

# **Tutorial 5: Relational Algebra**

**CS3402 Database Systems**

# Question 1

- Consider the two tables T1 and T2 shown below; show the results of the following operations.

a)  $T1 \times T2$

b)  $T1 \bowtie_{T1.P=T2.A} T2$

c)  $T1 \bowtie_{T1.Q=T2.B} T2$

d)  $T1 \bowtie_{T1.R>T2.R} T2$

e)  $T1 * T2$

T1

P	Q	R
10	a	5
15	b	8
25	a	6

T2

A	B	R
10	b	6
25	c	3
10	b	5

# Question 1(a) (Answer) (1/3)

➤ T1 × T2

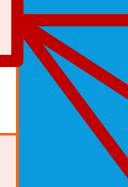
P	Q	R1	A	B	R2
10	a	5	10	b	6
10	a	5	25	c	3
10	a	5	10	b	5
15	b	8	10	b	6
15	b	8	25	c	3
15	b	8	10	b	5
25	a	6	10	b	6
25	a	6	25	c	3
25	a	6	10	b	5

T1

P	Q	R
10	a	5
15	b	8
25	a	6

T2

A	B	R
10	b	6
25	c	3
10	b	5



# Question 1(a) (Answer) (2/3)

➤ T1 × T2

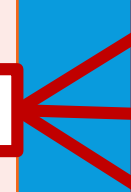
P	Q	R1	A	B	R2
10	a	5	10	b	6
10	a	5	25	c	3
10	a	5	10	b	5
15	b	8	10	b	6
15	b	8	25	c	3
15	b	8	10	b	5
25	a	6	10	b	6
25	a	6	25	c	3
25	a	6	10	b	5

T1

P	Q	R
10	a	5
15	b	8
25	a	6

T2

A	B	R
10	b	6
25	c	3
10	b	5



# Question 1(a) (Answer) (3/3)

➤ T1 × T2

P	Q	R1	A	B	R2
10	a	5	10	b	6
10	a	5	25	c	3
10	a	5	10	b	5
15	b	8	10	b	6
15	b	8	25	c	3
15	b	8	10	b	5
25	a	6	10	b	6
25	a	6	25	c	3
25	a	6	10	b	5

