

Domain Relational Calculus (59)

$$\{ \langle l, n \rangle \mid \exists \langle l, f, s, x, d \rangle \in \text{Employee} (\\ \exists \langle n, i, m \rangle \in \text{Department} (\\ \wedge x = \text{'M'} \wedge d = i)) \}$$

Tuple Relational Calculus (89)

$$\{ t \mid \exists e \in \text{Employee} (\\ \exists d \in \text{Department} (\\ t.\text{lname} = e.\text{lname} \\ \wedge t.\text{dname} = d.\text{dname} \\ \wedge e.\text{sex} = \text{'M'} \wedge e.\text{dno} = d.\text{dnumber})) \}$$

Relational Algebra [in RC/SQL style] (71)

$e \leftarrow \text{Employee}$
 $d \leftarrow \text{Department}$
 $t \leftarrow \Pi \text{lname, dname}$
 $(\sigma_{e.\text{sex}=\text{'M'} \wedge e.\text{dno} = d.\text{dnumber}} (e \times d))$

Relational Algebra [in “native” (and underspecified) style] (64)

$$\Pi \text{lname, dname} (\sigma_{\text{sex}=\text{'M'}} (\text{Employee} \bowtie_{\text{dno} = \text{dnumber}} \text{Department}))$$

English (82)

List the last name and department number of all male employees.

SQL – underspecified (74)

```
SELECT lname, dname
FROM Employee, Department
WHERE sex = 'M'
      and dno = dnumber
```

SQL - aliased (82)

```
SELECT e.lname, d.dname
FROM Employee e, Department d
WHERE e.sex = 'M'
      and e.dno = d.dnumber
```

Color Meaning:

Red = Existentialization
Green = Projection
Blue = Selection
Gold = Join

Domain Relational Calculus (59)

$$\{ \langle l, n \rangle \mid \exists \langle l, f, s, x, d \rangle \in \text{Employee} (\\ \exists \langle n, i, m \rangle \in \text{Department} (\\ \wedge x = \text{'M'} \wedge d = i)) \}$$

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Relational Algebra [in RC/SQL style] (71)

```
e ← Employee
d ← Department
t ←  $\Pi$  lname, dname
( $\sigma$  e.sex='M'  $\wedge$  e.dno = d.dnumber (e x d))
```

Relational Algebra [in “native” (underspecified) style] (64)

$$\Pi \text{ lname, dname } (\sigma \text{ sex='M'} (\\ \text{Employee} \bowtie \text{dno} = \text{dnumber Department}))$$

English (82)

List the last name and department number of all male employees.

SQL – underspecified (74)

```
SELECT lname, dname
FROM Employee, Department
WHERE sex = 'M'
and dno = dnumber
```

SQL - aliased (82)

```
SELECT e.lname, d.dname
FROM Employee e, Department d
WHERE e.sex = 'M'
and e.dno = d.dnumber
```

QBE (29)

EMPL	ssn	lname	sex	dno
		<u>l</u>	M	<u>d</u>

DEPT	dnumber	dname	mgrssn
	<u>d</u>	<u>n</u>	

RESULT	lname	dname
	P. <u>l</u>	P. <u>n</u>

Color Meaning:

Red = Existentialization
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Domain Relational Calculus (59)

$$\{ \langle l, n \rangle \mid \exists \langle l, f, s, x, d \rangle \in \text{Employee} (\\ \exists \langle n, i, m \rangle \in \text{Department} (\\ \wedge x = 'M' \wedge d = i)) \}$$

Tuple Relational Calculus (89)

$$\{ t \mid \exists e \in \text{Employee} (\\ \exists d \in \text{Department} (\\ t.\text{lname} = e.\text{lname} \\ \wedge t.\text{dname} = d.\text{dname} \\ \wedge e.\text{sex} = 'M' \wedge e.\text{dno} = d.\text{dnumber})) \}$$

SQL – underspecified (74)

```
SELECT lname, dname
FROM Employee, Department
WHERE sex = 'M'
      and dno = dnumber
```

SQL - aliased (82)

```
SELECT e.lname, d.dname
FROM Employee e, Department d
WHERE e.sex = 'M'
      and e.dno = d.dnumber
```

Relational Algebra [in RC/SQL style] (71)

$e \leftarrow \text{Employee}$

$d \leftarrow \text{Department}$

$t \leftarrow \Pi \text{lname, dname}$

$(\sigma_{e.\text{sex}='M' \wedge e.\text{dno} = d.\text{dnumber}} (e \times d))$

