CS2102 DATABASE SYSTEMS
Problem II

SQL

1. Find the names of pizzas that come in a 10 inch size

```
SELECT name FROM pizza WHERE size = 10
```

2. Find the names of pizzas that come in a 10 inch or a 12 inch size

```
SELECT name FROM pizza WHERE size = 10 OR size = 12
```

3. Find the names of pizzas that come in both a 10 inch and a 12 inch size

```
SELECT P1.name FROM pizza P1, pizza P2 WHERE P1.size = 10 AND P2.size = 12 AND P1.name=p2.name
```

4. Find the pairs of different codes of pizzas with the same name and the same size (is there any?)

```
SELECT T1.code, T2.code FROM pizza T1, pizza T2
WHERE T1.code <> T2.code AND T1.name = T2.name AND  T1.size = T2.size
```

5. Find the names and phone numbers of the stores in "College Park" or "Greenbelt" that sell a 10 inch pizza named "pepperoni" for less than $8

```
SELECT T2.name, T2.phone FROM pizza T1, store T2, sells T3
WHERE T1.code= T3.code AND T2.name = T3.store_name
AND (T2.area = « College Park » OR T3.area = « Greenbelt »)
AND T1.name = “pepperoni” ∧ T1.size = 10
```

6. Find the codes of the most expensive pizzas – assume the scheme of the database is reduced to a relation pizza(<u>code</u>, price) to simplify –

   homework

7. Find the names of the stores that sell all the pizzas

   homework

Tuple Relational Calculus

8. Find the names of pizzas that come in a 10 inch size

$\{T \mid \exists T1$
$(T1 \in pizza \wedge T1.size = 10$
$\wedge T1.name = T.name)\}$

9. Find the names of pizzas that come in a 10 inch or a 12 inch size

$\{T \mid \exists T1$
$(T1 \in pizza \wedge (T1.size = 10 \vee T1.size = 12)$
$\wedge T1.name = T.name)\}$

10. Find the names of pizzas that come in both a 10 inch and a 12 inch size

$\{T \mid \exists T1 \exists T2$
$(T1 \in pizza \wedge T2 \in pizza \wedge T1.name = T2.name \wedge T1.size = 10 \wedge T2.size = 12$
$\wedge T1.name = T.name)\}$

11. Find the pairs of different codes of pizzas with the same name and the same size (is there any?)

$\{T \mid \exists T1 \exists T2$
$(T1 \in pizza \wedge T2 \in pizza \wedge T1.code <> T2.code \wedge T1.name = T2.name \wedge T1.size = T2.size$
$\wedge T.code1 = T1.code \wedge T.code2 = T2.code)\}$

Yes there some possibly {code} is the key, not {name, size}

12. Find the names and phone numbers of the stores in "College Park" or "Greenbelt" that sell a 10 inch pizza named "pepperoni" for less than $8

$\{T \mid \exists T1 \exists T2 \exists T3$
$(T1 \in pizza \wedge T2 \in store \wedge T3 \in sells \wedge T1.code= T3.code \wedge T2.name = T3.store\_name \wedge (T2.area =$ « College Park » $\vee T2.area =$ « Greenbelt »$) \wedge T1.name =$ “pepperoni” $\wedge T1.size = 10 \wedge T3.price < 8$
$\wedge T2.name = T.name \wedge T2.phone = T.phone)\}$

13. Find the codes of the most expensive pizzas – assume the scheme of the database is reduced to a relation pizza(<u>code</u>, price) to simplify –

$\{T \mid \exists T1 \forall T2$
$(T1 \in pizza \wedge (T2 \in pizza \Rightarrow T1.price \geq T2.price)$
$\wedge T1.code = T.code)\}$

14. Find the names of the stores that sell all the pizzas

$\{T \mid \exists T1 \forall T2 \exists T3$
$(T1 \in store \wedge (T2 \in pizza \Rightarrow (T3 \in sells \wedge T2.code= T3.code \wedge T1.name = T3.store\_name))$
$\wedge T1.name = T.name)\}$

Domain Relational Calculus

15. Find the names of pizzas that come in a 10 inch size

$$\{\langle N\rangle \mid \exists C\ \exists S$$
$$(pizza(C, N, S) \wedge S = 10)\}$$

16. Find the names of pizzas that come in a 10 inch or a 12 inch size

$$\{\langle N\rangle \mid \exists C\ \exists S$$
$$(pizza(C, N, S) \wedge (S = 10 \vee S = 12))\}$$