T1

P	Q	R
10	a	5
15	b	8
25	a	6

T2

A	B	R
10	b	6
25	c	3
10	b	5

# Question 1(b) (Answer) (1/9)

➤  $T1 \bowtie_{T1.P=T2.A} T2$

P	Q	R1	A	B	R2
10	a	5	10	b	6
10	a	5	10	b	5
25	a	6	25	c	3

T1

P	Q	R
10	a	5
15	B	8
25	A	6

T2

A	B	R
10	b	6
25	c	3
10	b	5

# Question 1(b) (Answer) (2/9)

➤  $T1 \bowtie_{T1.P=T2.A} T2$

P	Q	R1	A	B	R2
10	a	5	10	b	6
10	a	5	10	b	5
25	a	6	25	c	3

T1

P	Q	R
10	a	5
15	b	8
25	a	6

T2

A	B	R
10	b	6
25	c	3
10	b	5

# Question 1(b) (Answer) (3/9)

➤  $T1 \bowtie_{T1.P=T2.A} T2$

P	Q	R1	A	B	R2
10	a	5	10	b	6
10	a	5	10	b	5
25	a	6	25	c	3

T1

P	Q	R
10	a	5
15	b	8
25	a	6

T2

A	B	R
10	b	6
25	c	3
10	b	5



# Question 1(b) (Answer) (4/9)

➤  $T1 \bowtie_{T1.P=T2.A} T2$

P	Q	R1	A	B	R2
10	a	5	10	b	6
10	a	5	10	b	5
25	a	6	25	c	3

T1

P	Q	R
10	a	5
15	b	8
25	a	6

T2

A	B	R
10	b	6
25	c	3
10	b	5

# Question 1(b) (Answer) (5/9)

➤  $T1 \bowtie_{T1.P=T2.A} T2$

P	Q	R1	A	B	R2
10	a	5	10	b	6
10	a	5	10	b	5
25	a	6	25	c	3

T1

P	Q	R
10	a	5
15	b	8
25	a	6

T2

A	B	R
10	b	6
25	c	3
10	b	5

# Question 1(b) (Answer) (6/9)

➤  $T1 \bowtie_{T1.P=T2.A} T2$

P	Q	R1	A	B	R2
10	a	5	10	b	6
10	a	5	10	b	5
25	a	6	25	c	3

T1

P	Q	R
10	a	5
15	b	8
25	a	6

T2

A	B	R
10	b	6
25	c	3
10	b	5

# Question 1(b) (Answer) (7/9)

➤  $T1 \bowtie_{T1.P=T2.A} T2$

P	Q	R1	A	B	R2
10	a	5	10	b	6
10	a	5	10	b	5
25	a	6	25	c	3

T1

P	Q	R
10	a	5
15	b	8
25	a	6

T2

A	B	R
10	b	6
25	c	3
10	b	5

# Question 1(b) (Answer) (8/9)

➤  $T1 \bowtie_{T1.P=T2.A} T2$

P	Q	R1	A	B	R2
10	a	5	10	b	6
10	a	5	10	b	5
25	a	6	25	c	3

T1

P	Q	R
10	a	5
15	b	8
25	a	6

T2

A	B	R
10	b	6
25	c	3
10	b	5

# Question 1(b) (Answer) (9/9)

➤  $T1 \bowtie_{T1.P=T2.A} T2$

P	Q	R1	A	B	R2
10	a	5	10	b	6
10	a	5	10	b	5
25	a	6	25	c	3

T1

P	Q	R
10	a	5
15	b	8
25	a	6

T2


A	B	R
10	b	6
25	c	3
10	b	5

# Question 1(c) (Answer)

➤  $T1 \bowtie_{T1.Q=T2.B} T2$

P	Q	R1	A	B	R2
15	b	8	10	b	6
15	b	8	10	b	5

T1			T2		
P	Q	R	A	B	R
10	a	5	10	b	6
15	b	8	25	c	3
25	a	6	10	b	5



# Question 1(d) (Answer) (1/3)

➤  $T1 \bowtie_{T1.R > T2.R} T2$

P	Q	R1	A	B	R2
10	a	5	25	c	3
15	b	8	10	b	6
15	b	8	25	c	3
15	b	8	10	b	5
25	a	6	25	c	3
25	a	6	10	b	5

T1

P	Q	R
10	a	5
15	b	8
25	a	6

T2

A	B	R
10	b	6
25	c	3
10	b	5



# Question 1(d) (Answer) (2/3)

➤  $T1 \bowtie_{T1.R > T2.R} T2$

P	Q	R1	A	B	R2
10	a	5	25	c	3
15	b	8	10	b	6
15	b	8	25	c	3
15	b	8	10	b	5
25	a	6	25	c	3
25	a	6	10	b	5

T1

P	Q	R
10	a	5
15	b	8
25	a	6

T2

A	B	R
10	b	6
25	c	3
10	b	5

# Question 1(d) (Answer) (3/3)

➤  $T1 \bowtie_{T1.R > T2.R} T2$

P	Q	R1	A	B	R2
10	a	5	25	c	3
15	b	8	10	b	6
15	b	8	25	c	3
15	b	8	10	b	5
25	a	6	25	c	3
25	a	6	10	b	5

