Exercise session: ER to Relational Model

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Relational Algebra: A

Question: Retrieve the names of all employees in department 5 who work more than 10 hours per week on the ProductX project

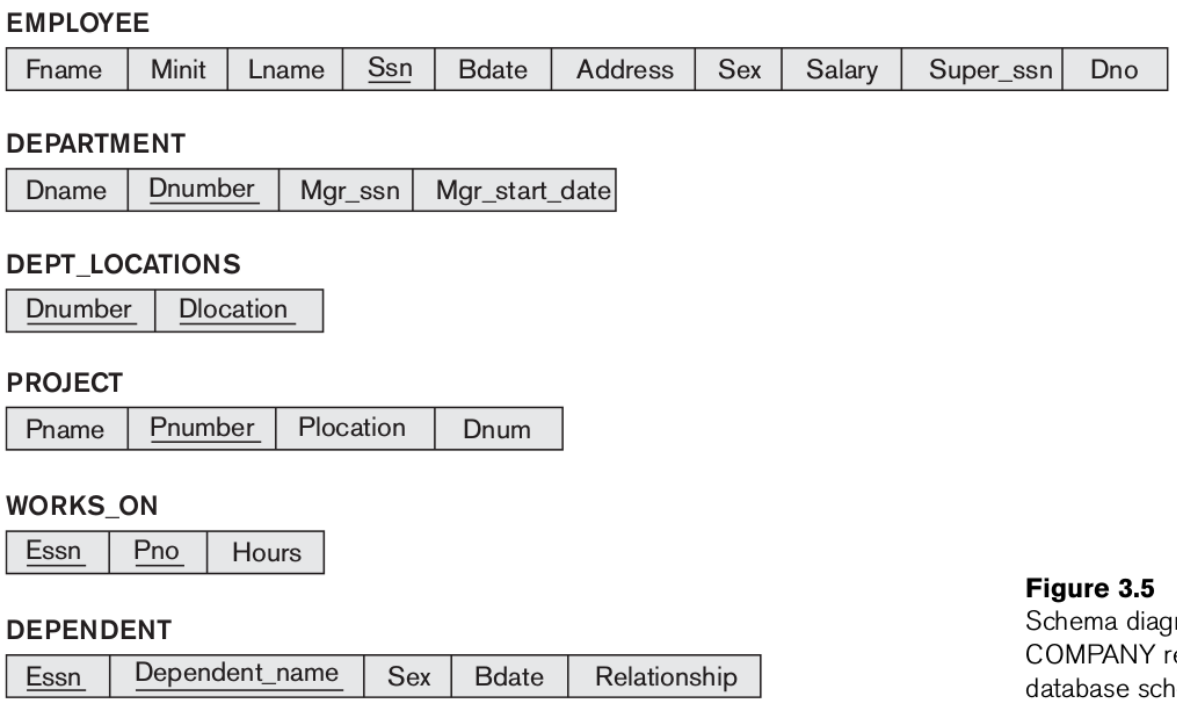


Figure 3.5
Schema diagram for the COMPANY relational database schema.

Relational Algebra: A

Question: Retrieve the names of all employees in department 5 who work more than 10 hours per week on the ProductX project

Answer:

A.

$$
\begin{aligned}
&\text{EMP5} \leftarrow \sigma_{\text{DNO=5}}(\text{EMPLOYEE})\\
&\text{PRODX} \leftarrow \sigma_{\text{PNAME='ProductX'}}(\text{PROJECT})\\
&\text{WORKS\_10\_PRODX} \leftarrow \sigma_{\text{HOURS>10}}(\text{WORKS ON} \rhd\lhd_{\text{PNO=PNUMBER}} \text{PRODX})\\
&\text{RESULT} \leftarrow \pi_{\text{FNAME, LNAME}}(\text{EMP5} \rhd\lhd_{\text{SSN=ESSN}} \text{WORKS\_10\_PRODX})
\end{aligned}
$$

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 3.5
Schema diagram for the COMPANY relational database schema.

