure date);

Where:

–City is identified by its zip code. It has a name and it belongs to a state

–Customer is identified by a customer number cno. Each customer has a firstname, a name. A customer comes from a city identified by its zip code (zip is a foreign key referencing city) and has an address (e.g., street name).

–A hotel is identified by its hotel number hno. Each hotel has a name. A hotel is located in a city identified by its zip code (zip is a foreign key referencing city) and has an address (e.g., street name).

–A room is identified by its room number and roomtype (rno, type). Examples of room types are double room, or single room. A price is associated with each room.

–A reservation is identified by a reservation number (rno). A reservation associates a customer (cno

foreign key referencing customer), a hotel (hno foreign key referencing hotel), a room type (hno, type foreign key referencing room). To a reservation are associated an arrival and departure date.

Express the following queries in relational algebra

1. Find the name of a city where at least 5 hotels are located
2. Find the name of all the hotels located in Los Angeles
3. Find the name of the hotels that have double rooms
4. Find the name of the customers that have had reservations in all the hotels from Los Angeles
5. Find the hotel with the most expensive room