

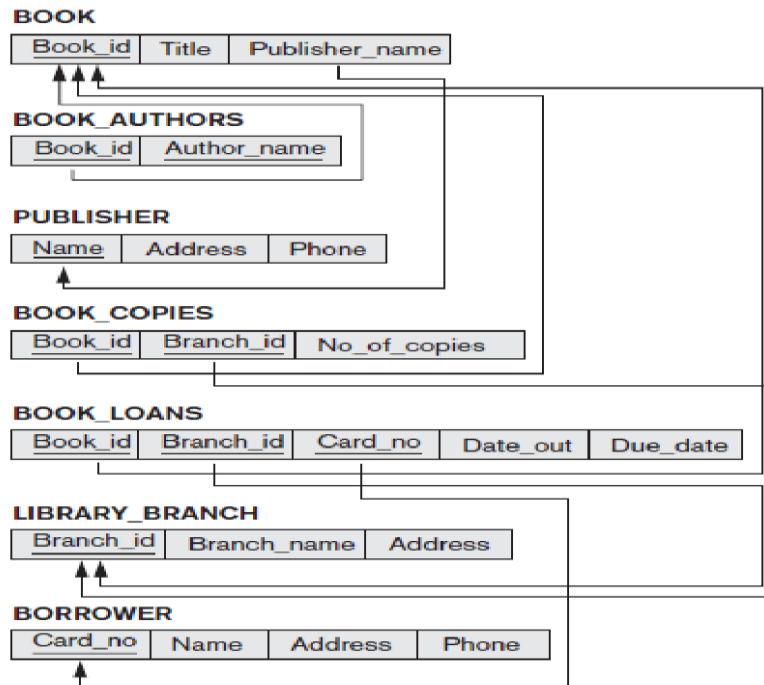


Midterm Exam Model Answers

Course Name: Database Systems	Semester: Spring 2021-2022
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Answer the following questions:

Question 1: Given the following database schema, write **SQL** statements to express each of the following queries. [8 Marks]



1. Create table Book.

```
CREATE TABLE Book
(
  Book_id INT PRIMARY KEY,
  Title VARCHAR(20),
  Publisher_name VARCHAR(20),
)
```

2. Add a new Book with the following data: 1, Database Systems and Hindawi.
Insert into Book values (1, 'Database Systems', 'Hindawi');

3. Change the publisher's name of the book whose title is Database Systems to McGraw.

```
Update Book
Set Publisher_name = 'McGraw'
Where Title ='Database Systems'
```

4. Remove the table Borrower.
Drop table Borrower
5. Retrieve all books that have titles that contain "IS".

```
Select Title
From Book
Where Title like '%IS%' – IS form either capital, small, capitalized, ... does not matter.
```

6. Get the total number of books found in Giza branch.

```
Select Sum(No_of_copies)
From Book_Copies, Library_Branch
Where Book_Copies.Branch_id = Library_Branch.Branch_id
and Library_Branch.Branch_name = 'Giza'
```

7. Get a list of books containing the number of copies of each book in every branch. Sort the result alphabetically by the branch name.

```
Select Library_Branch.Branch_name, Book.title, Sum(No_of_copies)
From Book_Copies, Library_Branch, Book
Where Book_Copies.Branch_id = Library_Branch.Branch_id
and Book_Copies.Book_id=Book.Book_id
Group by Library_Branch.Branch_name, Book.Title
Order by Library_Branch.Branch_name
```

8. Using sub queries, list all the branches which do not have books written by 'Omar'.

```
SELECT Library_Branch.Branch_name
From Library_Branch, Book_Copies
Where Book_Copies.Branch_id = Library_Branch.Branch_id
and Book_Copies.Book_id not in (
    select Book_authors.Book_id
    from Book_authors
    where Author_name ='Omar')
```

Question 2: Given the following database schema of banking system, write the **relational algebra expressions** to express each of the following queries. [8 Marks]

Branch (branch_name, branch_city, assets)

Customer (customer_name, customer_street, customer_city)

Account (account_number, branch_name, balance)

Loan (loan_number, branch_name, amount)
 Depositor (customer_name, account_number)
 Borrower (customer_name, loan_number)

1. Find all loans of over 1200.

$\sigma_{\text{amount} > 1200}(\text{Loan})$

2. Find the account number for each account having a balance greater than 3000.

$\pi_{\text{account_number}}(\sigma_{\text{balance} > 3000}(\text{Account}))$

3. Find the names of all customers who have a loan, an account, or both, from the bank.

$\pi_{\text{customer_name}}(\text{Borrower}) \cup \pi_{\text{customer_name}}(\text{Depositor})$

4. Find the names of all customers who have a loan at the Cairo branch.

$\pi_{\text{customer_name}}(\sigma_{\text{branch_name} = \text{"Cairo"}}(\text{Borrower} \bowtie \text{Loan}))$
 $\text{borrower.loan_number} = \text{loan.loan_number}$

Question 3: State whether the following statements are True or False. [2 Marks]

1. Every relation schema should have a foreign key. **False**
2. Relation **R** has **n** tuples and relation **S** has **m** tuples, then **R x S** has **n + m** tuples with unknown degree for the result. **False**
3. A relation schema may have several foreign keys but exactly one primary key. **True**
4. The foreign key can be composite. **True**

Question 4: Rewrite the following Relational Algebra expression in SQL [2 Marks]

$\sigma_{\text{Salary} < 10000}(\pi_{\text{Name, Salary}}(\sigma_{\text{Age} < 40}(\text{EMPLOYEE})))$

SELECT **Name, Salary**
FROM **EMPLOYEE**
WHERE **Age < 40 AND Salary < 10000**

Question 5: Assume we have two database tables R & S with the same degree. |R| = 100, |S| = 10 with the following characteristics: [3 Marks & 2 Bonus]

1. There is a relationship between R & S (Referential Relationship from R to S).
2. Number of distinct values in the foreign key column in S = 10 values.
3. When applying any operation **OPERN** on R and S; R will be the first mentioned table. Except for Question 2 below.
4. All R's Fields are Type Compatible with S's fields.
5. |R| = 100; means R has 100 tuples, and |S| = 10 means S has 10 tuples.

A database operation **OPERN** is applied to get data from both R and S. You are required to name the operation **OPERN** which applied if the number of tuples retrieved as results to **OPERN** is:

- Note: More than one operation may give the same result. You must name ALL the alternative operations corresponding to **OPERN** along with the Relational Algebra Symbol to represent **OPERN**.
1. 100 tuples (R **Union** S), (R **Left Outer Join** S), (R **Full Outer Join** S)
 2. Zero tuples (S **Except** R).
 3. 10 tuples (R **Equi Join** S), (R **Natural Join** S), (R **Intersect** S).
 4. 90 tuples (R **Except** S)
 5. 1000 tuples (R **Cross Join** S)

Relational Algebra Symbols for the mentioned operations are:

- | | | |
|----------------------|---|--|
| 1. Union → | | |
| 2. Left Outer Join → | | |
| 3. Full Outer Join | | |
| 4. Except — | | |
| 5. Equi Join | | |
| 6. Natural Join | * | |
| 7. Intersect | | |
| 8. Cross Join | X | |