Relational Algebra: B

Question: List the names of all employees who have a dependent with the same first name as themselves

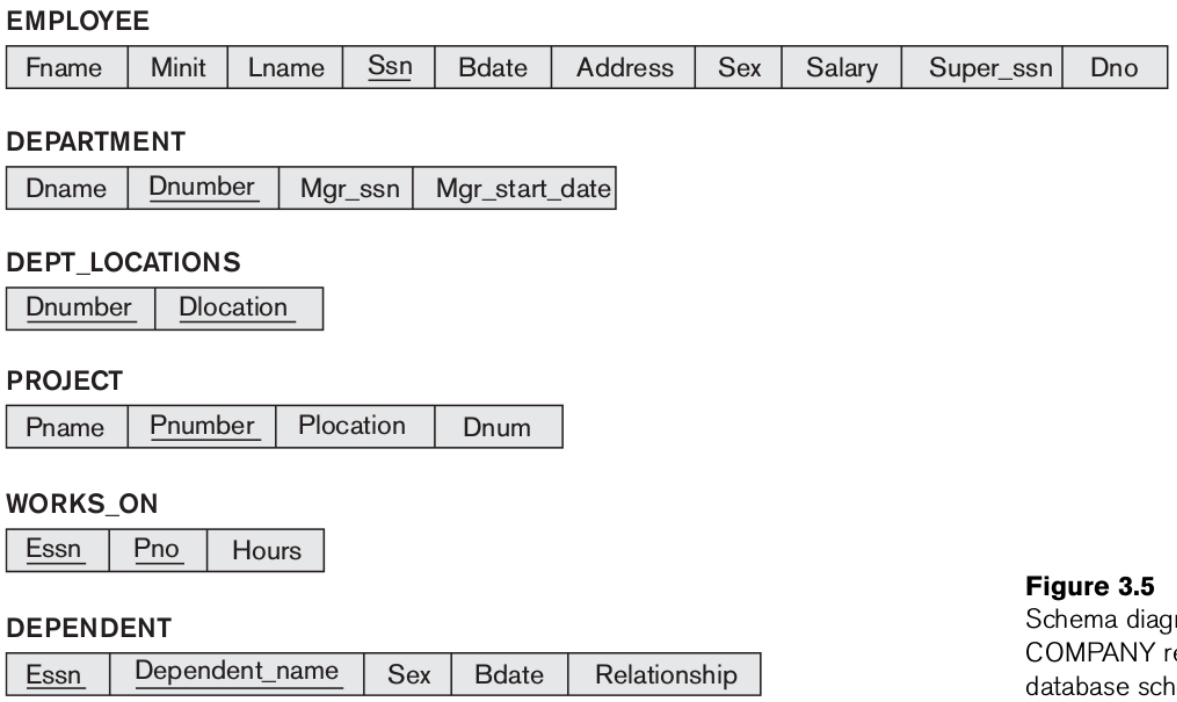


Figure 3.5
Schema diagram for the COMPANY relational database schema.

Relational Algebra: B

Question: List the names of all employees who have a dependent with the same first name as themselves

Answer:

B.

RESULT $\leftarrow \pi_{\text{FNAME, LNAME}}\,(\text{EMPLOYEE} \rhd\lhd_{\text{(SSN=ESSN)AND(FNAME=DEPENDENT NAME)}} \text{DEPENDENT})$

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 3.5
Schema diagram for the COMPANY relational database schema.

Relational Algebra: C

Question: Find the names of all employees who are directly supervised by "Franklin Wong"

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 3.5
Schema diagram for the COMPANY relational database schema.

Relational Algebra: C

Question: Find the names of all employees who are directly supervised by "Franklin Wong"

Answer:

C.

WONG $\leftarrow$ $\pi_{SSN}\,(\sigma_{(FNAME='Franklin')\,AND\,(LNAME='Wong')}\,(EMPLOYEE))$

RESULT $\leftarrow$ $\pi_{FNAME,\,LNAME}\,(EMPLOYEE \rhd\lhd_{SUPERSSN=SSN}\,WONG)$

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 3.5
Schema diagram for the COMPANY relational database schema.

Relational Algebra: D

Question: For each project, list the project name and the total hours per week (by all employees) spent on that project