17. Find the names of pizzas that come in both a 10 inch and a 12 inch size

$$\{\langle N1\rangle \mid \exists C1\ \exists S1\ \exists C2\ \exists N2\ \exists S2$$
$$(pizza(C1, N1, S1) \wedge pizza(C2, N2, S2) \wedge N1 = N2 \wedge S1 = 10 \wedge S2 = 12)\}$$

18. Find the pairs of different codes of pizzas with the same name and the same size (is there any?)

$$\{\langle C1, C2\rangle \mid \exists N1\ \exists S1\ \exists N2\ \exists S2$$
$$(pizza(C1, N1, S1) \wedge pizza(N2, C2, S2) \wedge C1 <> C2 \wedge N1 = N2 \wedge S1 = S2)\}$$

19. Find the names and phone numbers of the stores in "College Park" or "Greenbelt" that sell a 10 inch pizza named "pepperoni" for less than $8

$$\{\langle SN, P\rangle \mid \exists C\ \exists N\ \exists S\ \exists A\ \exists Pr$$
$$(pizza(C,N, S) \wedge store(SN, A, P) \wedge sells(SN, C, Pr) \wedge (A = \text{« College Park »} \vee A = \text{« Greenbelt »}) \wedge N = \text{“pepperoni”} \wedge S = 10 \wedge Pr<8)\}$$

20. Find the codes of the most expensive pizzas – assume the scheme of the database is reduced to a relation pizza(<u>code</u>, price) to simplify –

$$\{\langle C1\rangle \mid \exists N1\ \exists S1\ \forall C2\ \forall N2\ \forall S2$$
$$(pizza(C1, N1, S1) \wedge (pizza(C2, N2, S2) \Rightarrow P1 \geq P2))\}$$

21. Find the names of the stores that sell all the pizzas

$$\{\langle SN\rangle \mid \exists SN\ \exists A\ \exists P\ \forall C\ \forall N\ \forall S\ \exists Pr$$
$$(store(SN, A, P) \wedge (pizza(C,N, S) \Rightarrow sells(SN, C, Pr)))\}$$

Relational Algebra

P $\longrightarrow$ Pizza(code, pname, size)
S $\longrightarrow$ Store(sname, area, phone)
L $\longrightarrow$ Sells(sname, code, price)

1. Find the names of pizzas that come in a 10 inch size.

$$\pi_{pname}(\sigma_{size=10}(P))$$

2. Find the names of pizzas that come in a 10 inch or a 12 inch size.

$$\pi_{pname}(\sigma_{size=10 \vee size=12}(P))$$

3. Find the names of pizzas that come in both a 10 inch and a 12 inch size.

$$\pi_{pname}(\sigma_{size=10}(P))$$

$$\pi_{pname}(\sigma_{size=12}(P))$$

4. Find the pairs of different codes of pizzas with the same name and the same size (is there any?).

%(P 1, P))
%(P 2, P))

$$\pi_{P1.code,P2.code}(\sigma_{P1.code=P2.code \wedge P1.name=P2.name \wedge P1.size=P2.size}(P1 \times P2))$$

5. Find the names and phone numbers of the stores in “College Park” or “Greenbelt” that sell a 10 inch pizza named “pepperoni” for less than \$8.

$\pi_{S.sname,phone}($
$\sigma_{size=10 \wedge pname=\text{‘pepperoni‘} \wedge price<8 \wedge (area=\text{‘CollegePark‘} \vee area=\text{‘Greenbelt‘})}($
$P \;/_{n}\; S \;/_{n}\; L))$

6. Find the codes of the most expensive pizzas assume the scheme of the database is reduced to a relation P $\longrightarrow$ Pizza(code, price) to simplify.

%(P 1, P))
%(P 2, P))

$$\pi_{P1.code,P2.code}(\sigma_{P1.price \geq P2.price}(P1 \times P2))/\pi_{code}(P1)$$

The intuition is: (i) Find all pairs (code1, code2) of pizza codes where the price of code1 is more or equal to the price of code2. (ii) For a specific $c \in$ code1, if c is paired with all possible codes, it means that its price is more or equal to all prices. Therefore c is the most expensive pizza. Note that many such pizzas may exist (if all have the same high price).

Recall that, for two tables A(x, y), B(y), division is defined as:

$$A/B = \pi_x(A) - \pi_x((\pi_x(A) \times B) - A)$$

7. Find the names of the stores that sell all the pizzas.

$\pi_{sname,code}(L)/\pi_{code}(P) =$

$$= \pi_{sname}(L) - \pi_{sname}((\pi_{sname}(L) \times \pi_{code}(P)) - \pi_{sname,code}(L))$$

Observe, this is division. In this case:

$$A \equiv \pi_{sname,code}(L)$$
$$B \equiv \pi_{code}(P)$$