UNIT 2

Lecture 21
Relational Algebra
Questions with solutions

Question 1

Consider the relational database below, where the primary keys are underlined. Give an expression in the relational algebra to express each of the following queries :

Employee (pname, street, city)

Works (pname, cname, salary)

Company (cname, city)

Manages (pname, mgrname)

1. Find the names of all employees who work for First Bank Corporation.

2. Find the names and cities of residence of all employees who work for First Bank Corporation.

3. Find the names, street address, and cities of residence of all employees who work for First Bank Corporation and earn more than $10,000 per annum.

4. Find the names of all employees in this database who live in the same city as the company for which they work.

5. Find the names of all employees who live in the same city and on the same street as do their managers.

6. Find the names of all employees in this database who do not work for First Bank Corporation.

7. Find the names of all employees who earn more than every employee of Small Bank Corporation.

8. Assume the companies may be located in several cities. Find all companies located in every city in which Small Bank Corporation is located.

1. Find the names of all employees who work for First Bank Corporation.

Employee (pname, street, city)

Works (pname, cname, salary)

Company (cname, city)

Manages (pname, mgrname)

RA : $\prod_{pname}(\sigma_{cname\ =\ \text{"First Bank Corporation"}}(Works))$

SQL : Select distinct pname from works where cname = 'First Bank Corporation';

2. Find the names and cities of residence of all employees who work for First Bank Corporation.

Employee (pname, street, city)

Works (pname, cname, salary)

Company (cname, city)

Manages (pname, mgrname)

RA : $\Pi_{pname, city}(Employee \bowtie (\sigma_{cname = \text{"First Bank Corporation"}}(Works)))$

RA : $\Pi_{pname, city}(\sigma_{cname = \text{"First Bank Corporation"}}(Employee \bowtie Works))$

SQL : Select distinct pname, city from employee natural join works where cname = 'First Bank Corporation';

3. Find the names, street address, and cities of residence of all employees who work for First Bank Corporation and earn more than $10,000 per annum.

Employee (pname, street, city)

Works (pname, cname, salary)

Company (cname, city)

Manages (pname, mgrname)

RA : $\Pi_{pname, street, city}(\sigma_{cname = \text{"First Bank Corporation"} \wedge salary > 10000}(Employee \bowtie Works))$

SQL : select distinct pname, street, city from employee natural join works where cname = 'First Bank Corporation' and salary > 10000;

4. Find the names of all employees in this database who live in the same city as the company for which they work.

Employee (pname, street, city)
Works (pname, cname, salary)
Company (cname, city)
Manages (pname, mgrname)

RA : $\Pi_{employee.pname}(\sigma_{employee.city\ =\ company.city\ \wedge\ employee.pname\ =\ works.pname\ \wedge\ works.cname\ =\ company.cname}(Employee \times Works \times Company))$

SQL : select distinct employee.pname from employee, works, company where employee.city = company.city and employee.pname = works.pname and works.cname = company.cname;

4. Find the names of all employees in this database who live in the same city as the company for which they work.

Employee (pname, street, city)

Works (pname, cname, salary)

Company (cname, city)

Manages (pname, mgrname)

RA : $\Pi_{pname}(Employee \bowtie Works \bowtie Company)$

SQL : select distinct pname from employee natural join works natural join company;

5. Find the names of all employees who live in the same city and on the same street as do their managers.

Employee (pname, street, city)
Works (pname, cname, salary)
Company (cname, city)
Manages (pname, mgrname)

RA : $\Pi_{e.pname} (\rho_e(Employee) \times Manages \bowtie_{(e1.pname = manages.pname \wedge mgrname = m.pname \wedge e.street = m.street \wedge e.city = m.city)} \rho_m(Employee))$

SQL : select distinct e1.pname from employee e, manages, employee m where e.street = m.street and e.city = m.city and mgrname = m.pname and e1.pname = manages.pname;

6. Find the names of all employees in this database who do not work for First Bank Corporation.

Employee (pname, street, city)

Works (pname, cname, salary)

Company (cname, city)

Manages (pname, mgrname)

RA : $\Pi_{pname}(\sigma_{cname \neq \text{"First Bank Corporation"}}(Works))$

SQL : Select distinct pname from works where cname <> 'First Bank Corporation';