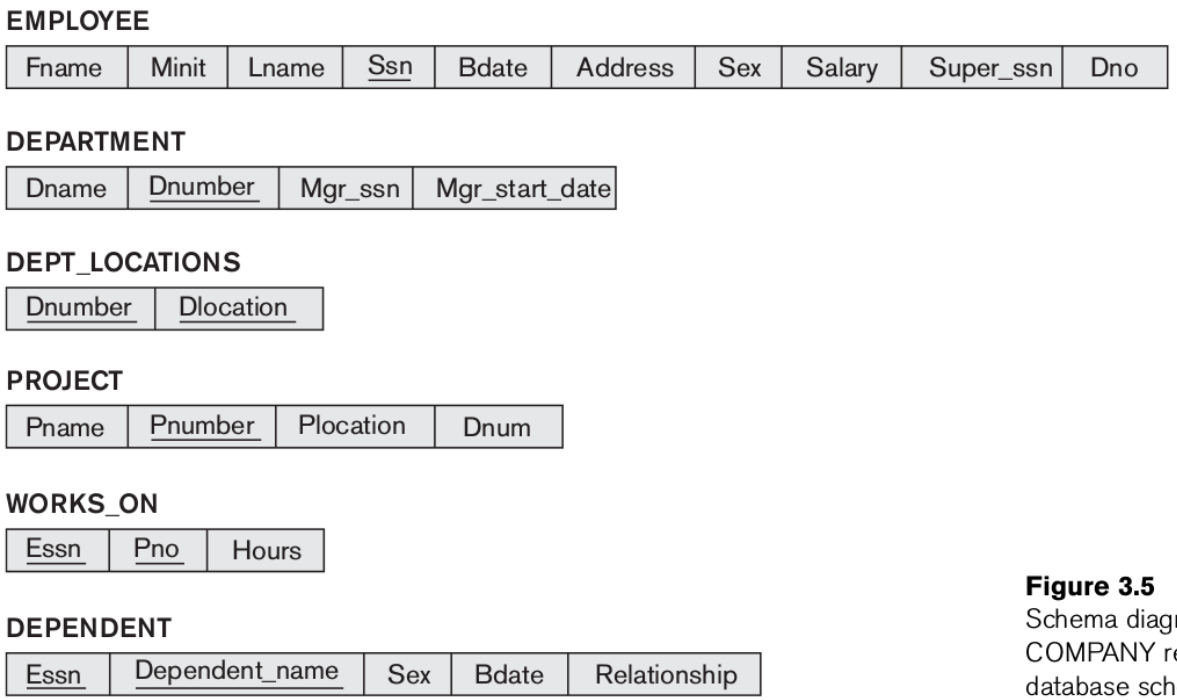


Figure 3.5
Schema diagram for the COMPANY relational database schema.

Relational Algebra: D

Question: For each project, list the project name and the total hours per week (by all employees) spent on that project

Answer:

D.

TIME $\leftarrow$ $_{\text{PNO}}\mathcal{F}_{\text{SUM HOURS}}$ (WORKS ON)

RESULT $\leftarrow$ $\pi_{\text{PNAME,SUM HOURS}}$ (TIME $\rhd\lhd_{\text{PNO=PNUMBER}}$ PROJECT)

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 3.5
Schema diagram for the COMPANY relational database schema.

