

Figure 7.7 Referential integrity constraints displayed on the COMPANY relational database schema diagram.

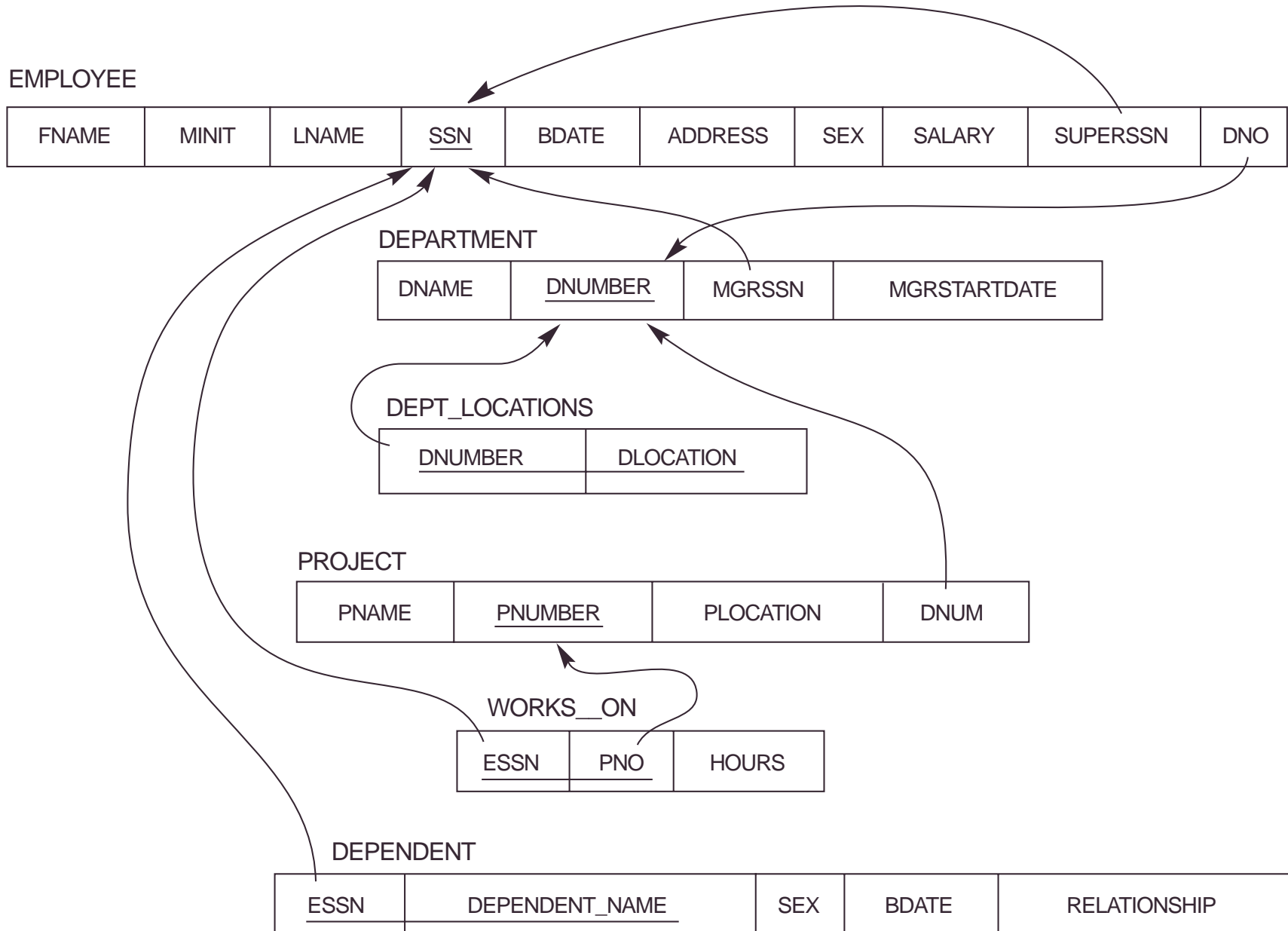


Figure 7.8 Results of SELECT and PROJECT operations.

(a) $\sigma_{(DNO=4 \text{ AND } SALARY>25000) \text{ OR } (DNO=5 \text{ AND } SALARY>30000)}$ (EMPLOYEE).

