Query Examples in Relational Algebra and SQL

Consider the relation schemas as follows.

works(person_name, company_name, salary);
lives(person_name, street, city);
located_in(company_name, city);
managers(person_name, manager_name);
where manager_name refers to person_name.

a Find the names of the persons who work for company 'FBC' (company_name='FBC').

Relational algebra:

$$\texttt{result} = \pi_{\texttt{person\_name}}(\sigma_{\texttt{company\_name}='\texttt{FBC}'}(works))$$

SQL:

```
Select person_name
From   works
Where  company_name = 'FBC'
```


b List the names of the persons who work for company 'FBC' along with the cities they live in.

Relational algebra:

$$\texttt{NamesForFBC} = \pi_{\texttt{person\_name}}\sigma_{\texttt{company\_name}='\texttt{FBC}'}(works)$$
$$\texttt{TheyLiveIn} = \texttt{NamesForFBC} \bowtie \texttt{lives}$$
$$\texttt{result} = \pi_{\texttt{person\_name,city}}(\texttt{TheyLiveIn})$$

SQL:

```
Select lives.person_name, city
From   works, lives
Where  company_name = 'FBC' and
       works.person_name = lives.person_name
```

c Find the persons who work for company 'FBC' with a salary of more than 10000. List the names of these persons along with the streets and cities where they live.

Relational algebra:

$$\texttt{PersonsOfFBC} = \sigma_{\texttt{company\_name}='\texttt{FBC}'}(\texttt{works})$$
$$\texttt{NameWithBigSal} = \pi_{\texttt{person\_name}}\sigma_{\texttt{salary}>10000}(\texttt{PersonsOfFBC})$$
$$\texttt{result} = \texttt{NameWithBigSal} \bowtie \texttt{lives}$$

SQL:

```
Select lives.person_name, stree, city
From   lives, works
Where  lives.person_name = works.person_name and salary > 10000
       and works.company_name = 'FBC'
```

d Find the names of the persons who live and work in the same city.

Relational algebra:

$$\texttt{WorkLocation} = \pi_{\texttt{person\_name,city}}(\texttt{works} \bowtie \texttt{located\_in})$$
$$\texttt{result} = \pi_{\texttt{person\_name}}\sigma_{\texttt{city=L.city}}(\texttt{WorkLocation} \times \rho_L(\texttt{lives}))$$

SQL:

```
Select person_name
From   works, lives, locates_in
Where  works.person_name = lives.person_name and
       works.company_name = located_in.company_name and
       located_in.city = lives.city
```

e Find the names of the persons who live in the same city and on the same street as their managers.

Relational algebra:

$$\texttt{EAddMAdd} = \sigma_{\texttt{manager\_name=M.person\_name}}(\rho_E(\texttt{lives}) \bowtie \texttt{manager}) \times \rho_M(\texttt{lives})$$
$$\texttt{SameStreetCity} = \sigma_{\texttt{E.street=M.street/E.city=M.city}}(\texttt{EAddMAdd})$$
$$\texttt{result} = \pi_{\texttt{E.person\_name}}(\texttt{SameStreetCity})$$

SQL:


```
Select e.person_name
From   lives e, lives m, managers
Where  e.person_name = managers.person_name and
       m.person_name = manages.manager_name and
       e.street = m.street and e.city = m.city
```


f Find the names of the persons who do not work for company 'FBC'.

Relational algebra:

$$\texttt{PersonForFBC} = \pi_{\texttt{person\_name}}\sigma_{\texttt{companry\_name='FBC'}}(\texttt{works})$$
$$\texttt{WorkPersons} = \pi_{\texttt{person\_name}}(\texttt{works})$$
$$\texttt{result} = \texttt{WorkPersons} - \texttt{PersonForFBC}$$

SQL:

```
Select person_name
From   works
Where  person_name not in (Select person_name
                           From   works
                           Where  company_name = 'FBC')
```

g Find the persons whose salaries are more than the salary of everybody who work for company 'SBC'.

Relational algebra:

$$\texttt{SalariesOfSBC} = \pi_{\texttt{salary}}\sigma_{\texttt{company\_name='SBC'}}(\texttt{works})$$
$$\texttt{WorksWithSalaryOfSBC} = \texttt{works} \times \rho_S(\texttt{SalariesOfSBC})$$
$$\texttt{EarnsLessThanSomeSBC} = \pi_{\texttt{person\_name}}\sigma_{\texttt{salary}\leq\texttt{S.salary}}(\texttt{WorksWithSalaryOfSBC})$$
$$\texttt{result} = \pi_{\texttt{person\_name}}(\texttt{works}) - \texttt{EarnsLessThanSomeSBC}$$

SQL:

```
Select person_name
From   works
Where  salary > all (Select salary
                     From   works
                     Where  company_name = 'SBC')
```

h Find the names of the companies that is located in every city where company 'SBC' is located in.

Relational algebra:

$$\texttt{AllSBCCities} = \pi_{\texttt{city}}\sigma_{\texttt{company\_name}='\texttt{SBC}'}(\texttt{located\_in})$$
$$\texttt{ImaginAllCompanyAtAllSBCLocations} = \pi_{\texttt{company\_name}}(\mathit{located\_in}) \times \texttt{AllSBCCities}$$
$$\texttt{NotReallyTrue} = \texttt{ImaginAllCompanyAtAllSBCLocations} - \texttt{located\_in}$$
$$\texttt{result} = \pi_{\texttt{company\_name}}(\texttt{located\_in}) - \pi_{\texttt{company\_name}}(\texttt{NotReallyTrue})$$

Relational algebra (another solution):

$$\texttt{AllSBCCities} = \pi_{\texttt{city}}\sigma_{\texttt{company\_name}='\texttt{SBC}'}(\texttt{located\_in})$$
$$\texttt{result} = \texttt{located\_in} / \texttt{AllSBCCities}$$

SQL:


```
Select company_name
From   located_in t
Where  (Select city
        From   located_in s
        Where  t.company_name = s.company_name)
         contains (Select city
                   From   located_in s1
                   Where  s1.company_name = 'SBC')
```


SQL (another solution):

```
Select company_name
From   located_in t
Where  not exists
         (Select *
          From located_in s

          Where s.company_name = 'SBC' and
                s.city not in
                   (Select city
                    From   located_in l
                    Where  l.company_name = t.company_name))
```