Relational Algebra: E

Question: Retrieve the names of all employees who work on every project

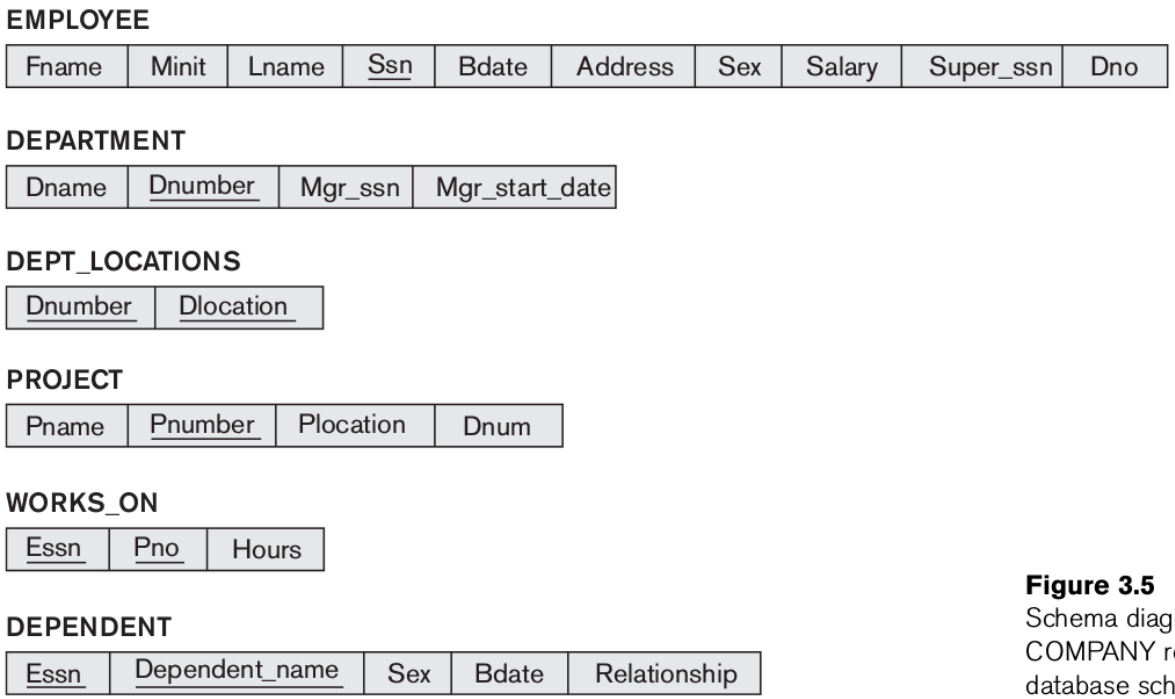


Figure 3.5
Schema diagram for the COMPANY relational database schema.

Relational Algebra: E

Question: Retrieve the names of all employees who work on every project

Answer:

E.

PROJS(PNO) $\leftarrow$ π_{PNUMBER} (PROJECT)

EMPS_AND_PROJS $\leftarrow$ $\pi_{\text{ESSN, PNO}}$ (WORKS_ON)

ACTIVE_EMPS $\leftarrow$ EMPS_AND_PROJS $\div$ PROJS

RESULT $\leftarrow$ $\pi_{\text{FNAME, LNAME}}$ (EMPLOYEE $\rhd\lhd_{\text{ESSN=SSN}}$ ACTIVE_EMPS)

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 3.5
Schema diagram for the COMPANY relational database schema.

Relational Algebra: F

Question: Retrieve the names of all employees who do not work on any project

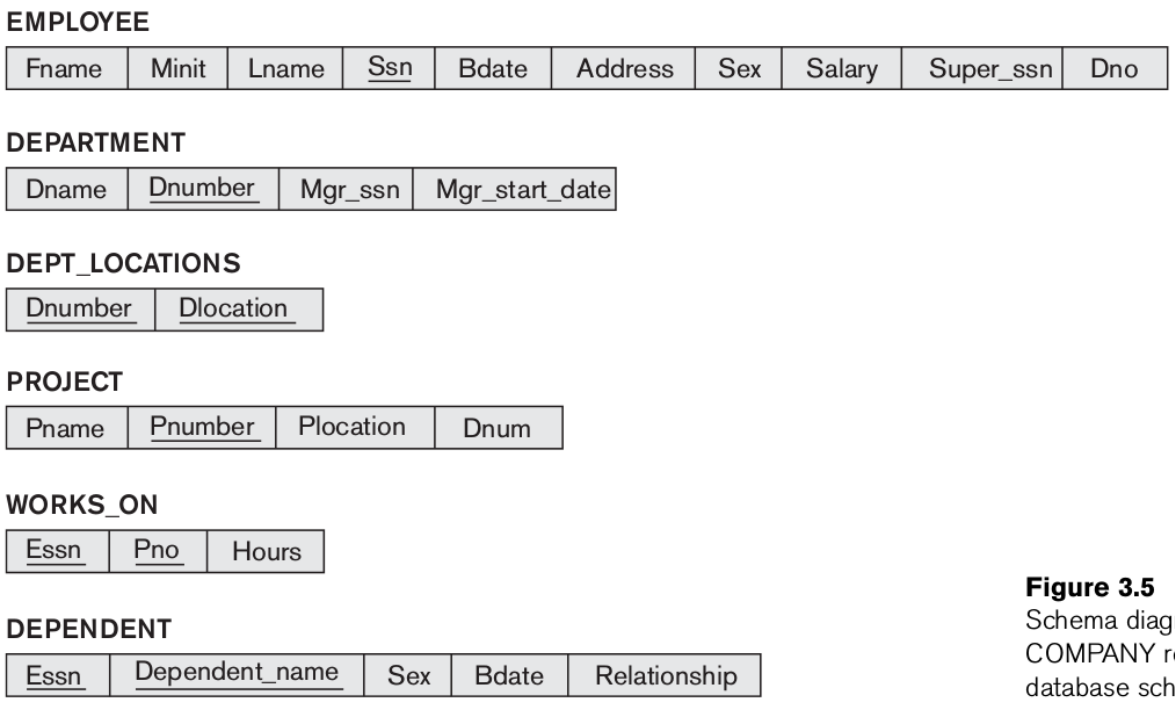


Figure 3.5
Schema diagram for the COMPANY relational database schema.