T1

P	Q	R
10	a	5
15	b	8
25	a	6

T2

A	B	R
10	b	6
25	c	3
10	b	5

# Question 1(e) (Answer) (1/2)

➤  $T1 * T2$

P	Q	R	A	B
10	a	5	10	b
25	a	6	10	b

T1

P	Q	R
10	a	5
15	b	8
25	a	6

T2

A	B	R
10	b	6
25	c	3
10	b	5

# Question 1(e) (Answer) (2/2)

➤  $T1 * T2$

P	Q	R	A	B
10	a	5	10	b
25	a	6	10	b

T1

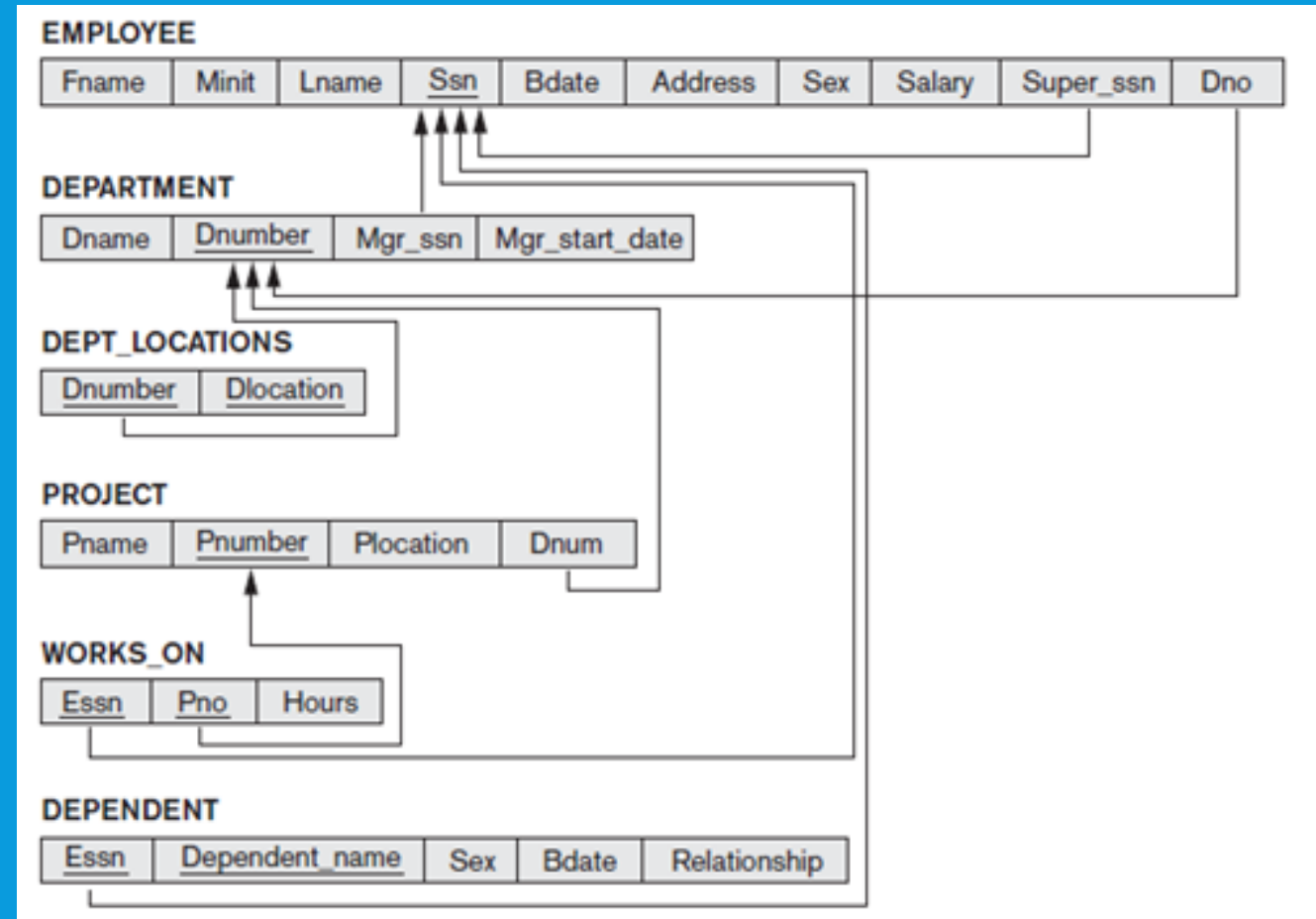
P	Q	R
10	a	5
15	b	8
25	a	6

T2

A	B	R
10	b	6
25	c	3
10	b	5

## Question 2 (1/2)

- Consider the COMPANY relational schema shown below; specify the following queries in relational algebra.

