

CSE 4701 — Homework 1

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8.16 Company Database

(a) Retrieve the names of all employees in department 5 who work more than 10 hours per week on the ProductX project.

```
rel1 ← σPname='ProductX'(PROJECT)
rel2 ← rel1 ⋈ WORKS_ON
rel3 ← EMPLOYEE *SSN=Essn (σHours>10(rel2))
result ← πFname,Lname(σDno=5(rel3))
```

Table 1: Operation result for 8.16(a)

Fname	Lname
John	Smith
Joyce	English

(b) List the names of all employees who have a dependent with the same first name as themselves.

```
rel ← EMPLOYEE ⋈SSN=Essn AND Fname=DEPENDENT_NAME (DEPENDENT)
result ← πFname,Lname(rel)
```

Table 2: Operation result for 8.16(b)

Fname	Lname

(c) Find the names of all employees who are directly supervised by ‘Franklin Wong’.

```
rel1 ← σFname = Franklin AND Lname = Wong(EMPLOYEE)
rel2 ← EMPLOYEE ⋈Super_ssn=SSN (rel1)
result ← πFname,Lname(rel2)
```

Table 3: Operation result for 8.16(c)

Fname	Lname
John	Smith
Joyce	English
Ramesh	Narayan

(d) For each project, list the project name and the total hours per week (by all employees) spent on that project.

$$\begin{aligned} \text{rel}_1(\text{Pno}, \text{Total_hours}) &\leftarrow \left[\text{Pno}, \sum \text{WORKS_ON} \right] \\ \text{rel}_2 &\leftarrow \text{rel}_1 \bowtie_{\text{Pno}=\text{Pnumber}} (\text{PROJECT}) \\ \text{result} &\leftarrow \pi_{\text{Pname}, \text{Total_hours}}(\text{rel}_2) \end{aligned}$$

Table 4: Operation result for 8.16(d)

Pname	Total_hours
ProductX	52.5
ProductY	37.5
ProductZ	50.0
Computerization	55.0
Reorganization	25.0
NewBenefits	55.0

(e) Retrieve the names of all employees who work on every project.

$$\begin{aligned} \text{rel}_1(\text{Pno}, \text{Ssn}) &\leftarrow \pi_{\text{Pno}, \text{Essn}}(\text{WORKS_ON}) \\ \text{rel}_2 &\leftarrow \pi_{\text{Pnumber}}(\text{PROJECT}) \\ \text{rel}_3 &\leftarrow \pi_{\text{Fname}, \text{Lname}}(\text{rel}_1 \div \text{rel}_2) \\ \text{result} &\leftarrow \pi_{\text{Fname}, \text{Lname}}(\text{EMPLOYEE} * \text{rel}_3) \end{aligned}$$

Table 5: Operation result for 8.16(e)

Fname	Lname

(f) Retrieve the names of all employees who do not work on any project.

$$\begin{aligned} \text{rel}_1(\text{Pno}, \text{Ssn}) &\leftarrow \pi_{\text{Pno}, \text{Essn}}(\text{WORKS_ON}) \\ \text{rel}_2 &\leftarrow \pi_{\text{Pnumber}}(\text{PROJECT}) \\ \text{rel}_3 &\leftarrow \pi_{\text{Fname}, \text{Lname}}(\text{rel}_1 - \text{rel}_2) \\ \text{result} &\leftarrow \pi_{\text{Fname}, \text{Lname}}(\text{EMPLOYEE} * \text{rel}_3) \end{aligned}$$

Table 6: Operation result for 8.16(f)

Fname	Lname

(g) For each department, retrieve the department name and the average salary of all employees working in that department.

$$\begin{aligned} \text{rel}_1(\text{Dnumber}, \text{Avg_salary}) &\leftarrow [\text{Dnumber}, \text{Avg}(\text{SALARY})] \\ \text{result} &\leftarrow \pi_{\text{Dname}, \text{Avg_salary}}(\text{rel}_1 * \text{DEPARTMENT}) \end{aligned}$$

Table 7: Operation result for 8.16(g)