Relational Algebra: F

Question: Retrieve the names of all employees who do not work on any project

Answer:

F.

WORKING ← π_{ESSN} (WORKS ON)

NOT_WORKING ← π_{SSN} (EMPLOYEE) - WORKING

RESULT ← $\pi_{FNAME, LNAME}$ (NOT_WORKING $\rhd\lhd$ EMPLOYEE)

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 3.5
Schema diagram for the COMPANY relational database schema.

Relational Algebra: G

Question: For each department, retrieve the department name and the average salary

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 3.5
Schema diagram for the COMPANY relational database schema.

Relational Algebra: G

Question: For each department, retrieve the department name and the average salary

Answer:

G.

$$\text{AVGSAL} \leftarrow {}_{\text{DNO}}\mathcal{F}_{\text{AVG SALARY}}(\text{EMPLOYEE})$$

$$\text{RESULT} \leftarrow \pi_{\text{DNAME, AVG SALARY}}(\text{AVGSAL} \rhd\lhd_{\text{DNO=DNUMBER}} \text{DEPARTMENT})$$

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 3.5
Schema diagram for the COMPANY relational database schema.

Relational Algebra: H

Question: Retrieve the average salary of all female employees

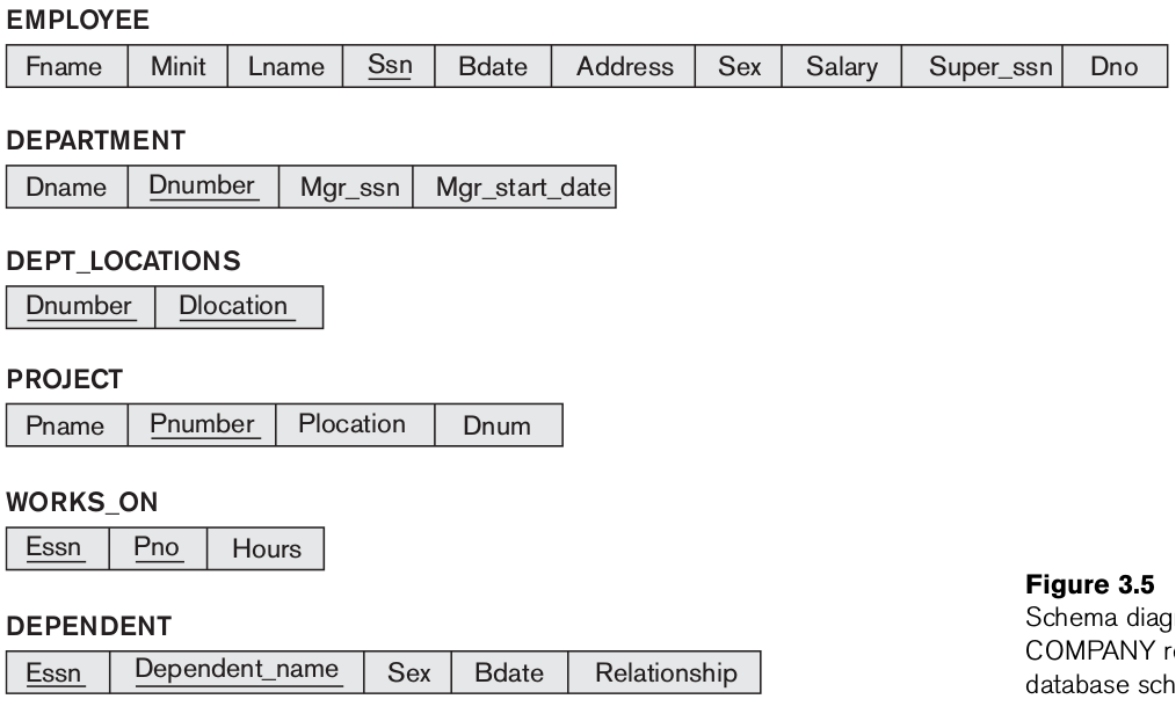


Figure 3.5
Schema diagram for the COMPANY relational database schema.

Relational Algebra: H

Question: Retrieve the average salary of all female employees

Answer:

H.

