

Relational Algebra overview

| Symbol | Explanation |
|---|--|
| <ul style="list-style-type: none"> ❖ σ < selection condition AND > (R) ❖ π < attribute list, .. > (R) ❖ Relation \cup Relation ❖ Relation \cap Relation ❖ Relation $-$ Relation ❖ $\rho_{a/b}$ R ❖ \bowtie <selection condition> R ❖ Relation 1 x Relation 2 ❖ <group on att>\mathcal{F}<Agg func><Attribute> (R) | <ul style="list-style-type: none"> ❖ Select from R on a condition ❖ Project/list attributes in table R ❖ Union ❖ Intersection ❖ Difference ❖ Rename; result is identical to R except that the b attribute in all tuples is renamed to an a attribute. ❖ Natural join on a condition, also R^*R ❖ Cartesian Product, Pair every row in relation 1 with every row in relation 2 ❖ Aggregate Functional operation \mathcal{F} operating on R and grouped on attributes |

Problems

6.22 Consider the two tables T1 and T2 shown in Figure 6.15. Show the results of the following operations:

- A. $T1 \bowtie \langle T1.P = T2.A \rangle T2$
- B. $T1 \bowtie \langle T1.Q = T2.B \rangle T2$
- E. $T1 \cup T2$
- F. $T1 \bowtie \langle T1.P = T2.A \text{ AND } T1.R = T2.C \rangle T2$

Figure 6.15

A database state for the relations $T1$ and $T2$.

TABLE T1

| P | Q | R |
|----|---|---|
| 10 | a | 5 |
| 15 | b | 8 |
| 25 | a | 6 |

TABLE T2

| A | B | C |
|----|---|---|
| 10 | b | 6 |
| 25 | c | 3 |
| 10 | b | 5 |

6.16 Specify the following queries on the COMPANY relational database schema shown in Figure 5.5, using the relational operators discussed in this chapter. Also show the result of each query as it would apply to the database state of Figure 3.6.

- A. Retrieve the names of employees in department 5 who work more than 10 hours per week on the 'ProductX' project.
- B. List the names of employees who have a dependent with the same first name as themselves.
- C. Find the names of employees that are directly supervised by 'Franklin Wong'.
- D. For each project, list the project name and the total hours per week (by all employees) spent on that project.
- E. Retrieve the names of employees who work on every project.
- F. Retrieve the names of employees who do not work on any project.
- G. For each department, retrieve the department name, and the average salary of employees working in that department.
- H. Retrieve the average salary of all female employees.
- I. Find the names and addresses of employees who work on at least one project located in Houston but whose department has no location in Houston.
- J. List the last names of department managers who have no dependents.

EMPLOYEE

| | | | | | | | | | |
|-------|-------|-------|------------|-------|---------|-----|--------|-----------|-----|
| Fname | Minit | Lname | <u>Ssn</u> | Bdate | Address | Sex | Salary | Super_ssn | Dno |
|-------|-------|-------|------------|-------|---------|-----|--------|-----------|-----|

DEPARTMENT

| | | | |
|-------|----------------|---------|----------------|
| Dname | <u>Dnumber</u> | Mgr_ssn | Mgr_start_date |
|-------|----------------|---------|----------------|

DEPT_LOCATIONS

| | |
|----------------|------------------|
| <u>Dnumber</u> | <u>Dlocation</u> |
|----------------|------------------|

PROJECT

| | | | |
|-------|----------------|-----------|------|
| Pname | <u>Pnumber</u> | Plocation | Dnum |
|-------|----------------|-----------|------|

WORKS_ON

| | | |
|-------------|------------|-------|
| <u>Essn</u> | <u>Pno</u> | Hours |
|-------------|------------|-------|

DEPENDENT

| | | | | |
|-------------|-----------------------|-----|-------|--------------|
| <u>Essn</u> | <u>Dependent_name</u> | Sex | Bdate | Relationship |
|-------------|-----------------------|-----|-------|--------------|

Figure 5.5
Schema diagram for
the COMPANY
relational database
schema.