$(\sigma_{e.\text{sex}='M'} (\sigma_{e.\text{dno} = d.\text{dnumber}} (e \times d)))$

$(\sigma_{e.\text{sex}='M'} (e \bowtie_{e.\text{dno} = d.\text{dnumber}} d))$

Relational Algebra [in “native” (and underspecified) style] (64)

$\Pi \text{lname, dname} (\sigma_{\text{sex}='M'} (\text{Employee} \bowtie_{\text{dno} = \text{dnumber}} \text{Department}))$

Domain Relational Calculus (84)

$$\{ \langle l, n \rangle \mid \exists \langle l, f, s, x, d \rangle \in \text{Employee} (\\ \exists \langle n, i, m \rangle \in \text{Department} (\\ \wedge x = 'M' \wedge d = i \\ \wedge \sim \exists \langle p, a, g \rangle \in \text{Dependent} (s = p))) \}$$

Tuple Relational Calculus (119)

$$\{ t \mid \exists e \in \text{Employee} (\\ \exists d \in \text{Department} (\\ t.\text{lname} = e.\text{lname} \\ \wedge t.\text{dname} = d.\text{dname} \\ \wedge e.\text{sex} = 'M' \wedge e.\text{dno} = d.\text{dnumber} \\ \wedge \sim \exists c \in \text{Dependent} (e.\text{ssn} = c.\text{essn})) \}$$

English (82)

List the last name and department number of all male employees without dependents.

SQL - aliased (127)

```
SELECT e.lname, d.dname
FROM Employee e, Department d
WHERE e.sex = 'M'
      and e.dno = d.dnumber
      and e.ssn not in (SELECT essn
                        FROM Dependent)
```

Relational Algebra [in RC/SQL style] (109)

```
e ← Employee
d ← Department
c ← Dependent
A ← Π lname, dname, ssn (σ e.sex='M' ∧ e.dno = d.dnumber (e x d))
W ← Π lname, dname, ssn A ⋈ a.ssn = c.essn C
T ← Π lname, dname (A - W)
```

Relational Algebra [in “native” (and underspecified) style] (102)

```
A ← Π lname, dname (σ sex='M' (Employee ⋈ dno = dnumber Department))
```

Domain Relational Calculus (84)

$$\{ \langle l, n \rangle \mid \exists \langle l, f, s, x, d \rangle \in \text{Employee} (\\ \exists \langle n, i, m \rangle \in \text{Department} (\\ \wedge x = \text{'M'} \wedge d = i \\ \wedge \sim \exists \langle p, a, g \rangle \in \text{Dependent} (s = p))) \}$$

Tuple Relational Calculus (119)

$$\{ t \mid \exists e \in \text{Employee} (\\ \exists d \in \text{Department} (\\ t.\text{lname} = e.\text{lname} \\ \wedge t.\text{dname} = d.\text{dname} \\ \wedge e.\text{sex} = \text{'M'} \wedge e.\text{dno} = d.\text{dnumber} \\ \wedge \sim \exists c \in \text{Dependent} (e.\text{ssn} = c.\text{essn})) \}$$

Relational Algebra [in RC/SQL style] (109)

$e \leftarrow \text{Employee}$
 $d \leftarrow \text{Department}$
 $c \leftarrow \text{Dependent}$
 $A \leftarrow \Pi \text{lname, dname, ssn} (\sigma_{e.\text{sex}=\text{'M'} \\ \wedge e.\text{dno} = d.\text{dnumber}} (e \times d))$
 $W \leftarrow \Pi \text{lname, dname, ssn} A \bowtie_{a.\text{ssn} = c.\text{essn}} C$
 $T \leftarrow \Pi \text{lname, dname} (A - W)$

English (82)

List the last name and department number of all male employees without dependents.

SQL - aliased (127)

```

SELECT e.lname, d.dname
FROM Employee e, Department d
WHERE e.sex = 'M'
      and e.dno = d.dnumber
      and e.ssn not in (SELECT essn
                        FROM Dependent)
    
```

QBE (34)

EMPL	ssn	lname	sex	dno
	<u>_s</u>	<u>_l</u>	M	<u>_d</u>

DEPT	dnumber	dname	mgrssn
	<u>_d</u>	<u>_n</u>	

DEPN	essn	depname
~	<u>_s</u>	

RESULT	lname	dname
	P._l	P._n