RESULT $\leftarrow$ $\mathcal{F}_{AVG\ SALARY}(\sigma_{SEX='F'}(EMPLOYEE))$

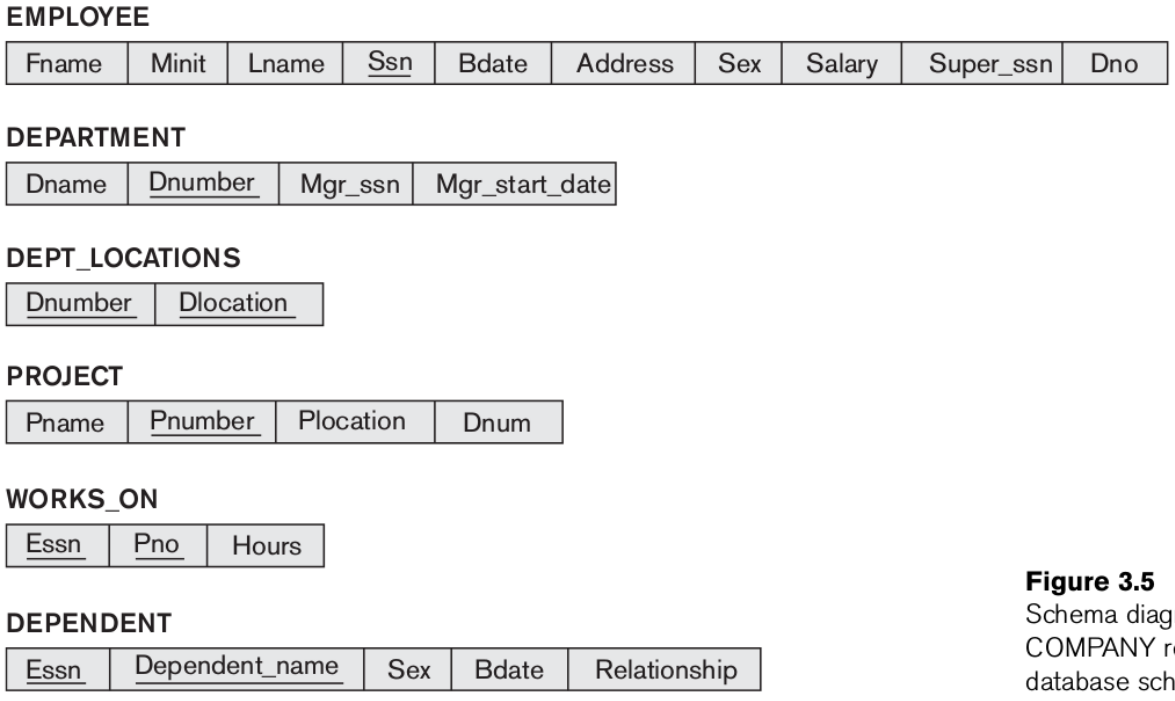


Figure 3.5
Schema diagram for the COMPANY relational database schema.

Relational Algebra: I

Question: Find the names and addresses of all employees who work on at least one project located in Houston but whose department has no location in Houston

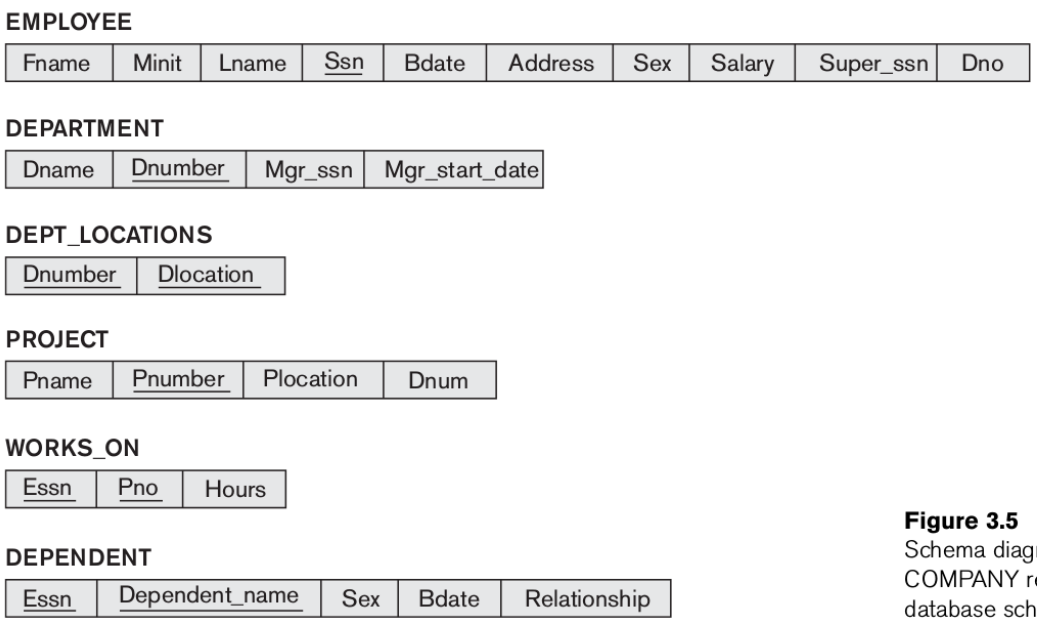


Figure 3.5
Schema diagram for the COMPANY relational database schema.

