

SUMMARY OF FORMING QUERIES

1. Find the minimal set of schemas:

- i) Find those attributes that involve in either the conditions or the results.
- ii) Find the relation schemas that contain the attributes in i).
- iii) Find additional relation schemas that are needed to connect the schemas in ii), make sure that they form the minimal set you can have.

2. Form the query

- i) Start from the most specific condition, always do select first.
- ii) If join is necessary, join two schemas every time.
- iii) Project to the necessary attributes: namely the attributes that are either in the results or are necessary for further connecting two schemas together.
- iv) Repeat ii) and iii) until all results are retrieved.

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QUERY 1. RETRIEVE THE NAMES AND ADDRESSES OF ALL EMPLOYEES WHO WORK FOR THE RESEARCH DEPARTMENT.

◆ In relational algebra:

$$RD \leftarrow \sigma_{DNAME = 'research'}(DEPARTMENT)$$

$$Result \leftarrow \pi_{FNAME, LNAME, ADDRESS}(EMPLOYEE \bowtie_{DNO=DNUMBER} RD)$$

• In SQL:

```
SELECT FNAME, LNAME, ADDRESS
FROM EMPLOYEE, DEPARTMENT
WHERE DNAME='research' AND DNUMBER=DNO;
```

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QUERY 2. LIST THE NAMES OF ALL EMPLOYEES WHO WORK ON BOTH PROJECT #3 AND #5.

- In relational algebra:

$$W1 \leftarrow \sigma_{PNO='3'}(WORK_ON)$$

$$W2 \leftarrow \sigma_{PNO='5'}(WORK_ON)$$

$$EP12 \leftarrow \pi_{W1.ESSN} (W1 \bowtie_{W1.ESSN=W2.ESSN} W2)$$

$$Result \leftarrow \pi_{FNAME, LNAME} (EMPLOYEE \bowtie_{SSN=ESSN} EP12)$$

- ◆ In SQL:

```
SELECT FNAME, LNAME
FROM EMPLOYEE, WORK_ON W1, WORK_ON W2
WHERE W1.PNO='3' AND W2.PNO='5' AND W1.ESSN=W2.ESSN
AND W1.ESSN=SSN;
```

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QUERY 3. LIST THE NAMES OF ALL EMPLOYEES WHO WORK ON BOTH THE 'PINE' PROJECT AND THE 'BAMBOO' PROJECT.

- In relational algebra:

$$P1 \leftarrow \sigma_{PNAME='Pine'}(PROJECT)$$

$$P2 \leftarrow \sigma_{PNAME='Bamboo'}(PROJECT)$$

$$EP1 \leftarrow \pi_{ESSN} (P1 \bowtie_{PNUMBER=PNO} WORK_ON)$$

$$EP2 \leftarrow \pi_{ESSN} (P2 \bowtie_{PNUMBER=PNO} WORK_ON)$$

$$EP12 \leftarrow \pi_{EP1.ESSN} (EP1 \bowtie_{EP1.ESSN=EP2.ESSN} EP2)$$

$$Result \leftarrow \pi_{FNAME, LNAME} (EMPLOYEE \bowtie_{SSN=ESSN} EP12)$$

- ◆ In SQL:

```
SELECT FNAME, LNAME
FROM EMPLOYEE, PROJECT P1, PROJECT P2, WORK_ON W1,
WORK_ON W2
WHERE P1.PNAME='Pine' AND P2.PNAME='Bamboo' AND
P1.PNUMBER=W1.PNO AND P2.PNUMBER=W2.PNO AND
W1.ESSN=W2.ESSN AND W1.ESSN=SSN;
```

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QUERY 4. RETRIEVE THE NAMES AND ADDRESSES OF ALL EMPLOYEES.

