Relational Aljebra

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1 Introduction

Relational aljebra are a set of operation on relations/tables. Recalled that in integer like 1,2,3,4,5, etc., we have operation like $+, -, \times, \div$. Similarly, in relations/tables, we have operations; union $\cup$, intersection $\cap$, differences, cartesian products $\times$, join $\bowtie$. There need to use symbols make it difficult to use ascii-based text editor to write notes.

Given a relation R (a table with data called R), we could use relational aljebra operation on the relation R. These operations are union, intersection, differences, cartesian and join.

In the text, it uses these sysmbols;

1. π for rows operation, select certain rows
2. σ for column operation, choose certain attributes

For instance, see example on page 43-47. The relational aljebra can be combined to for arbitrary complex expresson.

2 Question 2.4.1

Recalled that, there are 4 relations. The common attributes in all relations/tables are model. We would use ra, mysql/sqlite3 for answers.

(a) Choose *maker* that sell *printer*, but not pc. We need *maker*, thus it is a projection. We only need *printer* but not *pc*, thus a selection. The relation we would use is *Product*.

Let Ri where $i = 1, 2, 3, ..$ be a temporary relation/table in our computation.

$$R1 := (\pi_{maker})(\sigma_{type=printer})(Product) \quad (1)$$

$$R2 := (\pi_{maker})(\sigma_{type=pc})(Product) \quad (2)$$

$$R3 := (\pi_{maker})(R1 - R2) \quad (3)$$

R1 find all maker that sell printer (D,E, H), R2 find all maker that sell pc (A, B, C, D, E). Therefore, those who sell printer, but not pc is (R1-R2) which is (H).

SQL:

```
CREATE VIEW [ U] AS
select distinct maker from Product where type="pc";

CREATE VIEW [ V] AS
select distinct maker from Product where type="printer";

select maker from V where maker not in ( select maker from U);
```

(b) what pc model have speed at least 2.5? (1001,1004,1005,1006,1010,1012,1013)

$$R1 := (\sigma_{speed} \geq 2.5)(PC) \quad (4)$$

$$R2 := (\pi_{maker})(R1) \quad (5)$$

SQL: SELECT maker from PC where speed >= 2.5

(c) What maker produced laptop with hd atleast 120GB? (A,B,E,G)

$$R1 := (\sigma_{hd>120})(LapTop) \quad (6)$$

$$R2 := (\pi_{maker})(R1) \quad (7)$$

$$R3 := (Product) \bowtie (R2) \quad (8)$$

SQL;

```
select maker from Product where model in
(select model  from LapTop where hd >= 120)

select Product. maker from Product, LapTop where
Product. model=LapTop. model AND LapTop. hd >= 120;
```

(d)Find the model and price for all product by maker C. (1007, 510)

$$R1 := (\sigma_{maker=C})(Product \bowtie PC) \quad (9)$$

$$R2 := (\sigma_{maker=C})(Product \bowtie LapTop) \quad (10)$$

$$R3 := (\sigma_{maker=C})(Product \bowtie Printer) \quad (11)$$

$$R4 := (\pi_{model,price})(R1) \quad (12)$$

$$R5 := (\pi_{model,price})(R2) \quad (13)$$

$$R6 := (\pi_{model,price})(R3) \quad (14)$$

$$R7 := R4 \cup R5 \cup R6 \quad (15)$$

SQL:

```
select maker, Product. model from Product JOIN
   LapTop on Product. model = LapTop. model
   where Product. maker="C";
select maker, Product. model from Product JOIN
   PC on Product. model = LapTop. model
   where Product. maker="C";
```

```
select maker, Product. model from Product JOIN
  Printer on Product. model = LapTop. model
  where Product. maker="C";

select model, price from LapTop where model in
(select model from Product where maker="C") UNION
select model, price from PC where model in
(select model from Product where maker = "C" )
```

(e) find model of black-and-white printer. (3002, 3005)

$$R1 := (\sigma_{color=0})(Printer) \quad (16)$$

$$R2 := (\pi_{model})(R1) \quad (17)$$

SQL:

```
select model from Printer where color=0;
```

(f) find hd sizes that occur in 2 or more PC.(80(2),160(2),250(6))
SQL:

```
CREATE VIEW W SELECT hd, count(hd) as hdc from PC group by hd
select * from W where hdc >= 2

select * from (select hd, count(*) as hdc from PC group by hd )
where hdc >=2
```

(g)find pairs of PC that have same speed and RAM. (1004,1012)

$$R1 := (\sigma_{speed_a=speed_b, ram_a=ram_b, model_a<model_b})(PC_a \bowtie PC_b) \quad (18)$$

```
select A. model, B. model, A. speed, A. ram, B. speed, B. ram from
PC as A join PC as B on A. speed = B. speed AND A. ram = B. ram
AND A. model < B. model
```

(h) find makers of atleast 2 different pc or laptop with atleast speed 2.2. (B, E)
SQL:

```
create view  X as select model, speed from PC where
    speed >=2. 2 UNION select model, speed
    from LapTop where speed >= 2. 2

select maker from ( select maker, count(*) as mkc
   from X group by maker)
   where mkc >=2
```

(k) Find makers with exectly 3 different models PC. (A,B,D,E)

```
select maker from  ( select maker,count(*) as mkc
    from ( Product JOIN  PC on Product.model = PC.model )
    group by maker  )
    where mkc =3
```

(j) find makers with the highest speed for PC and LapTop. (maker=B, model=1005,1006).

```
select maker,model from Product where model in
     (select model from PC where speed in
     (select max(speed) from
     ( select model,speed from PC UNION
     select model,speed from LapTop )))
```

(l) makers with atleast 3 different speeds. (A (1.42,2.1,2.66), D(2,2.2,2.8), E(1.86,2.8,3.06))

```
create view Ri as select Product.maker, PC.model, PC.speed from
      PC JOIN Product on Product.model = PC.model
      # note i = 1,2,3
select R1.maker, R1.speed, R2.speed,R3.speed from R1,R2,R3
      where R1.maker=R2.maker and R1.maker = R3.maker and
      R1.speed < R2.speed and R1.speed < R3.speed and
      R2.speed < R3.speed
```