Sample Data

employee

ename	street	city
Barkat	*x*	Bogra
Jabbar	*x*	Comilla
Jubayer	*u*	Faridpur
Najmun Nahar	*y*	Sylhet
Oronno	*z*	Dhaka
Rafique	*z*	Rajshahi
Rahim	*w*	Dhaka
Sabbir	*v*	Chittagong
Salam	*y*	Comilla
Sharafat	*w*	Dhaka

works

ename	cname	salary	jdate
Rahim	First Bank Corporation	50000	2008-01-01
Barkat	First Bank Corporation	40000	2007-01-01
Salam	First Bank Corporation	60000	2009-07-01
Rafique	Small Bank Corporation	30000	2009-06-08
Sharafat	First Bank Corporation	80000	2005-06-01
Jabbar	Small Bank Corporation	10000	2009-06-05
Najmun Nahar	Small Bank Corporation	20000	2009-06-30
Oronno	The ONE Limited	50000	2007-06-01
Jubayer	Square Pharma	15000	2008-01-01
Sabbir	Vegabond Company	100000	2001-01-01

company

cname	city
Anonymous IT	Chittagong
Dream Tech	Chittagong
First Bank Corporation	Dhaka
JONS IT (Pvt.) Limited	Sylhet
Small Bank Corporation	Dhaka
Square Pharma	Bogra
The ONE Limited	Dhaka
Unique Softs	Dhaka
Unknown Systems	Rajshahi
Vegabond Company	Bogra

manages

ename	mname
Rahim	Sharafat
Barkat	Sharafat
Salam	Sharafat
Rafique	Oronno
Jabbar	Oronno
Najmun Nahar	Sabbir
Jubayer	Sabbir

employee (ename, street, city)
works (ename, cname, salary, jdate)
company (cname, city)
manages (ename, mname)

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

SQL:
```
select ename from works where cname = 'First Bank Corporation';
```

RA: $\Pi_{\text{ename}}(\sigma_{\text{cname = "First Bank Corporation"}}(\text{works}))$

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

SQL:
```
select ename, city from employee natural join works
where cname = 'First Bank Corporation';
```

RA: $\Pi_{\text{ename, city}}(\sigma_{\text{cname = "First Bank Corporation"}}(\text{employee} \bowtie \text{works}))$

3. Find the names, street address, and cities of residence of all employees who work for First Bank Corporation and earn more than Tk. 30000.

SQL:
```
select ename, street, city from employee natural join works
where cname = 'First Bank Corporation' and salary > 30000;
```

RA: $\Pi_{\text{ename, street, city}}(\sigma_{\text{cname = "First Bank Corporation"} \wedge \text{salary} > 30000}(\text{employee} \bowtie \text{works}))$

4. Find names, street addresses and cities of residence of all employees who work under manager Sabbir and who joined before January 01, 2009.

SQL:
```
select ename, street, city
from employee natural join works natural join manages
where mname = 'Sabbir' and jdate < '01-JAN-09';
```

RA: $\Pi_{\text{ename, street, city}}(\sigma_{\text{mname = "Sabbir"} \wedge \text{jdate} < \text{"01-jan-09"}}(\text{employee} \bowtie \text{works} \bowtie \text{manages}))$

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

SQL:
```
select ename from employee natural join works natural join company;
```

RA: $\Pi_{\text{ename}}(\text{employee} \bowtie \text{works} \bowtie \text{company})$

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

SQL:
```
select employee.ename from employee natural join manages, employee as emp
where mname = emp.ename and employee.street = emp.street and employee.city = emp.city;
```

RA: $\Pi_{\text{employee.ename}}$

$(\sigma_{\text{mname = emp.ename} \wedge \text{employee.street = emp.street} \wedge \text{employee.city = emp.city}}(\text{employee} \bowtie \text{manages} \times \rho_{\text{emp}}(\text{employee})))$

7. Find the names of the employees living in the same city where Rahim is residing.

SQL:
```
select ename from employee where city = (
    select city from employee where ename = 'Rahim'
);
```

RA: $t \leftarrow \Pi_{\text{city}}(\sigma_{\text{ename = "Rahim"}}(\text{employee}))$

