

Examples of Queries in Relational Algebra

Given the below relational model of a COMPANY database schema; calculate the following queries:

EMPLOYEE

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

Dname	<u>Dnumber</u>	Mgr_ssn	Mgr_start_date
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DEPT_LOCATIONS

<u>Dnumber</u>	<u>Dlocation</u>
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PROJECT

Pname	<u>Pnumber</u>	Plocation	Dnum
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WORKS_ON

<u>Essn</u>	<u>Pno</u>	Hours
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DEPENDENT

<u>Essn</u>	<u>Dependent_name</u>	Sex	Bdate	Relationship
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Figure 3.5

Schema diagram for the COMPANY relational database schema.

Query 1.

Retrieve the name and address of all employees who work for the 'Research' department.

Solution:

```

RESEARCH_DEPT ←  $\sigma_{Dname='Research'}$ (DEPARTMENT)
RESEARCH_EMPS ← (RESEARCH_DEPT  $\bowtie_{Dnumber=Dno}$  EMPLOYEE)
RESULT ←  $\pi_{Fname, Lname, Address}$ (RESEARCH_EMPS)
    
```

As a single in-line expression, this query becomes:

```

 $\pi_{Fname, Lname, Address}(\sigma_{Dname='Research'}(DEPARTMENT \bowtie_{Dnumber=Dno}(EMPLOYEE)))$ 
    
```

Query 2.

For every project located in 'Stafford', list the project number, the controlling department number, and the department manager's last name, address, and birth date.

Solution:

```
STAFFORD_PROJS ←  $\sigma_{Plocation='Stafford'}$ (PROJECT)
CONTR_DEPTS ← (STAFFORD_PROJS  $\bowtie_{Dnum=Dnumber}$  DEPARTMENT)
PROJ_DEPT_MGRS ← (CONTR_DEPTS  $\bowtie_{Mgr\_ssn=Ssn}$  EMPLOYEE)
RESULT ←  $\pi_{Pnumber, Dnum, Lname, Address, Bdate}$ (PROJ_DEPT_MGRS)
```

Query 3.

Find the names of employees who work on all the projects controlled by department number 5.

Solution:

```
DEPT5_PROJS ←  $\rho_{(Pno)}(\pi_{Pnumber}(\sigma_{Dnum=5}(\text{PROJECT})))$ 
EMP_PROJ ←  $\rho_{(Ssn, Pno)}(\pi_{Essn, Pno}(\text{WORKS\_ON}))$ 
RESULT_EMP_SSNS ← EMP_PROJ  $\div$  DEPT5_PROJS
RESULT ←  $\pi_{Lname, Fname}$ (RESULT_EMP_SSNS  $\times$  EMPLOYEE)
```

Query 4.

Make a list of project numbers for projects that involve an employee whose last name is 'Smith', either as a worker or as a manager of the department that controls the project.

Solution:

```
SMITHS(Essn) ←  $\pi_{Ssn}(\sigma_{Lname='Smith'}(\text{EMPLOYEE}))$ 
SMITH_WORKER_PROJS ←  $\pi_{Pno}(\text{WORKS\_ON} \times \text{SMITHS})$ 
MGRS ←  $\pi_{Lname, Dnumber}(\text{EMPLOYEE} \bowtie_{Ssn=Mgr\_ssn} \text{DEPARTMENT})$ 
SMITH_MANAGED_DEPTS(Dnum) ←  $\pi_{Dnumber}(\sigma_{Lname='Smith'}(\text{MGRS}))$ 
SMITH_MGR_PROJS(Pno) ←  $\pi_{Pnumber}(\text{SMITH\_MANAGED\_DEPTS} \times \text{PROJECT})$ 
RESULT ← (SMITH_WORKER_PROJS  $\cup$  SMITH_MGR_PROJS)
```

Query 5.

List the names of all employees with two or more dependents.

Solution:

$$\begin{aligned} T1(\text{Ssn}, \text{No_of_dependents}) &\leftarrow \pi_{\text{Ssn}} \left(\text{COUNT } \text{Dependent_name}(\text{DEPENDENT}) \right) \\ T2 &\leftarrow \sigma_{\text{No_of_dependents} > 2}(T1) \\ \text{RESULT} &\leftarrow \pi_{\text{Lname}, \text{Fname}}(T2 * \text{EMPLOYEE}) \end{aligned}$$

Query 6.

Retrieve the names of employees who have no dependents.

Solution:

$$\begin{aligned} \text{ALL_EMPS} &\leftarrow \pi_{\text{Ssn}}(\text{EMPLOYEE}) \\ \text{EMPS_WITH_DEPS}(\text{Ssn}) &\leftarrow \pi_{\text{Essn}}(\text{DEPENDENT}) \\ \text{EMPS_WITHOUT_DEPS} &\leftarrow (\text{ALL_EMPS} - \text{EMPS_WITH_DEPS}) \\ \text{RESULT} &\leftarrow \pi_{\text{Lname}, \text{Fname}}(\text{EMPS_WITHOUT_DEPS} * \text{EMPLOYEE}) \end{aligned}$$

Query 7.

List the names of managers who have at least one dependent.

Solution:

$$\begin{aligned} \text{MGRS}(\text{Ssn}) &\leftarrow \pi_{\text{Mgr_ssn}}(\text{DEPARTMENT}) \\ \text{EMPS_WITH_DEPS}(\text{Ssn}) &\leftarrow \pi_{\text{Essn}}(\text{DEPENDENT}) \\ \text{MGRS_WITH_DEPS} &\leftarrow (\text{MGRS} \cap \text{EMPS_WITH_DEPS}) \\ \text{RESULT} &\leftarrow \pi_{\text{Lname}, \text{Fname}}(\text{MGRS_WITH_DEPS} * \text{EMPLOYEE}) \end{aligned}$$