Domain Relational Calculus (59)

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

Tuple Relational Calculus (89)

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

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)

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

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.

Color Meaning:

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

Domain Relational Calculus (59)

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

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)

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

Relational Algebra [in "native" (underspecified) style] (64)

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

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
```

QBE (29)

EMPL	ssn	lname	sex	dno
		_l	M	_d

DEPT	dnumber	dname	mgrssn
	_d	_n	

RESULT	lname	dname
	P._l	P._n

Color Meaning:

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

Domain Relational Calculus (59)

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

Tuple Relational Calculus (89)

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

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)

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

English (82)

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

Tuple Relational Calculus (119)

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

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)

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

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

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

Domain Relational Calculus (84)

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

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
	_s	_l	M	_d

DEPT	dnumber	dname	mgrssn
	_d	_n	

DEPN	essn	depname
~	_s	

RESULT	lname	dname
	P._l	P._n