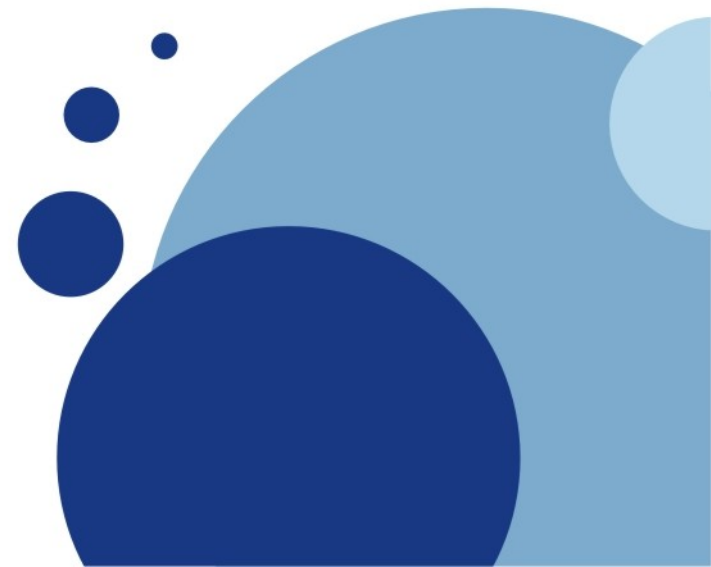


Division

Dr. Rim Moussa



DIVISION Operation

- DIVISION operation, denoted by \div
- Typical Query: *Retrieve the names of employees who work on all the projects that 'John Smith' works on.*

Smith employee:

$SMITH \leftarrow \sigma_{Fname='John' \text{ AND } Lname='Smith'}(EMPLOYEE)$

Smith projects' numbers

$SMITH_PNOS \leftarrow \pi_{\{Pno\}}(WORKS_ON \bowtie_{Essn = Ssn} SMITH)$

WORKS_ON projected on employee-ssn and project-number

$SSN_PNOS \leftarrow \pi_{\{Essn, Pno\}}(WORKS_ON)$

Division

$SSNS (Ssn) \leftarrow SSN_PNOS \div SMITH_PNOS$

*: natural join

$RESULT \leftarrow \pi_{\{Fname, Minit, Lname\}}(SSNS * EMPLOYEE)$

DIVISION Operation (details 1)

EMPLOYEE

Fname	Minit	Lname	<u>Ssn</u>	Bdate	Address	Sex	Salary	Super_ssn	Dno
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4
Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NULL	1

Smith employee:

$SMITH \leftarrow \sigma_{Fname='John' \text{ AND } Lname='Smith'}(EMPLOYEE)$

Fname	Minit	Lname	<u>Ssn</u>	Bdate	Address	Sex	Salary	Super_ssn	Dno
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5

DIVISION Operation (details 2)

WORKS_ON

<u>Essn</u>	<u>Pno</u>	Hours
123456789	1	32.5
123456789	2	7.5
666884444	3	40.0
453453453	1	20.0
453453453	2	20.0
333445555	2	10.0
333445555	3	10.0
333445555	10	10.0
333445555	20	10.0
999887777	30	30.0
999887777	10	10.0
987987987	10	35.0
987987987	30	5.0
987654321	30	20.0
987654321	20	15.0
888665555	20	NULL

SMITH

<u>Fname</u>	<u>Minit</u>	<u>Lname</u>	<u>Ssn</u>	Bdate	Address	Sex	Salary	Super_ssn	Dno
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5

SMITH_PNOS

Pno
1
2

Smith projects' numbers

$SMITH_PNOS \leftarrow \pi_{\{Pno\}} (WORKS_ON \bowtie_{Essn = Ssn} SMITH)$

DIVISION Operation (details 3)

WORKS_ON projected on *employee-ssn* and *project-number*

$SSN_PNOS \leftarrow \pi_{\{Essn, Pno\}}(WORKS_ON)$

WORKS_ON

<u>Essn</u>	<u>Pno</u>	Hours
123456789	1	32.5
123456789	2	7.5
666884444	3	40.0
453453453	1	20.0
453453453	2	20.0
333445555	2	10.0
333445555	3	10.0
333445555	10	10.0
333445555	20	10.0
999887777	30	30.0
999887777	10	10.0
987987987	10	35.0
987987987	30	5.0
987654321	30	20.0
987654321	20	15.0
888665555	20	NULL

