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:

\[ \text{result} = \pi_{\text{person.name}}(\sigma_{\text{company.name} = 'FBC'}(\text{works})) \]

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:

\[ \text{NamesForFBC} = \pi_{\text{person.name}}(\sigma_{\text{company.name} = 'FBC'}(\text{works})) \]
\[ \text{TheyLiveIn} = \text{NamesForFBC} \bowtie \text{lives} \]
\[ \text{result} = \pi_{\text{person.name}, \text{city}}(\text{TheyLiveIn}) \]

SQL:

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

\[ \text{PersonsOfFBC} = \sigma_{\text{company.name} = 'FBC'}(\text{works}) \]
\[ \text{NameWithBigSal} = \pi_{\text{person.name}, \text{salary}>10000}(\text{PersonsOfFBC}) \]
\[ \text{result} = \text{NameWithBigSal} \bowtie \text{lives} \]

SQL:

Select lives.person_name, street, 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:
   \[
   \begin{align*}
   \text{WorkLocation} &= \pi_{\text{person.name}, \text{city}}(\text{works} \bowtie \text{located_in}) \\
   \text{result} &= \pi_{\text{person.name}, \text{city}}(\text{WorkLocation} \times \rho_E(\text{lives}))
   \end{align*}
   \]

   SQL:
   
   ```
   SELECT `person.name`
   FROM `works`, `lives`, `located_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:
   \[
   \begin{align*}
   \text{EAddMAdd} &= \sigma_{\text{manager.name} = \text{person.name}}(\rho_E(\text{lives}) \bowtie \text{manager}) \times \rho_M(\text{lives}) \\
   \text{SameStreetCity} &= \sigma_{\text{street} = \text{street}}(\text{city} = \text{city})(\text{EAddMAdd}) \\
   \text{result} &= \pi_{\text{person.name}}(\text{SameStreetCity})
   \end{align*}
   \]

   SQL:
   
   ```
   SELECT `e.person.name`
   FROM `lives e`, `lives m`, `managers`
   WHERE `e.person.name` = `managers.person.name` and
   `m.person.name` = `managers.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:
   \[
   \begin{align*}
   \text{PersonForFBC} &= \pi_{\text{person.name}, \text{company.name} = 'FBC'}(\text{works}) \\
   \text{WorkPersons} &= \pi_{\text{person.name}}(\text{works}) \\
   \text{result} &= \text{WorkPersons} - \text{PersonForFBC}
   \end{align*}
   \]

   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:
   \[
   \begin{align*}
   \text{SalariesOfSBC} &= \pi_{\text{salary}, \text{company.name} = 'SBC'}(\text{works}) \\
   \text{WorksWithSalaryOfSBC} &= \text{works} \times \rho_S(\text{SalariesOfSBC}) \\
   \text{EarnsLessThanSomeSBC} &= \pi_{\text{person.name}, \text{salary} \leq \text{salary}}(\text{WorksWithSalaryOfSBC}) \\
   \text{result} &= \pi_{\text{person.name}}(\text{works}) - \text{EarnsLessThanSomeSBC}
   \end{align*}
   \]
h) Find the names of the companies that is located in every city where company 'SBC' is located in.

Relational algebra:

\[
\begin{align*}
\text{AllSBCCities} &= \pi_{\text{city}'}(\text{company.name} = 'SBC') \text{(located_in)} \\
\text{ImaginAllCompanyAtAllSBCLocations} &= \pi_{\text{company.name}}(\text{located_in}) \times \text{AllSBCCities} \\
\text{NotReallyTrue} &= \text{ImaginAllCompanyAtAllSBCLocations} \setminus \text{located_in} \\
\text{result} &= \pi_{\text{company.name}}(\text{located_in}) - \pi_{\text{company.name}}(\text{NotReallyTrue})
\end{align*}
\]

Relational algebra (another solution):

\[
\begin{align*}
\text{AllSBCCities} &= \pi_{\text{city}'}(\text{company.name} = 'SBC') \text{(located_in)} \\
\text{result} &= \text{located_in/AllSBCCities}
\end{align*}
\]

SQL:

\[
\begin{align*}
\text{Select} & \quad \text{company.name} \\
\text{From} & \quad \text{located_in t} \\
\text{Where} & \quad (\text{Select} \quad \text{city} \\
& \quad \text{From} \quad \text{located_in s} \\
& \quad \text{Where} \quad t.\text{company.name} = s.\text{company.name}) \\
& \quad \text{contains} \quad (\text{Select} \quad \text{city} \\
& \quad \text{From} \quad \text{located_in s1} \\
& \quad \text{Where} \quad s1.\text{company.name} = 'SBC')
\end{align*}
\]

SQL (another solution):

\[
\begin{align*}
\text{Select} & \quad \text{company.name} \\
\text{From} & \quad \text{located_in t} \\
\text{Where} & \quad \text{not exists} \\
& \quad (\text{Select} \quad * \\
& \quad \text{From} \quad \text{located_in s} \\
& \quad \text{Where} \quad s.\text{company.name} = 'SBC' \quad \text{and} \\
& \quad s.\text{city} \text{ not in} \\
& \quad (\text{Select} \quad \text{city} \\
& \quad \text{From} \quad \text{located_in l} \\
& \quad \text{Where} \quad l.\text{company.name} = t.\text{company.name}))
\end{align*}
\]