6.18 Consider the LIBRARY relational database schema shown in Figure 6.14, which is used to keep track of books, borrowers, and book loans. Referential integrity constraints are shown as directed arcs in Figure 6.14, as in the notation of Figure 3.6. Write down relational expressions for the following queries:

- A. How many copies of the book titled The Lost Tribe are owned by the library branch whose name is 'Sharpstown'?
- B. How many copies of the book titled The Lost Tribe are owned by each library branch?
- C. Retrieve the names of all borrowers who do not have any books checked out.
- D. For each book that is loaned out from the Sharpstown branch and whose Due_date 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 coauthored) by Stephen King, retrieve the title and the number of copies owned by the library branch whose name is Central.

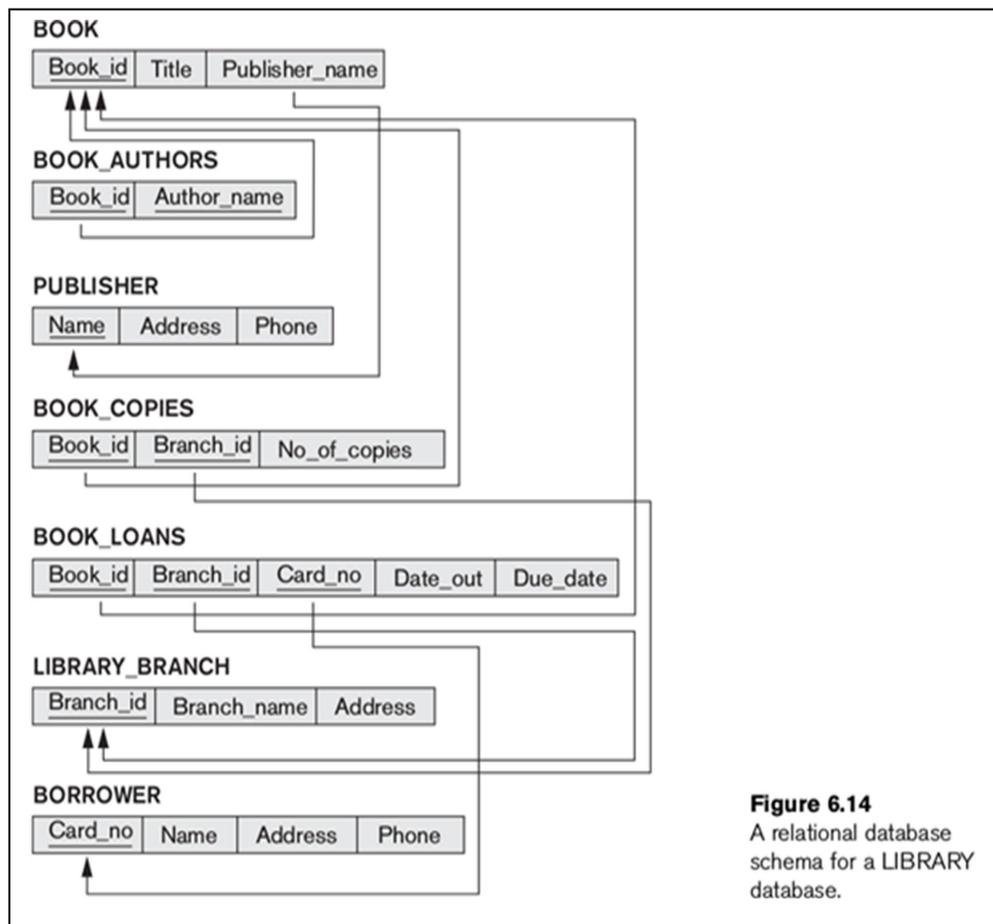


Figure 6.14
A relational database
schema for a LIBRARY
database.