- In relational algebra:

$$\text{Result} \leftarrow \pi_{\text{FNAME, LNAME, ADDRESS}}(\text{EMPLOYEE})$$

- In SQL:

```
SELECT FNAME, LNAME, ADDRESS  
FROM EMPLOYEE;
```

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QUERY 5. RETRIEVE ALL INFORMATION OF THE EMPLOYEES WHO WORK FOR DEPARTMENT #5.

- In relational algebra:

$$\text{Result} \leftarrow \sigma_{\text{DNO} = '5'}(\text{EMPLOYEE})$$

- In SQL:

```
SELECT *  
FROM EMPLOYEE  
WHERE DNO='5';
```

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QUERY 6. LIST ALL MAJORS THAT THE STUDENTS HAVE MAJORED IN (SELECT DISTINCT).

- In relational algebra:

$\text{Result} \leftarrow \pi_{\text{MAJOR}}(\text{STUDENT})$

- In SQL:

```
SELECT DISTINCT MAJOR
FROM STUDENT;
```

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QUERY 2(A). LIST THE NAMES OF ALL EMPLOYEES WHO WORK ON BOTH PROJECT #3 AND #5.

- In relational algebra:

$W1 \leftarrow \sigma_{\text{PNO}='3'}(\text{WORK_ON})$

$W2 \leftarrow \sigma_{\text{PNO}='5'}(\text{WORK_ON})$

$\text{EPI2} \leftarrow \pi_{\text{ESSN}} W1 \cap \pi_{\text{ESSN}} W2$

$\text{Result} \leftarrow \pi_{\text{FNAME, LNAME}} (\text{EMPLOYEE} \bowtie_{\text{SSN}=\text{ESSN}} \text{EPI2})$

- ◆ In SQL:

```
SELECT FNAME, LNAME
FROM EMPLOYEE
WHERE SSN IN (SELECT ESSN FROM WORK_ON WHERE PNO='3'
INTERSECT SELECT ESSN FROM WORK_ON WHERE PNO='5');
```

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QUERY 2(B). LIST THE NAMES OF ALL EMPLOYEES WHO WORK ON EITHER PROJECT #3 OR #5.

- In relational algebra:

$$W1 \leftarrow \sigma_{PNO='3'}(WORK_ON)$$

$$W2 \leftarrow \sigma_{PNO='5'}(WORK_ON)$$

$$EP12 \leftarrow \pi_{ESSN}(W1 \cup W2)$$

$$Result \leftarrow \pi_{FNAME, LNAME}(EMPLOYEE \bowtie_{SSN=ESSN} EP12)$$

- ◆ In SQL:

```
SELECT FNAME, LNAME
FROM EMPLOYEE
WHERE SSN IN (SELECT ESSN FROM WORK_ON WHERE PNO='3'
UNION SELECT ESSN FROM WORK_ON WHERE PNO='5');
```

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QUERY 2(C). LIST THE NAMES OF ALL EMPLOYEES WHO WORK ON AT LEAST TWO PROJECTS.

- In relational algebra:

$$R(ESSN, T) \leftarrow \pi_{ESSN, COUNT(*)}(WORK_ON)$$

$$R1 \leftarrow \pi_{ESSN} \sigma_{T>1}(R)$$

$$Result \leftarrow \pi_{FNAME, LNAME}(EMPLOYEE \bowtie_{SSN=ESSN} R1)$$

- ◆ In SQL:

```
SELECT FNAME, LNAME
FROM EMPLOYEE
WHERE SSN IN
(SELECT ESSN FROM (SELECT ESSN, COUNT(*) AS T FROM
WORK_ON GROUP BY ESSN) WHERE T>1);
```

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**QUERY 2(C). LIST THE NAMES OF ALL EMPLOYEES WHO
WORK ON AT LEAST TWO PROJECTS.**

- In SQL:

```
SELECT FNAME, LNAME
```

```
FROM EMPLOYEE
```

```
WHERE
```

```
(SELECT COUNT(*) FROM WORK_ON WHERE ESSN=SSN) > 1;
```