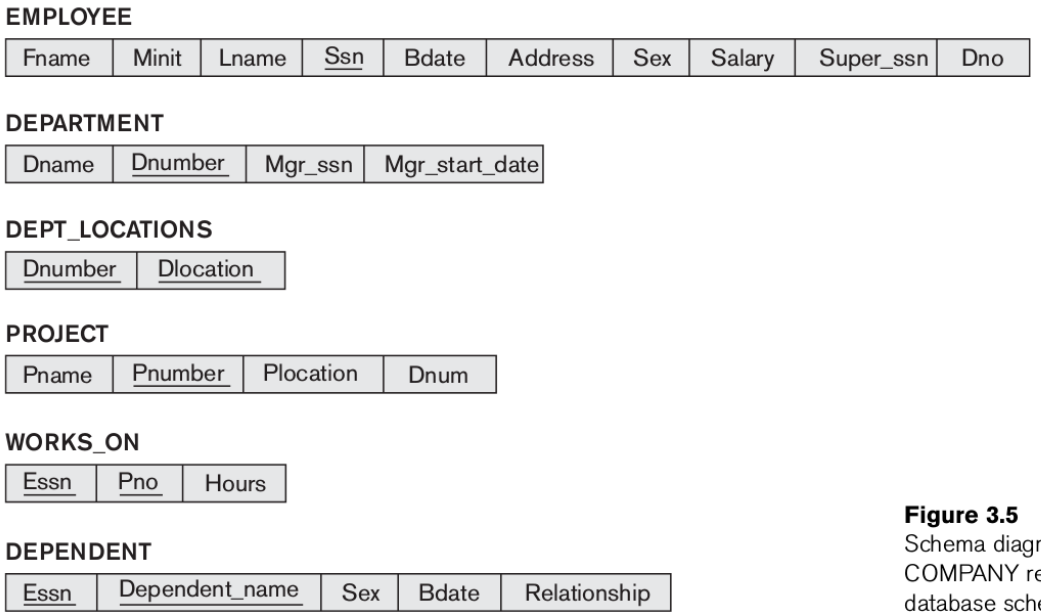
Relational Algebra: I

Question: Find the names and addresses of all employees who work on at least one project located in Houston but whose department has no location in Houston

Answer:

I.

$$
\begin{aligned}
&\text{DEPTSHOUSTON} \leftarrow \pi_{\text{DNUMBER}}\,(\sigma_{\text{DLOCATION='Houston'}}\,(\text{DEPT LOCATIONS}))\\
&\text{EMPDEPTHOUSTON} \leftarrow \pi_{\text{SSN}}\,(\text{EMPLOYEE} \rhd\lhd_{\text{DNO=DNUMBER}} \text{DEPTSHOUSTON})\\
&\text{PROJSHOUSTON} \leftarrow \pi_{\text{PNUMBER}}\,(\sigma_{\text{PLOCATION='Houston'}}(\text{PROJECT}))\\
&\text{EMPPROJHOUSTON} \leftarrow \pi_{\text{ESSN}}\,(\text{WORKS ON} \rhd\lhd_{\text{PNO=PNUMBER}} \text{PROJSHOUSTON})\\
&\text{RESULTSSN(SSN)} \leftarrow \text{EMPROJHOUSTON - EMPDEPTHOUSTON}\\
&\text{RESULT} \leftarrow \pi_{\text{FNAME, LNAME, ADDRESS}}\,(\text{RESULTSSN} * \text{EMPLOYEE})
\end{aligned}
$$



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Schema diagram for the COMPANY relational database schema.