$\Pi_{\text{ename}}(\text{employee} \bowtie t)$

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

SQL:
```
select ename from works where cname <> 'First Bank Corporation';
```

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

employee (ename, street, city)
works (ename, cname, salary, jdate)
company (cname, city)
manages (ename, mname)

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

SQL:
```
select ename from works where salary > (
    select max(salary) from works where cname = 'Small Bank Corporation'
);
```

RA: $t \leftarrow \mathcal{G}_{\max(salary)\ as\ max\_salary}(\sigma_{cname = "Small\ Bank\ Corporation"}(works))$
$\Pi_{ename}(\sigma_{salary > max\_salary}(works \times t))$

OR, $t_1 \leftarrow \Pi_{works.salary}(\sigma_{works.salary < w.salary\ and\ w.cname = "Small\ Bank\ Corporation"}(works \times \rho_{w}(works)))$
$t_2 \leftarrow \Pi_{salary}(\sigma_{w.cname = "Small\ Bank\ Corporation"}(works)) - t_1$
$\Pi_{ename}(\sigma_{works.salary > t2.salary}(works \times t_2))$

10. Find the names of all employees who earn more than *any* employee of Small Bank Corporation.

SQL:
```
select ename from works where salary > (
    select min(salary) from works where cname = 'Small Bank Corporation'
);
```

RA: $t \leftarrow \mathcal{G}_{\min(salary)\ as\ min\_salary}(\sigma_{cname = "Small\ Bank\ Corporation"}(works))$
$\Pi_{ename}(\sigma_{salary > min\_salary}(works \times t))$

OR, $t_1 \leftarrow \Pi_{works.salary}(\sigma_{works.salary > w.salary\ and\ w.cname = "Small\ Bank\ Corporation"}(works \times \rho_{w}(works)))$
$t_2 \leftarrow \Pi_{salary}(\sigma_{w.cname = "Small\ Bank\ Corporation"}(works)) - t_1$
$\Pi_{ename}(\sigma_{works.salary > t2.salary}(works \times t_2))$

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

SQL:
```
select cname from company where city in (
    select city from company where cname = 'Small Bank Corporation'
);
```

RA: $city \leftarrow \Pi_{city}(\sigma_{cname = "Small\ Bank\ Corporation"}(company))$

$\Pi_{cname}(company \bowtie city)$

OR, $\Pi_{cname}(company \div (\Pi_{city}(\sigma_{cname = "Small\ Bank\ Corporation"}(company))))$

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

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

RA: $t \leftarrow \Pi_{ename, cname, salary * 1.1, jdate}(\sigma_{cname = "First\ Bank\ Corporation"}(works))$

$works \leftarrow t \cup (works - \sigma_{cname = "First\ Bank\ Corporation"}(works))$

13. Give all managers in the database a 10% salary raise.

SQL:
```
update works set salary = salary * 1.1 where ename in (
    select distinct mname from manages
);
```

RA: $t_1 \leftarrow \Pi_{works.ename, cname, salary, jdate}(\sigma_{works.ename = mname}(works \times manages))$
$t_2 \leftarrow \Pi_{works.ename, cname, salary * 1.1, jdate}(t_1)$

$works \leftarrow (works - t_1) \cup t_2$

employee (ename, street, city)
works (ename, cname, salary, jdate)
company (cname, city)
manages (ename, mname)

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

SQL:
```
update works set salary = case
                              when salary * 1.1 > 100000 then salary * 1.03
                              else salary * 1.1
                          end
    where ename in (
        select distinct mname from manages
    );
```

RA: $t_1 \leftarrow \Pi_{\text{works.ename, cname, salary, jdate}} (\sigma_{\text{works.ename} = \text{mname}} (\text{works} \times \text{manages}))$

$t_2 \leftarrow \Pi_{\text{works.ename, cname, salary * 1.03, jdate}} (\sigma_{\text{t1.salary * 1.1} > 100000} (t_1))$

$t_2 \leftarrow t_2 \cup (\Pi_{\text{works.ename, cname, salary * 1.1, jdate}} (\sigma_{\text{t1.salary * 1.1} \leq 100000} (t_1)))$

$\text{works} \leftarrow (\text{works} - t_1) \cup t_2$

15. Increase the salary of employees by 10% for the companies those are located in Bogra.

SQL:
```
update works set salary = salary * 1.1 where cname in (
    select cname from company where city = 'Bogra'
);
```