Dname	Avg_salary
Research	33250
Administration	31000
Headquarters	55000

(h) Retrieve the average salary of all female employees.

$$\text{result}(\text{Avg_salary}) \leftarrow \text{Avg}(\sigma_{\text{Sex} = \text{F}}(\text{EMPLOYEE}))$$

Table 8: Operation result for 8.16(h)

Avg_salary
31000

8.18 Library Database

(a) How many copies of the book titled *The Lost Tribe* are owned by the library branch whose name is ‘Sharpstown’?

```
rel1 ← σBranch_name = Sharpstown(LIBRARY_BRANCH)
rel2 ← σTitle = The Lost Tribe(BOOK)
result ← πNo_of_copies((A × B) * (BOOK_COPIES))
```

(b) How many copies of the book titled *The Lost Tribe* are owned by each library branch?

```
rel1 ← σTitle = The Lost Tribe(BOOK)
rel2 ← ((rel1 × LIBRARY_BRANCH) * BOOK_COPIES)
result ← πTitle, Branch_name, No_of_copies(rel2)
```

(c) Retrieve the names of all borrowers who do not have any books checked out.

```
rel1 ← BORROWER − (BORROWER * BOOK_LOANS)
result ← πName(rel1)
```

(d) For each book that is loaned out from the Sharpstown branch and whose Due_date is today, retrieve the book title, the borrower’s name, and the borrower’s address.

```
rel1 ← σBranch_name = Sharpstown(LIBRARY_BRANCH)
rel2 ← σDue_date = TODAY()(BOOK_LOANS)
rel3 ← (rel1 × BOOK) * rel2
result ← πTitle, Name, Address(rel3 * BORROWER)
```

(e) For each library branch, retrieve the branch name and the total number of books loaned out from that branch.

```
rel1(Branch_no, Total) ← [Branch_no, Count(Book_id)] (BOOK_LOANS)
rel2 ← rel1 * LIBRARY_BRANCH
result ← πBranch_name, Total(rel2)
```

(f) Retrieve the names, addresses, and number of books checked out for all borrowers who have more than five books checked out.

```
rel1(Card_no, Total) ← [Card_no, Count(Book_id)] (BOOK_LOANS)
rel2 ← σTotal > 5(rel1)
rel3 ← rel2 * BORROWER
result ← πName, Address, Total(rel3)
```

(g) For each book authored (or coauthored) by *Stephen King*, retrieve the title and the number of copies owned by the library branch whose name is ‘Central’.

```
rel1 ← σBranch_name = Central(LIBRARY_BRANCH)
rel2 ← σAuthor_name = Stephen King(BOOK_AUTHORS)
rel3 ← rel2 * BOOK
rel4 ← rel1 * BOOK_COPIES
result ← πTitle, No_of_copies(rel3 * rel4)
```

8.22 Join Operations

(a) $T_1 \bowtie_{T_1.P=T_2.A} T_2$

P	Q	R	A	B	C
10	a	5	10	b	6
10	a	5	10	b	5
25	a	6	25	c	3

(b) $T_1 \bowtie_{T_1.Q=T_2.B} T_2$

P	Q	R	A	B	C
15	b	8	10	b	6
15	b	8	10	b	5

(c) $T_1 \bowtie_{T_1.P=T_2.A} T_2$

P	Q	R	A	B	C
10	a	5	10	b	6
10	a	5	10	b	5
15	a	8	<i>null</i>	<i>null</i>	<i>null</i>
25	a	8	25	c	3

(d) $T_1 \bowtie_{T_1.Q=T_2.B} T_2$

P	Q	R	A	B	C
15	b	8	10	b	6
<i>null</i>	<i>null</i>	<i>null</i>	25	c	3
15	b	8	10	b	5

(e) $T_1 \cup T_2$

P	Q	R
10	a	5
15	b	8
25	a	6
10	b	6
25	c	3
10	b	5

(f) $T_1 \bowtie_{T_1.P=T_2.A \text{ AND } T_1.R=T_2.C} T_2$

P	Q	R	A	B	C
10	a	5	10	b	5