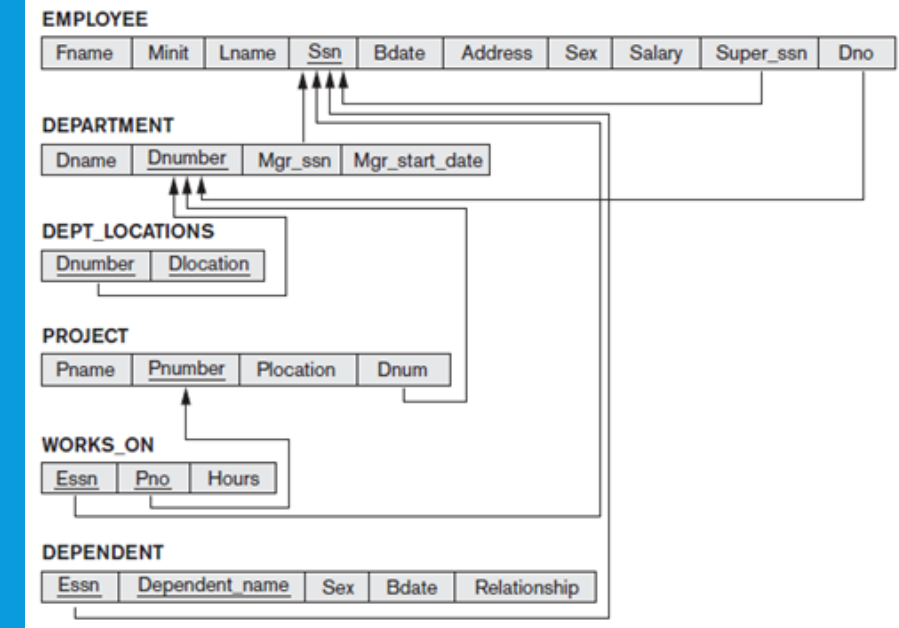


## Question 2 (2/2)

- a) Find the Ssn (social security number) of all employees who are not supervisors
- b) Find the Ssn of all employees who either work in department 5 or directly supervise an employee who works in department 5
- c) List the names and numbers of all departments locating in 'Houston'
- d) List the first names of all employees who have a dependent with the same first name as themselves
- e) Retrieve the salary of all employees in department 5 who work more than 10 hours on the project named 'ProjectX'

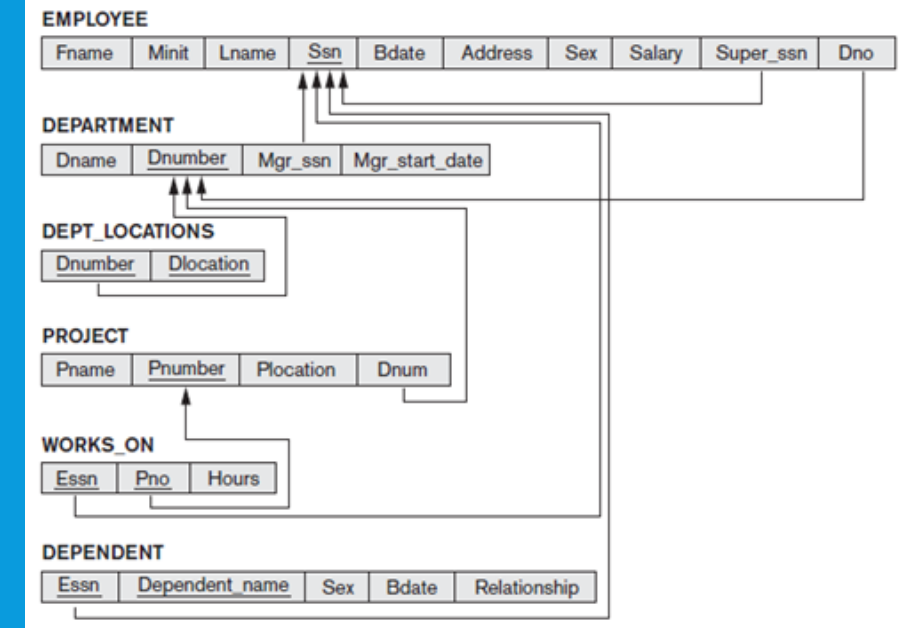
## Question 2(a) (Answer)

- Find the Ssn (social security number) of all employees who are not supervisors
- $\pi_{ssn}(\text{EMPLOYEE}) - \pi_{super\_ssn}(\text{EMPLOYEE})$