RA: $t_1 \leftarrow \Pi_{\text{ename, cname, salary, jdate}} (\sigma_{\text{city} = \text{"Bogra"}} (\text{works} \bowtie \text{company}))$

$t_2 \leftarrow \Pi_{\text{ename, cname, salary * 1.1, jdate}} (t_1)$

$\text{works} \leftarrow (\text{works} - t_1) \cup t_2$

16. Modify the database so that Rahim now lives in Bhola.

SQL:
```
update employee set city = 'Bhola' where ename = 'Rahim';
```

RA: $t \leftarrow \Pi_{\text{ename, street, "Bhola"}} (\sigma_{\text{ename} = \text{"Rahim"}} (\text{employee}))$

$\text{works} \leftarrow (\text{works} - (\sigma_{\text{ename} = \text{"Rahim"}} (\text{employee}))) \cup t$

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

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

RA: $\text{works} \leftarrow \text{works} - (\sigma_{\text{cname} = \text{"Small Bank Corporation"}} (\text{works}))$

18. Delete records from *works* that contain employees living in Rajshahi.

SQL:
```
delete from works where ename in (
    select ename from employee where city = 'Rajshahi'
);
```

RA: $t \leftarrow \Pi_{\text{ename}} (\sigma_{\text{city} = \text{"Rajshahi"}} (\text{employee}))$

$\text{works} \leftarrow \text{works} - \Pi_{\text{ename, cname, salary, jdate}} (\text{works} \bowtie t)$

19. Display the average salary of each company except Square Pharma.

SQL:
```
select cname, avg(salary) from works where cname <> 'Square Pharma' group by cname;
```

RA: $_{\text{cname}}\mathcal{G}_{\text{avg(salary)}} (\sigma_{\text{cname} \neq \text{"Square Pharma"}} (\text{works}))$

employee (ename, street, city)
works (ename, cname, salary, jdate)
company (cname, city)
manages (ename, mname)

20. Find the company with the most employees.

SQL:
```
select cname, count(distinct ename) from works group by cname
having count(distinct ename) >= all (
    select count(distinct ename) from works group by cname
);
```

RA: $t_1 \leftarrow {}_{\text{cname}}\mathcal{G}_{\text{count(ename) as num\_employees}}$ (works)
$t_2 \leftarrow \mathcal{G}_{\text{max(num\_employees) as num\_employees}}$ (t_1)

Π_{cname} ($t_1 \bowtie t_2$)

21. Find the company that has the smallest payroll[1]. [*Similar to query 20*]

SQL:
```
select cname, sum(salary) from works group by cname
having sum(salary) <= all (
    select sum(salary) from works group by cname
);
```

RA: $t_1 \leftarrow {}_{\text{cname}}\mathcal{G}_{\text{sum(salary) as payroll}}$ (works)
$t_2 \leftarrow \mathcal{G}_{\text{min(payroll) as payroll}}$ (t_1)

Π_{cname} ($t_1 \bowtie t_2$)

22. Find the company with payroll less than Tk. 100000.

SQL:
```
select cname, sum(salary) from works group by cname having sum(salary) < 100000;
```

RA: $t \leftarrow {}_{\text{cname}}\mathcal{G}_{\text{sum(salary)}}$ (works)
Π_{cname} ($\sigma_{\text{payroll} < 100000}$ ($\rho_{\text{c\_payroll (cname, payroll)}}$ (t)))

23. Find those companies whose employees earn a higher salary, on average, than the average salary of Small Bank Corporation.

SQL:
```
select cname from works group by cname
having avg(salary) > (
    select avg(salary)
    from works
    where cname = 'Small Bank Corporation'
);
```

RA: $t_1 \leftarrow {}_{\text{cname}}\mathcal{G}_{\text{avg(salary)}}$ (works)
$t_2 \leftarrow \sigma_{\text{cname = "Small Bank Corporation"}}$ (t_1)
$\Pi_{\text{t3.cname}}$ ($\sigma_{\text{t3.avg\_salary > small-bank.avg\_salary}}$ ($\rho_{\text{t3 (cname, avg\_salary)}}$ (t_1) × $\rho_{\text{small-bank (cname, avg\_salary)}}$ (t_2)))

[1] **Payroll:** The total amount of money paid by a company as salary for all the employers.