

# CSC343 Worksheet 4 Solution

June 18, 2020

1. a)  $[(1, 0, 1), (5, 4, 9), (1, 0, 1), (6, 4, 16), (7, 9, 16)]$
- b)  $[(1, 0), (3, 3), (3, 4), (4, 3), (1, 1), (4, 3)]$
- c)  $[(0, 1), (0, 1), (2, 3), (2, 4), (3, 4)]$

## Notes:

- $\tau_L(R)$  sorts tuples in order indicated by  $L$ .
  - e.g.

$\tau_{C,B}(R)$  in  $R(A, B, C)$  orders the tuples of  $R$  by their values of  $C$ , and tuples with the same  $C$ -value are ordered by their  $B$  value.

- d)  $[(0, 1), (0, 2), (2, 4), (2, 5), (3, 4), (3, 4)]$
- e)  $[(0, 1), (2, 4), (2, 5), (3, 4), (0, 2)]$

## Notes:

- $\delta(R)$  converts a bag into a set
  - e.g.

Let  $R = [(1, 2), (3, 4), (1, 2), (1, 2)]$

$\delta(R(A, B)) = [(1, 2), (3, 4)]$

- f)  $[(0, 2), (2, 7), (3, 4)]$

## Notes:

- $\gamma_L(R)$  is an operator that groups a relation and/or aggregate some columns.
  - $L$  in  $\gamma_L(R)$  is either
    1. **Grouping attribute** or an attribute by which  $R$  will be grouped.

2. **Aggregated attribute** or an attribute where an aggregation operator is applied to.

**Example:**

$\gamma_{starName, MIN(year) \rightarrow minYear, COUNT(title) \rightarrow ctTitle} (StarsIn)$

studioName
Disney
Disney
Disney
MGM
MGM

groups by studioName

Figure 5.4: A relation with imaginary division into groups

- g)  $[(0, 1.5), (2, 4.5), (3, 4)]$   
 h)  $[(0, 1), (0, 1), (2, 3), (2, 4), (3, 4)]$   
 i)  $\gamma_{A, MAX(C)}([(2, 3, 4), (2, 3, 4)]) \rightarrow [(2, 4)]$   
 j)  $[(0, 1, \perp), (2, 3, 4), (2, 3, 4), (0, 1, \perp), (2, 4, \perp), (3, 4, \perp)]$

**Notes:**

- $\bowtie$  is an outerjoin operator
  - $\bowtie_L$  means Natural Left Outer Join
  - $\bowtie_R$  means Natural Right Outer Join
  - $\bowtie$  means Natural Full Outer Join
  - $\perp$  means null
- e.g.  $U \bowtie V$

<i>A</i>	<i>B</i>	<i>C</i>
1	2	3
4	5	6
7	8	9

(a) Relation *U*

<i>B</i>	<i>C</i>	<i>D</i>
2	3	10
2	3	11
6	7	12

(b) Relation *V*

<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>
1	2	3	10
1	2	3	11
4	5	6	⊥
7	8	9	⊥
⊥	6	7	12

(c) Result  $U \bowtie V$ 

- k)  $[(\perp, 0, 1), (\perp, 2, 4), (\perp, 2, 5), (2, 3, 4), (\perp, 0, 2), (2, 3, 4)]$   
 l)  $[(0, 1, \perp), (2, 3, 4), (2, 3, 4), (0, 1, \perp), (2, 4, \perp), (3, 4, \perp),$   
 $(\perp, 0, 1), (\perp, 2, 4), (\perp, 2, 5), (2, 3, 4), (\perp, 0, 2), (2, 3, 4)]$   
 m)  $(0, 1) : \{(2, 4), (2, 5), (3, 4), (3, 4)\}$

But,  $\{(2, 3), (2, 4), (3, 4)\}$  from *R* and  $\{(0, 1), (0, 2)\}$  in *S* don't match. So,

$[(0, 1, 2, 4), (0, 1, 2, 5), (0, 1, 3, 4), (0, 1, 3, 4), (0, 1, 2, 4), (0, 1, 2, 5), (0, 1, 3, 4), (0, 1, 3, 4),$   
 $(2, 3, \perp, \perp), (2, 4, \perp, \perp), (3, 4, \perp, \perp), (\perp, \perp, 0, 1), (\perp, \perp, 0, 2)]$

### Notes:

- $R \bowtie_C S$  is equivalent form of  $\sigma_C(R \times S)$  but instead of filtering, the unmatched tuples are filled with null.

2. a) SELECT model FROM PC WHERE speed > 3.0;  
 b) SELECT DISTINCT maker FROM Products NATURAL JOIN Laptops WHERE hd >= 100;

```
c)
1  SELECT model, price FROM (
2      (SELECT model, price FROM PC NATURAL JOIN Products)
3      UNION
4      (SELECT model, price FROM Laptop NATURAL JOIN Products)
5      UNION
6      (SELECT model, price FROM Printer INNER JOIN Products ON
Printer.model = Product.model)
7  );
8
```

d) SELECT model FROM Printer WHERE color;

```
e) (SELECT DISTINCT makers FROM Products WHERE type='laptops') -
2 (SELECT DISTINCT makers FROM Products WHERE type='pc');
3
```

```
f) SELECT hd FROM PC WHERE EXISTS (
2 SELECT hd, COUNT(model) FROM PC GROUP BY hd
3 HAVING COUNT(model) > 2
4 );
5
```

3. a) SELECT class, country FROM classes WHERE bore >= 16;

b) SELECT \* FROM Ships WHERE launched < 1921;

c) SELECT \* FROM Outcomes WHERE result='sunk';

d) SELECT \* FROM Classes NATURAL JOIN Ships WHERE displacement > 35000;

```
e) SELECT name, displacement, numGuns FROM Classes NATURAL JOIN (
2 SELECT * FROM Ships INNER JOIN Outcomes ON Ships.name =
Outcome.ship
3 );
4
```

```
f) (SELECT name FROM Ships)
2 UNION
3 (SELECT ship AS name FROM Outcomes);
4
```

```
g) SELECT class, COUNT(class) FROM Ships
2 GROUP BY Class
3 HAVING COUNT(class) = 1;
4
```

```
h) (SELECT countries FROM Classes WHERE type='bb')
2 INTERSECT
3 (SELECT countries FROM Classes WHERE type='bc');
4
```

i) Current attempt:

```
1 (SELECT Table1.name FROM Outcomes AS Table1 INNER JOIN Ships ON
Outcome.ship = Ships.name)
2
```

Took too much time. Omitted for now.

4. a) SELECT AVG(speed) FROM PC;

b) SELECT AVG(speed) FROM Laptop HAVING price > 1000;

c) SELECT AVG(price) FROM PC NATURAL JOIN Product HAVING maker = 'A';

d)

```
SELECT AVG(price) FROM (  
  (SELECT model, price FROM PC NATURAL JOIN Product WHERE maker  
   = 'D')  
  UNION  
  (SELECT model, price FROM Laptop NATURAL JOIN Product WHERE  
   maker = 'D')  
);
```

e) SELECT speed, AVG(price) FROM PC GROUP BY speed;

f) SELECT maker, AVG(screen) FROM Laptop NATURAL JOIN Product GROUP BY maker;

g)

```
SELECT maker, COUNT(model) FROM Products GROUP BY maker HAVING  
COUNT(model) >= 3;
```

h)

```
SELECT maker, MAX(price) FROM PC  
NATURAL JOIN Products GROUP BY maker;
```

i)

```
SELECT speed, AVG(price) FROM PC GROUP BY speed  
HAVING speed > 2.0;
```