SSN_PNOS

<u>Essn</u>	<u>Pno</u>
123456789	1
123456789	2
666884444	3
453453453	1
453453453	2
333445555	2
333445555	3
333445555	10
333445555	20
999887777	30
999887777	10
987987987	10
987987987	30
987654321	30
987654321	20
888665555	20

DIVISION Operation (details 4)

Division

$SSNS (Ssn) \leftarrow SSN_PNOS \div SMITH_PNOS$

SSN_PNOS

Essn	Pno
123456789	1
123456789	2
666884444	3
453453453	1
453453453	2
333445555	2
333445555	3
333445555	10
333445555	20
999887777	30
999887777	10
987987987	10
987987987	30
987654321	30
987654321	20
888665555	20

SMITH_PNOS

Pno
1
2

SSNS

Ssn
123456789
453453453

DIVISION Operation (details 5)

*: natural join (equi-join on attributes with same label in both relations)

RESULT $\leftarrow \pi_{\{Fname, Minit, Lname\}}(SSNS * EMPLOYEE)$



EMPLOYEE

Fname	Minit	Lname	<u>Ssn</u>	Bdate	Address	Sex	Salary	Super_ssn	Dno
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4
Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NULL	1

SSNS



<u>Ssn</u>
123456789
453453453

Fname	Minit	Lname
John	B	Smith
Joyce	A	English

DIVISION Operation Examples on DVD Rental DB

- Query: *Retrieve the names of actors who played in all the films that actor 'Lucille Tracy' played in.*
- There is no direct way to express division in SQL
- *Double Negation*: It doesn't exist a movie that 'Penelope Guinness' played in, that actor(s) searched didn't play in

```
SELECT a1.*
```

```
FROM actor a1
```

```
WHERE NOT EXISTS (SELECT fa2.film_id
```

```
FROM film_actor fa2, actor a2
```

```
WHERE fa2.actor_id = a2.actor_id
```

```
AND a2.first_name = 'Lucille'
```

```
AND a2.last_name = 'Tracy'
```

```
AND NOT EXISTS (SELECT *
```

```
FROM film_actor fa1
```

```
WHERE fa1.actor_id = a1.actor_id
```

```
AND fa1.film_id = fa2.film_id));
```


Summary of RA Operations by Elmasri et Navathe

OPERATION	PURPOSE	NOTATION
SELECT	Selects all tuples that satisfy the selection condition from a relation R .	$\sigma_{\langle \text{selection condition} \rangle}(R)$
PROJECT	Produces a new relation with only some of the attributes of R , and removes duplicate tuples.	$\pi_{\langle \text{attribute list} \rangle}(R)$
THETA JOIN	Produces all combinations of tuples from R_1 and R_2 that satisfy the join condition.	$R_1 \bowtie_{\langle \text{join condition} \rangle} R_2$
EQUIJOIN	Produces all the combinations of tuples from R_1 and R_2 that satisfy a join condition with only equality comparisons.	$R_1 \bowtie_{\langle \text{join condition} \rangle} R_2$, OR $R_1 \bowtie_{(\langle \text{join attributes 1} \rangle, \langle \text{join attributes 2} \rangle)} R_2$
NATURAL JOIN	Same as EQUIJOIN except that the join attributes of R_2 are not included in the resulting relation; if the join attributes have the same names, they do not have to be specified at all.	$R_1^* \langle \text{join condition} \rangle R_2$, OR $R_1^* (\langle \text{join attributes 1} \rangle, \langle \text{join attributes 2} \rangle) R_2$ OR $R_1 * R_2$
UNION	Produces a relation that includes all the tuples in R_1 or R_2 or both R_1 and R_2 ; R_1 and R_2 must be union compatible.	$R_1 \cup R_2$
INTERSECTION	Produces a relation that includes all the tuples in both R_1 and R_2 ; R_1 and R_2 must be union compatible.	$R_1 \cap R_2$
DIFFERENCE	Produces a relation that includes all the tuples in R_1 that are not in R_2 ; R_1 and R_2 must be union compatible.	$R_1 - R_2$
CARTESIAN PRODUCT	Produces a relation that has the attributes of R_1 and R_2 and includes as tuples all possible combinations of tuples from R_1 and R_2 .	$R_1 \times R_2$
DIVISION	Produces a relation $R(X)$ that includes all tuples $t[X]$ in $R_1(Z)$ that appear in R_1 in combination with every tuple from $R_2(Y)$, where $Z = X \cup Y$.	$R_1(Z) \div R_2(Y)$

Query Trees Notation