Relational Algebra overview

Symbol	Explanation
❖ σ **< selection condition AND >** (R) ❖ π **< attribute list, .. >** (R) ❖ Relation U Relation ❖ Relation ∩ Relation ❖ Relation – Relation ❖ ρ **a/b** R ❖ ⋈ **<selection condition>** R ❖ Relation 1 x Relation 2 ❖ **<group on att>**$\mathcal{F}$**<Agg func><Attribute>** (R)	❖ 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 ⋈ **<T1.P = T2.A>** T2
B. T1 ⋈ **<T1.Q = T2.B>** T2
E. T1 ∪ T2
F. T1 ⋈ **<T1.P = T2.A AND T1.R = T2.C>** T2

Figure 6.15
A database state for the relations *T*1 and *T*2.

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

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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	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno

DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date

DEPT_LOCATIONS

Dnumber	Dlocation

PROJECT

Pname	Pnumber	Plocation	Dnum

WORKS_ON

Essn	Pno	Hours

DEPENDENT

Essn	Dependent_name	Sex	Bdate	Relationship

Figure 5.5
Schema diagram for the COMPANY relational database schema.

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Figure 3.6
One possible database state for the COMPANY relational database schema.

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4
Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NULL	1

DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date
Research	5	333445555	1988-05-22
Administration	4	987654321	1995-01-01
Headquarters	1	888665555	1981-06-19

DEPT_LOCATIONS

Dnumber	Dlocation
1	Houston
4	Stafford
5	Bellaire
5	Sugarland
5	Houston

WORKS_ON

Essn	Pno	Hours
123456789	1	32.5
123456789	2	7.5
666884444	3	40.0
453453453	1	20.0
453453453	2	20.0
333445555	2	10.0
333445555	3	10.0
333445555	10	10.0
333445555	20	10.0
999887777	30	30.0
999887777	10	10.0
987987987	10	35.0
987987987	30	5.0
987654321	30	20.0
987654321	20	15.0
888665555	20	NULL

PROJECT

Pname	Pnumber	Plocation	Dnum
ProductX	1	Bellaire	5
ProductY	2	Sugarland	5
ProductZ	3	Houston	5
Computerization	10	Stafford	4
Reorganization	20	Houston	1
Newbenefits	30	Stafford	4

DEPENDENT

Essn	Dependent_name	Sex	Bdate	Relationship
333445555	Alice	F	1986-04-05	Daughter
333445555	Theodore	M	1983-10-25	Son
333445555	Joy	F	1958-05-03	Spouse
987654321	Abner	M	1942-02-28	Spouse
123456789	Michael	M	1988-01-04	Son
123456789	Alice	F	1988-12-30	Daughter
123456789	Elizabeth	F	1967-05-05	Spouse

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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.

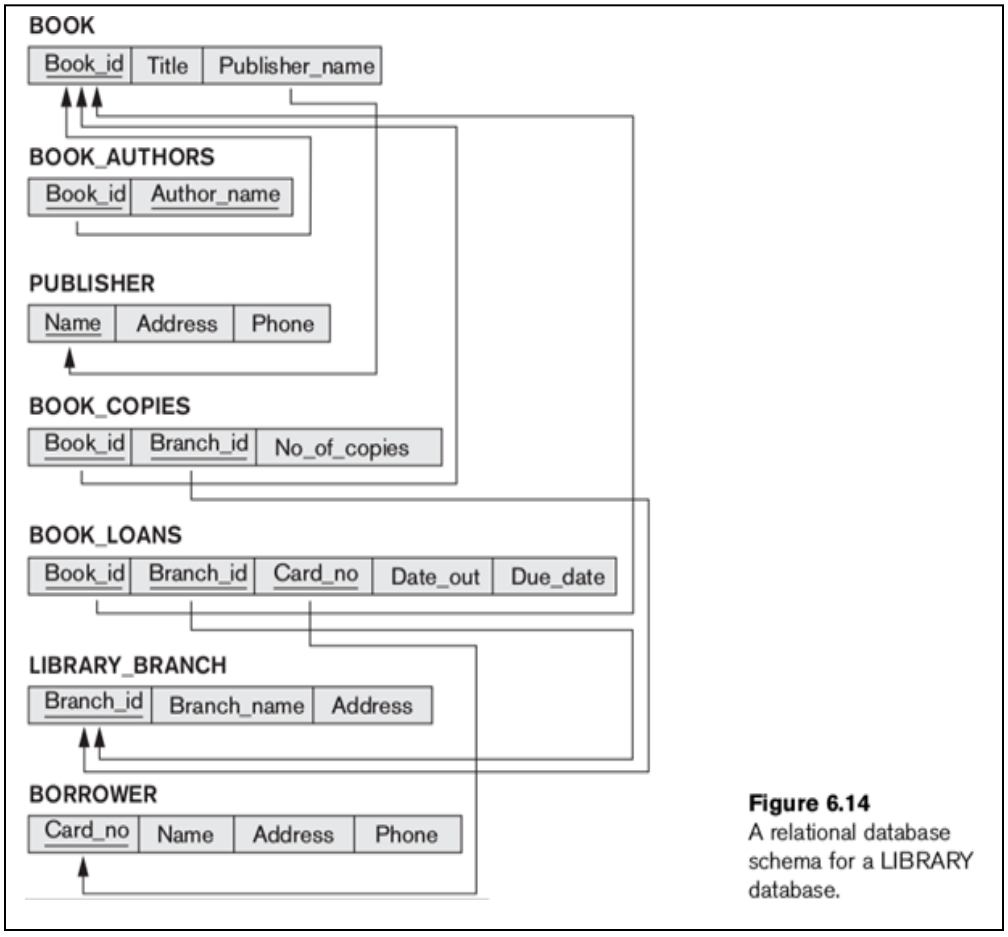

Figure 6.14
A relational database schema for a LIBRARY database.

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