(b) $\pi_{LNAME, FNAME, SALARY}$ (EMPLOYEE). (c) $\pi_{SEX, SALARY}$ (EMPLOYEE)

(a)

FNAME	MINIT	LNAME	<u>SSN</u>	BDATE	ADDRESS	SEX	SALARY	SUPERSSN	DNO
Franklin	T	Wong	333445555	1955-12-08	638 Voss,Houston,TX	M	40000	888665555	5
Jennifer		Wallace	987654321	1941-06-20	291 Berry,Bellaire,TX	F	43000	888665555	4
Ramesh		Narayan	666884444	1962-09-15	975 FireOak,Humble,TX	M	38000	333445555	5

(b)

LNAME	FNAME	SALARY
Smith	John	30000
Wong	Franklin	40000
Zelaya	Alicia	25000
Wallace	Jennifer	43000
Narayan	Ramesh	38000
English	Joyce	25000
Jabbar	Ahmad	25000
Borg	James	55000

(c)

SEX	SALARY
M	30000
M	40000
F	25000
F	43000
M	38000
M	25000
M	55000

Figure 7.9 Results of relational algebra expressions.

(a) $\pi_{\text{LNAME, FNAME, SALARY}} (\sigma_{\text{DNO}=5}(\text{EMPLOYEE}))$. (b) The same expression using intermediate relations and renaming of attributes.

(a)

FNAME	LNAME	SALARY
John	Smith	30000
Franklin	Wong	40000
Ramesh	Narayan	38000
Joyce	English	25000

(b)

TEMP	FNAME	MINIT	LNAME	<u>SSN</u>	BDATE	ADDRESS	SEX	SALARY	SUPERSSN	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
	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

	FIRSTNAME	LASTNAME	SALARY
	John	Smith	30000
	Franklin	Wong	40000
	Ramesh	Narayan	38000
	Joyce	English	25000

Figure 7.10 Query result after the UNION operation:

$$\text{RESULT} \leftarrow \text{RESULT1} \cup \text{RESULT2}.$$

RESULT1	SSN
	123456789
	333445555
	666884444
	453453453

RESULT2	SSN
	333445555
	888665555

RESULT	SSN
	123456789
	333445555
	666884444
	453453453
	888665555

Figure 7.11 Illustrating the set operations union, intersection, and difference. (a) Two union compatible relations. (b) $STUDENT \cup INSTRUCTOR$. (c) $STUDENT \cap INSTRUCTOR$. (d) $STUDENT - INSTRUCTOR$. (e) $INSTRUCTOR - STUDENT$.

(a)

STUDENT	FN	LN
	Susan	Yao
	Ramesh	Shah
	Johnny	Kohler
	Barbara	Jones
	Amy	Ford
	Jimmy	Wang
	Ernest	Gilbert

INSTRUCTOR	FNAME	LNAME
	John	Smith
	Ricardo	Browne
	Susan	Yao
	Francis	Johnson
	Ramesh	Shah

(b)

FN	LN
Susan	Yao
Ramesh	Shah
Johnny	Kohler
Barbara	Jones
Amy	Ford
Jimmy	Wang
Ernest	Gilbert
John	Smith
Ricardo	Browne
Francis	Johnson

(c)

FN	LN
Susan	Yao
Ramesh	Shah

(d)

FN	LN
Johnny	Kohler
Barbara	Jones
Amy	Ford
Jimmy	Wang
Ernest	Gilbert

(e)

FNAME	LNAME
John	Smith
Ricardo	Browne
Francis	Johnson

Figure 7.12 An illustration of the CARTESIAN PRODUCT operation.

FEMALE_EMPS	FNAME	MINIT	LNAME	SSN	BDATE	ADDRESS	SEX	SALARY	SUPERSSN	DNO
	Alicia	J	Zelaya	999887777	1968-07-19	3321 Castle, Spring, TX	F	25000	987654321	4
	Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4
	Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5

EMP_NAMES	FNAME	LNAME	SSN
	Alicia	Zelaya	999887777
	Jennifer	Wallace	987654321
	Joyce	English	453453453