7. Find the names of all employees who earn more than every employee of Small Bank Corporation.

Employee (pname, street, city)

Works (pname, cname, salary)

Company (cname, city)

Manages (pname, mgrname)

RA : $\Pi_{pname}(Works) - (\Pi_{pname}(\rho_{w1}(Works) \bowtie_{(w1.salary \leq w2.salary \wedge w2.cname = "Small Bank Corporation")} (\rho_{w2}(Works))))$

SQL : Select distinct pname from works where salary > all (select salary from works where cname = 'Small Bank Corporation');

8. Assume the companies may be located in several cities. Find all companies located in every city in which Small Bank Corporation is located.

Employee (pname, street, city)

Works (pname, cname, salary)

Company (cname, city)

Manages (pname, mgrname)

RA : $Company \div \sqcap_{city} (\sigma_{cname = \text{"Small Bank Corporation"}} (Company))$

SQL : Select distinct cname from company a where

not exists (select * from company b where cname = 'Small Bank Corporation' and

not exists (select * from company c where a.cname = c.cname and b.city = c.city));

1. Modify the database so that Jones now lives in Newtown.

Employee (pname, street, city)

Works (pname, cname, salary)

Company (cname, city)

Manages (pname, mgrname)

RA : Employee $\leftarrow$ $\prod_{\text{pname, street, "Newtown"}}$ ($\sigma_{\text{pname = "Jones"}}$ (Employee))

$\cup$ (Employee $-$ $\sigma_{\text{pname = "Jones"}}$ (Employee))

SQL : update employee set city = 'Newtown' where pname = 'Jones';

2. Give all employees of First Bank Corporation a 10 percent salary raise.

Employee (pname, street, city)

Works (pname, cname, salary)

Company (cname, city)

Manages (pname, mgrname)

RA : Works $\leftarrow \prod_{\text{pname, cname, 1.1* salary}} (\sigma_{\text{cname = "First Bank Corporation"}} (\text{Works}))$

$\cup$ (Works $- \sigma_{\text{cname = "First Bank Corporation"}} (\text{Works}))$

SQL : update works set salary = salary * 1.1 where cname = 'First Bank Corporation';

3. Give all managers in this database a 10 percent salary raise.

Employee (pname, street, city)

Works (pname, cname, salary)

Company (cname, city)

Manages (pname, mgrname)

RA :

$t1 \leftarrow \prod_{works.pname, cname, salary} (\sigma_{works.pname = mgrname} (Works \times Manages))$

$t2 \leftarrow \prod_{pname, cname, 1.1 * salary} (t1)$

Works $\leftarrow$ (Works $-$ t1) $\cup$ t2

SQL : update works set salary = salary * 1.1 where pname in (select mgrname from manages);

4. Give all managers in this database a 10 percent salary raise, unless the salary would be greater than $100,000. In such cases, give only a 3 percent raise.

Employee (pname, street, city)

Works (pname, cname, salary)

Company (cname, city)

Manages (pname, mgrname)

$$t1 \leftarrow \prod_{works.pname, \ cname, \ salary} (\sigma_{works.pname \ = \ mgrname} (Works \times Manages))$$

$$t2 \leftarrow \prod_{pname, \ cname, \ 1.03 \ * \ salary} (\sigma_{t1.salary \ * \ 1.1 \ > 100000} (t1))$$

$$t2 \leftarrow t2 \cup (\prod_{works.pname, \ cname, \ 1.1 \ * \ salary} (\sigma_{t1.salary \ * \ 1.1 \ \leq \ 100000} (t1)))$$

$$Works \leftarrow (Works - t1) \cup t2$$

5. Delete all tuples in the works relation for employees of Small Bank Corporation.

Employee (pname, street, city)

Works (pname, cname, salary)

Company (cname, city)

Manages (pname, mgrname)

RA : Works ← Works – $\sigma_{cname = \text{"Small Bank Corporation"}}$ (Works)

SQL : delete from works where cname = 'Small Bank Corporation';

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The link for my youtube channel is

https://www.youtube.com/channel/UCRWGtE76JlTp1iim6aOTRuw?sub_confirmation=1