

CIS 4301 – Information and Database Management Systems Homework # 3 Solution

NOTE : Most of questions can have more than one answer. The followings are just one of those.

Problem 1. Exercise 5.2.1. p207 from the textbook (22pt, 2pt for each)

5.2.1

a)

PI_model(SIGMA_{speed >= 1000}) (PC)

b)

PI Product.maker (SIGM {Laptop.hd >= 1} (Product Natural_Join Laptop))

c)

(PI model, price (SIGMA {maker = 'B'} (Product Natural_Join PC))) U

(PI model, price (SIGMA {maker = 'B'} (Product Natural_Join Laptop))) U

(PI model, price (SIGMA {maker = 'B'} (Product Natural_Join Printer)))

d)

PI model (SIGMA {color = 'true' and type = 'laser'} Printer)

e)

(PI maker (Product Natural_Join Laptop)) - (PI maker (Product Natural_Join PC))

f)

The trick is to theta-join PC with itself on the condition that the hard disk sizes are equal.

That gives us tuples that have two PC model numbers with the same value of hd.

However, these two PC's could in fact be the same, so we must also require in the theta-

join that the model numbers be unequal. Finally, we want the hard disk sizes, so we

project onto hd.

The expression is easiest to see if we write it using some temporary values. We start by renaming PC twice so we can talk about two occurrences of the same attributes.

R1 = RHO_{PC1} (PC)

R2 = RHO_{PC2} (PC)

R3 = R1 JOIN_{PC1.hd = PC2.hd AND PC1.model ≠ PC2.model} R2

R4 = PI_{PC1.hd} (R3)

g)

R1 = RHO {PC1} (PC)

R2 = RHO {PC2} (PC)

$R3 = R1 \text{ JOIN } \{PC1.model < PC2.model \text{ and } PC1.hd = PC2.hd \text{ and } PC1.ram = PC2.ram\} R2$
 $R4 = \text{PI } \{PC1.model, PC2.model\} (R3)$

h)

First, we find R1, the model-speed pairs from both PC and Laptop. Then, we find from R1 those computers that are "fast," at least 133Mh. At the same time, we join R1 with Product to connect model numbers to their manufacturers and we project out the speed to get R2. Then we join R2 with itself (after renaming) to find pairs of different models by the same maker. Finally, we get our answer, R5, by projecting onto one of the maker attributes. A sequence of steps giving the desired expression is:

$R1 = \text{PI}_{\{model, speed\}} (PC) \text{ UNION } \text{PI}_{\{model, speed\}} (Laptop)$
 $R2 = \text{PI}_{\{maker, model\}} (\text{SIGMA}_{\{speed \geq 700\}} (R1) \text{ JOIN Product})$
 $R3 = \text{RHO}_{\{T(maker2, model2)\}} (R2)$
 $R4 = R2 \text{ JOIN}_{\{maker = maker2 \text{ AND } model \neq model2\}} (R3)$
 $R5 = \text{PI}_{\{maker\}} (R4)$

i)

$R1 = \text{RHO } \{COMP1\} ((\text{PI } \{model, speed\} PC) \cup (\text{PI } \{model, speed\} Laptop))$
 $R2 = \text{RHO } \{COMP2\} ((\text{PI } \{model, speed\} PC) \cup (\text{PI } \{model, speed\} Laptop))$
 $R3 = \text{PI } COMP1.model (R1 \text{ JOIN } \{COMP1.speed < COMP2.speed\} R2)$
 $R4 = \text{RHO } \{COMP\} (\text{PI } \{model\} R1)$
 $R5 = R4 - R3$

j)

$R1 = \text{RHO } \{PC1\} (\text{PI } \{maker, speed\} (\text{Product Natural_Join PC}))$
 $R2 = \text{RHO } \{PC2\} (\text{PI } \{maker, speed\} (\text{Product Natural_Join PC}))$
 $R3 = \text{RHO } \{PC3\} (\text{PI } \{maker, speed\} (\text{Product Natural_Join PC}))$
 $R4 = \text{SIGMA } \{PC1.maker = PC2.maker \text{ and } PC2.maker = PC3.maker \text{ and } PC1.speed >> PC2.speed \text{ and } PC2.speed >> PC3.speed\} ((R1 \text{ JOIN } R2) \text{ JOIN } R3)$
 $R5 = \text{PI } \{maker\} (R4)$

k)

$R1 = \text{RHO } \{PC1\} (\text{PI } \{maker, speed\} (\text{Product Natural_Join PC}))$
 $R2 = \text{RHO } \{PC2\} (\text{PI } \{maker, speed\} (\text{Product Natural_Join PC}))$
 $R3 = \text{RHO } \{PC3\} (\text{PI } \{maker, speed\} (\text{Product Natural_Join PC}))$
 $R4 = \text{RHO } \{PC3\} (\text{PI } \{maker, speed\} (\text{Product Natural_Join PC}))$
 $R5 = \text{SIGMA } \{PC1.maker = PC2.maker \text{ and } PC2.maker = PC3.maker \text{ and } PC1.model >> PC2.model \text{ and } PC2.model >> PC3.model\} ((R1 \text{ JOIN } R2) \text{ JOIN } R3)$
 $R6 = \text{SIGMA } \{PC1.maker = PC2.maker \text{ and } PC2.maker = PC3.maker \text{ and } PC3.maker = PC4.maker \text{ and } PC1.model >> PC2.model \text{ and } PC2.model >> PC3.model \text{ and } PC3.model >> PC4.model\} (((R1 \text{ JOIN } R2) \text{ JOIN } R3) \text{ JOIN } R4)$
 $R7 = \text{PI } \{maker\} (R5 - R6)$

Problem 2. Exercise 6.1.3. a) , 6.2.2. b), 6.3.1. a) c), 6.4.6 i) (10pt, 2pt for each)

6.1.3. a)

```
SELECT model, speed, hd
FROM PC
WHERE price < 1200;
```

6.2.2. b)

```
(SELECT Product.model, price
  FROM Product, PC
  WHERE Product.model = PC.model AND
        maker = 'B')
UNION
(SELECT Product.model, price
  FROM Product, Laptop
  WHERE Product.model = Laptop.model AND
        maker = 'B')
UNION
(SELECT Product.model, price
  FROM Product, Printer
  WHERE Product.model = Printer.model AND
        maker = 'B');
```

6.3.1. a)

```
SELECT maker
FROM Product
WHERE model IN
  (SELECT model
   FROM PC
   WHERE speed >= 1200);

SELECT maker
FROM Product
WHERE EXISTS
  (SELECT *
   FROM PC
   WHERE speed >= 1200 AND
        Product.model = model);
```

Notice that the second solution uses a correlated subquery, and ``model" refers to the more local PC.model unless we explicitly say that the ``model" of the outer query is wanted by Product.model

c)

```
SELECT maker
FROM Laptop
WHERE speed <
  (SELECT MAX(speed)
   FROM PC);
```

6.4.6. a)