## Question 2(b) (Answer)

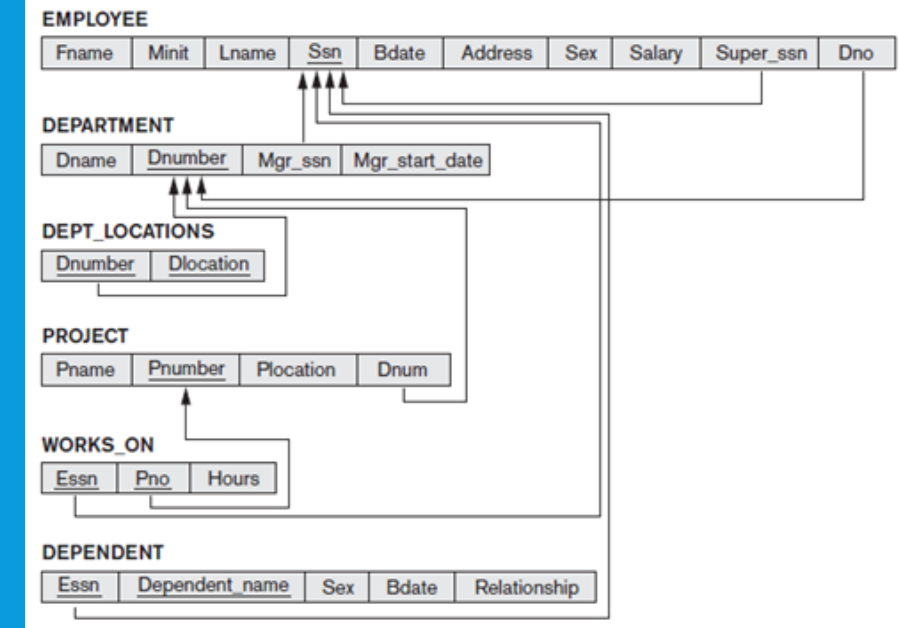
- Find the Ssn of all employees who either work in department 5 or directly supervise an employee who works in department 5
- $\pi_{Ssn} (\sigma_{Dno=5} (EMPLOYEE)) \cup \pi_{Super\_ssn} (\sigma_{Dno=5} (EMPLOYEE))$





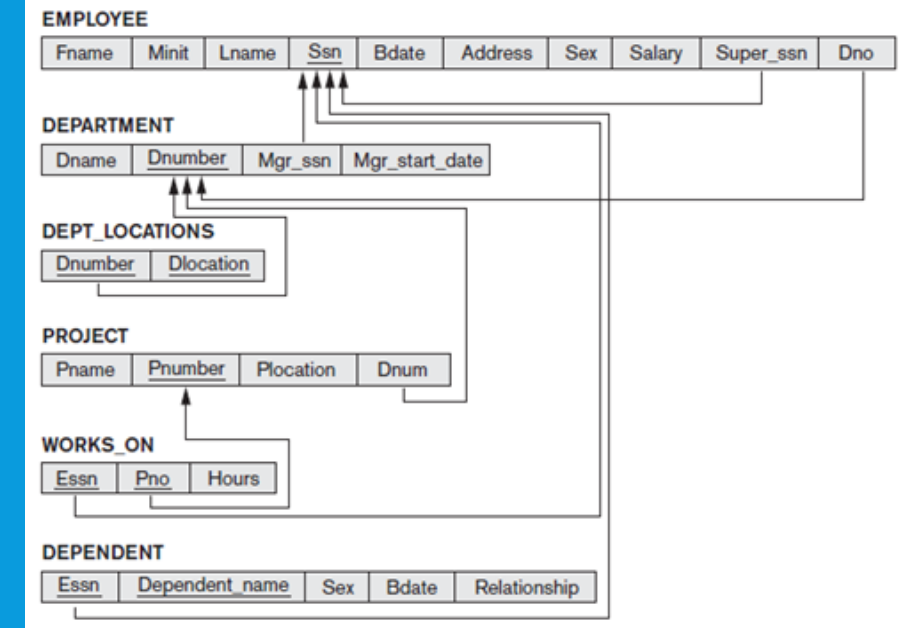
## Question 2(c) (Answer)

- List the names and numbers of all departments locating in 'Houston'
- $\pi_{Dname, Dnumber} (\sigma_{Dlocation='Houston'} (DEPARTMENT * DEPT\_LOCATIONS))$



## Question 2(d) (Answer)

- List the first names of all employees who have a dependent with the same first name (i.e., dependent\_name) as themselves
- $\pi_{Fname} (EMPLOYEE \bowtie_{Ssn=Essn \text{ AND } Fname=Dependent\_name} DEPENDENT))$



## Question 2(e) (Answer)

- Retrieve the salary of all employees in department 5 who work more than 10 hours on the project named 'ProjectX'
- $WORK5\_10 \leftarrow WORKS\_ON \bowtie_{Pnumber=Pno \text{ AND } Dnum=5 \text{ AND } Hours>10} PROJECT$
- $PROJECTX5\_10 \leftarrow \sigma_{Pname='ProjectX'} (WORK5\_10)$
- $\pi_{Salary} (PROJECTX5\_10 \bowtie_{Essn=Ssn} EMPLOYEE)$