EMP_DEPENDENTS	FNAME	LNAME	SSN	ESSN	DEPENDENT_NAME	SEX	BDATE	...
	Alicia	Zelaya	999887777	333445555	Alice	F	1986-04-05	...
	Alicia	Zelaya	999887777	333445555	Theodore	M	1983-10-25	...
	Alicia	Zelaya	999887777	333445555	Joy	F	1958-05-03	...
	Alicia	Zelaya	999887777	987654321	Abner	M	1942-02-28	...
	Alicia	Zelaya	999887777	123456789	Michael	M	1988-01-04	...
	Alicia	Zelaya	999887777	123456789	Alice	F	1988-12-30	...
	Alicia	Zelaya	999887777	123456789	Elizabeth	F	1967-05-05	...
	Jennifer	Wallace	987654321	333445555	Alice	F	1986-04-05	...
	Jennifer	Wallace	987654321	333445555	Theodore	M	1983-10-25	...
	Jennifer	Wallace	987654321	333445555	Joy	F	1958-05-03	...
	Jennifer	Wallace	987654321	987654321	Abner	M	1942-02-28	...
	Jennifer	Wallace	987654321	123456789	Michael	M	1988-01-04	...
	Jennifer	Wallace	987654321	123456789	Alice	F	1988-12-30	...
	Jennifer	Wallace	987654321	123456789	Elizabeth	F	1967-05-05	...
	Joyce	English	453453453	333445555	Alice	F	1986-04-05	...
	Joyce	English	453453453	333445555	Theodore	M	1983-10-25	...
	Joyce	English	453453453	333445555	Joy	F	1958-05-03	...
	Joyce	English	453453453	987654321	Abner	M	1942-02-28	...
	Joyce	English	453453453	123456789	Michael	M	1988-01-04	...
	Joyce	English	453453453	123456789	Alice	F	1988-12-30	...
	Joyce	English	453453453	123456789	Elizabeth	F	1967-05-05	...

ACTUAL_DEPENDENTS	FNAME	LNAME	SSN	ESSN	DEPENDENT_NAME	SEX	BDATE
	Jennifer	Wallace	987654321	987654321	Abner	M	1942-02-28

RESULT	FNAME	LNAME	DEPENDENT_NAME
	Jennifer	Wallace	Abner

Figure 7.13 Illustrating the JOIN operation.

DEPT_MGR	DNAME	DNUMBER	MGRSSN	• • •	FNAME	MINIT	LNAME	SSN	• • •
	Research	5	333445555	• • •	Franklin	T	Wong	333445555	• • •
	Administration	4	987654321	• • •	Jennifer	S	Wallace	987654321	• • •
	Headquarters	1	888665555	• • •	James	E	Borg	888665555	• • •

Figure 7.14 An illustration of the NATURAL JOIN operation. (a) PROJ_DEPT \leftarrow PROJECT * DEPT. (b) DEPT_LOCS \leftarrow DEPARTMENT * DEPT_LOCATIONS.

(a)

PROJ_DEPT	PNAME	PNUMBER	PLOCATION	DNUM	DNAME	MGRSSN	MGRSTARTDATE
	ProductX	1	Bellaire	5	Research	333445555	1988-05-22
	ProductY	2	Sugarland	5	Research	333445555	1988-05-22
	ProductZ	3	Houston	5	Research	333445555	1988-05-22
	Computerization	10	Stafford	4	Administration	987654321	1995-01-01
	Reorganization	20	Houston	1	Headquarters	888665555	1981-06-19
	Newbenefits	30	Stafford	4	Administration	987654321	1995-01-01

(b)

DEPT_LOCS	DNAME	DNUMBER	MGRSSN	MGRSTARTDATE	LOCATION
	Headquarters	1	888665555	1981-06-19	Houston
	Administration	4	987654321	1995-01-01	Stafford
	Research	5	333445555	1988-05-22	Bellaire
	Research	5	333445555	1988-05-22	Sugarland
	Research	5	333445555	1988-05-22	Houston

Figure 7.15 Illustrating the division operation.
 (a) Dividing SSN_PNOS by SMITH_PNOS. (b) $T \leftarrow R \div S$.

(a)

SSN_PNOS	ESSN	PNO
	123456789	1
	123456789	2
	666884444	3
	453453453	1
	453453453	2
	333445555	2
	333445555	3
	333445555	10
	333445555	20
	999887777	30
	999887777	10
	987987987	10
	987987987	30
	987654321	30
	987654321	20
	888665555	20

SMITH_PNOS	PNO
	1
	2

SSNS	SSN
	123456789
	453453453

(b)

R	A	B
	a1	b1
	a2	b1
	a3	b1
	a4	b1
	a1	b2
	a3	b2
	a2	b3
	a3	b3
	a4	b3
	a1	b4
	a2	b4
	a3	b4

S	A
	a1
	a2
	a3

T	B
	b1
	b4