CS34800 HOMEWORK 2

1. (1pt) What is the difference between a procedural and non-procedural query language? Give an example for each.
2. (2 pts) Consider the tables given in Figure 1. Give the results (as tables) for the following operations.

   a. $T1 \bowtie_{T1.P=T2.A} T2$

   b. $T1 \bowtie_{T1.Q=T2.B} T2$

   c. $T1 \rtimes_{T1.P=T2.A} T2$

   d. $T1 \ltimes_{T1.Q=T2.B} T2$

   e. $T1 \bowtie_{(T1.P=T2.A\ AND\ T1.R=T2.C)} T2$

3. (3 pts) Consider the relational schema for a library database as shown in Figure 2. Provide a relational algebra expression for each of the following queries:
   a. Retrieve the names of borrowers who do not have any books checked out.
   b. For each book that is loaned out from the Sharpstown branch (i.e. branch name is Sharpstown), retrieve the book title, the borrower's name, and the borrower's address.
   c. Retrieve the names of borrowers who have checked out books from at least two different library branches.
   d. Retrieve the names of branches, which have copies of all books authored (or coauthored) by Stephen King.
   e. Retrieve the names and phone numbers of borrowers who have checked out at least one book authored (or coauthored) by Dostoevsky and (at least) one book authored (or coauthored) by Tolstoy from the library with branch_id 5.
4. (3 pts) Provide a tuple relational calculus expression for each of the queries in Question 3.
5. (3 pts) Provide a domain relational calculus expression for each of the queries in Question 3.
6. (3 pts) Provide an SQL expression for each of the queries in Question 3.

Table T1

P	Q	R
b	2	e
a	1	d
c	1	f

Table T2

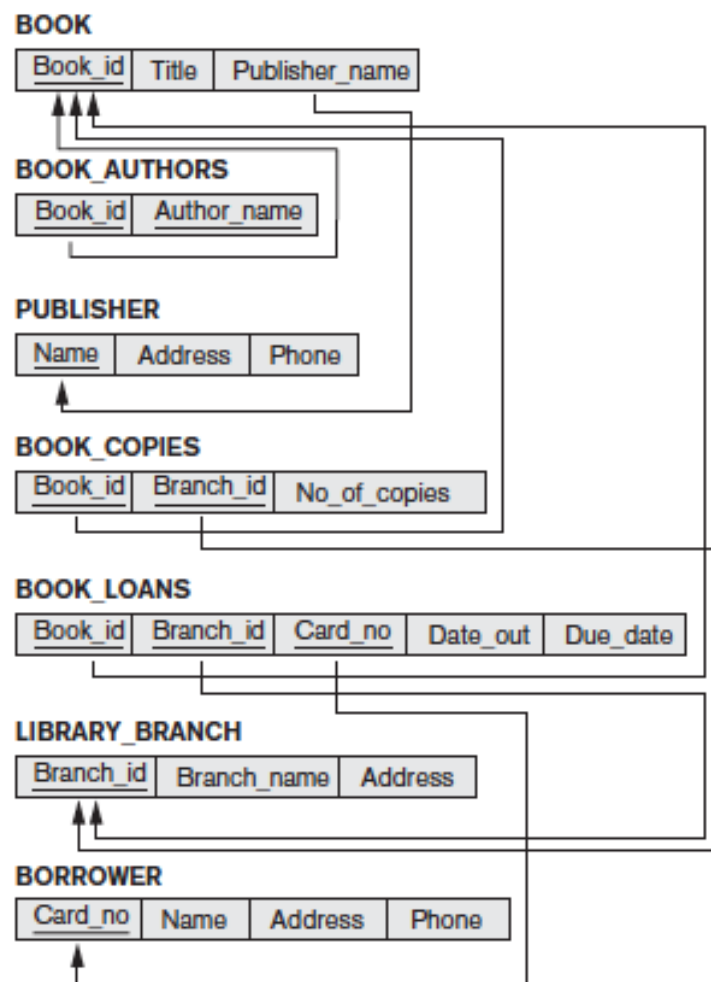| A	B	C
a	2	f
a	2	d
c	3	g

Figure 1. Database state for Question 2

Figure 2. Relational database schema for a library database