

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	\perp
7	8	9	\perp
\perp	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;
```

5. a) SELECT COUNT(class) FROM Classes;

b) SELECT class, AVG(numGuns) FROM Classes GROUP BY class;