Relational Algebra: J

Question: List the last names of all department managers who have no dependents

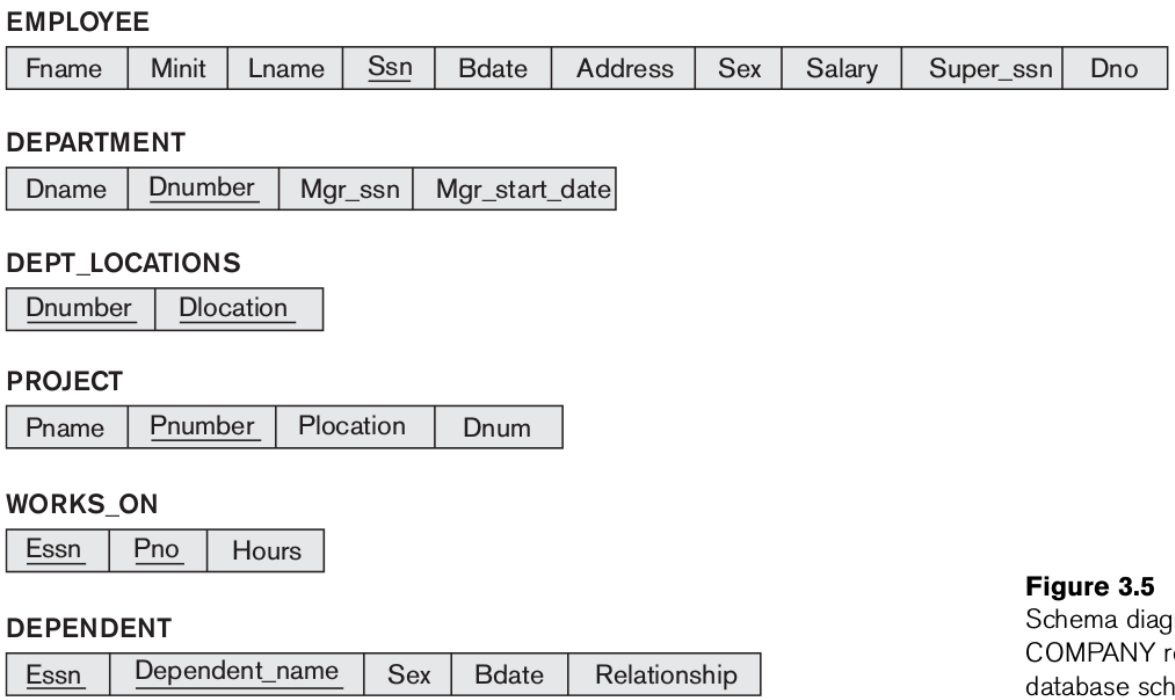

Figure 3.5
Schema diagram for the COMPANY relational database schema.

Relational Algebra: J

Question: List the last names of all department managers who have no dependents

Answer:

J.

$$
\begin{aligned}
&\text{MGRS} && \leftarrow && \pi_{\text{MGRSSN}}\,(\text{DEPARTMENT}) \\
&\text{EMPDEP} && \leftarrow && \pi_{\text{ESSN}}\,(\text{DEPENDENT}) \\
&\text{RESULTSSN(SSN)} && \leftarrow && \text{MGRS - EMPDEP} \\
&\text{RESULT} && \leftarrow && \pi_{\text{LNAME}}\,(\text{RESULTSSN * EMPLOYEE})
\end{aligned}
$$

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 3.5
Schema diagram for the COMPANY relational database schema.

Relational Algebra: K

Question: Extra exercise: Generalize query I such that the names of all employees are given that work on a project in a city for which their the employee's department has no location in this city

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

Figure 3.5
Schema diagram for the COMPANY relational

Relational Algebra: K

Question: Extra exercise: Generalize query I such that the names of all employees are given that work on a project in a city for which their the employee's department has no location in this city

Answer:

K.

$$\text{EMP\_DEP\_IN\_LOC} \leftarrow \pi_{\text{SSN;DLOCATION}}(\text{EMPLOYEE} \rhd\lhd_{\text{DNO=DNUMBER}} \text{DEPT\_LOCATIONS})$$

$$\text{EMP\_PROJ\_IN\_LOC} \leftarrow \pi_{\text{ESSN;PLOCATION}}(\text{WORKS\_ON} \rhd\lhd_{\text{PNO=PNUMBER}} \text{PROJECT})$$

$$\text{RES} \leftarrow \pi_{\text{SSN}}(\text{EMP\_PROJ\_IN\_LOC} - \text{EMP\_DEP\_IN\_LOC})$$

$$\text{RESULT} \leftarrow \pi_{\text{FNAME, LNAME, ADDRESS}}(\text{RES} * \text{EMPLOYEE})$$

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

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Schema diagram for the COMPANY relational