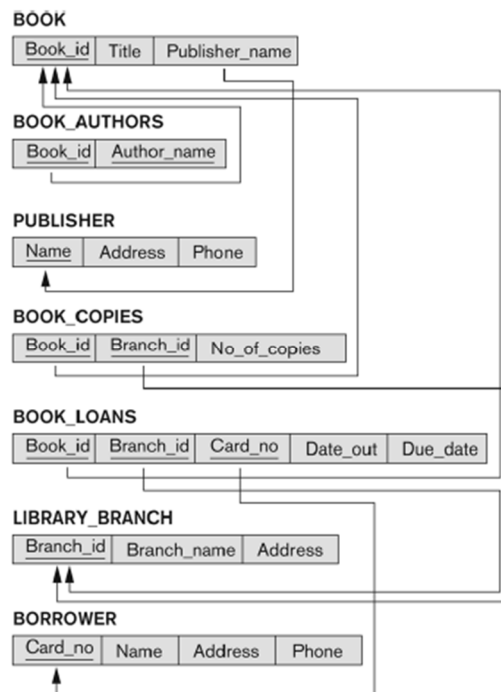


## Homework

No submissions!

1. Consider the LIBRARY relational schema shown in the following figure, which is used to keep track of books, borrowers, and book loans. Referential integrity constraints are shown as directed arcs. Write down relational algebra expressions for the following queries on the LIBRARY database:



**Figure 6.14**  
A relational database  
schema for a  
LIBRARY database.

- How many copies of the book titled The Lost Tribe are owned by the library branch whose name is "Sharpstown"?
- How many copies of the book titled The Lost Tribe are owned by each library branch?
- Retrieve the names of all borrowers who do not have any books checked out.
- For each book that is loaned out from the "Sharpstown" branch and whose DueDate is today, retrieve the book title, the borrower's name, and the borrower's address.

- (e) For each library branch, retrieve the branch name and the total number of books loaned out from that branch.
- (f) Retrieve the names, addresses, and number of books checked out for all borrowers who have more than five books checked out.
- (g) For each book authored (or co-authored) by "Stephen King", retrieve the title and the number of copies owned by the library branch whose name is "Central".

2. Download the script1 posted on the class website, run the script to create the three tables and design the following queries using PostgreSQL.

- a. Find the name(s) of the supplier(s) that haven't supplied any part.
- b. Find the names of suppliers who supply all red parts.
- c. For each part, find the name of the supplier that charges the least for that part
- d. Find the name of the supplier who supplies the most number of parts
- e. Find the names of the parts that have not been supplied by any supplier.
- f. Find the names of suppliers who supply both red parts and green parts.

3. Design the following functions and triggers based on the same database in problem 2.

- a. Given a supplier id, returns the part name of the most expensive part provided by the supplier.
- b. Given a part id, output the name of all suppliers that provide the part and the corresponding cost .
- c. Create a trigger to ensure that maximum number of parts provided by any supplier is 4.

4. Consider a relation with schema  $R(A, B, C, D)$  and a set of functional dependencies  $F: \{ AB \twoheadrightarrow D, BC \twoheadrightarrow A, CD \twoheadrightarrow B, AD \twoheadrightarrow C \}$ , answer the following questions:

a) Compute  $(CD)^+$  and  $(BD)^+$ .

b) Find all keys of  $R$ .

c) Find all super keys for  $R$  that are not keys.

5. For each of the following relation schemas and sets of FD's:

a:  $R$  is  $(A, B, C, D)$  with FD's  $D \twoheadrightarrow C, C \twoheadrightarrow B, B \twoheadrightarrow A, A \twoheadrightarrow D$ .

b:  $R$  is  $(A, B, C, D)$  with FD's  $C \twoheadrightarrow A$  and  $C \twoheadrightarrow B$ .

1) Identify candidate keys for  $R$

2) Indicate BCNF violations and decompose if necessary.

3) Indicate 3NF violations and decompose if necessary.

6. Consider a relation  $R: (A, B, C, D, E, F)$  and the FDs:  $BC \twoheadrightarrow F, DF \twoheadrightarrow E, F \twoheadrightarrow DE$ . Consider the following decomposition of  $R$ :  $R_1(A, B, C, D), R_2(B, C, E, F)$ , Check if this decomposition is lossless-join.

7. Show that  $AB \twoheadrightarrow C$  is in the closure of  $\{AB \twoheadrightarrow D, DE \twoheadrightarrow C, B \twoheadrightarrow E\}$