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Q0:

1)

User(userId: integer PRIMARY KEY, first_name: string NOT NULL, last_name: string NOT NULL)

2)

TRUE = 1
FALSE = 0
UNKNOWN = 0.5
(FALSE AND UNKNOWN) = MIN(FALSE, UNKNOWN) = FALSE
FALSE OR UNKNOWN = MAX(FALSE, UNKNOWN) = UNKNOWN
Thus, UNKNOWN

3)

When we project relation as sets, we need to compare each projected tuple with all the other projected tuples, to make sure that each projection appears only once. However, if we use a bag then we simply project each tuple and add it to the result and no comparison with other projected tuples is necessary.

4)

In registration forms, when entering last name is optional it can be stored as NULL.
User(userId: integer, first_name: string, last_name: string, agr: integer)

5)

{1,2,1,1} – {1,2,3}
Bag => {1,1}
Set => {1,1}

6)   {1,2,1,1} U {1,2,3} => Bag =>{1,1,1,1,2,2,3}
                              Set=> {1,2,3}

7)

{1,2,1,1} intersection {1, 1, 2, 3} = Bag => {1,1, 2}

8)

union of two relations as bags, we simply copy one relation and add to the copy all the tuples of the other relation (n+m)

Q1

model	speed	ram	hd	price
1001	2.66	1024	250	2114
1002	2.10	512	250	995
1003	1.42	512	80	478
1004	2.80	1024	250	649
1005	3.20	512	250	630
1006	3.20	1024	320	1049
1007	2.20	1024	200	510
1008	2.20	2048	250	770
1009	2.00	1024	250	650
1010	2.80	2048	300	770
1011	1.86	2048	160	959
1012	2.80	1024	160	649
1013	3.06	512	80	529

(a) Sample data for relation PC

As Set =>
Pl speed (PC) = {2.66, 2.10, 1,42, 2.80, 3.20, 2.20, 2, 1.86, 3.06 } =>
Average value = 2.36
As Bag

PI speed (PC) = {2.66, 2.10, 1.42, 2.80, 3.20, 3.20, 2.20, 2.20, 2.00, 2.80, 1.86, 2.80, 3.06}

Average value = 2.48

Q2

a) $R(A+B, A^2, B^2)$ = {(1, 0, 1), (5, 0, 1), (1, 0, 1), (6, 4, 16), (7, 9, 16) }
  e) duplicateElimination(R) = {(0,1), (2,3), (2,4), (3,4)}
  f) duplicateElimination(S) = {(0,1),(2,4), (2,5), (3,4), (0,2)}

Q3

Product(manufacturer, model)
PC(model, speed, ram, screensize, price)

a) AVG(speed)

2b) $\gamma \left(\sigma_{Price > 1000} \left(G_{avg(speed), max(ram)} \right) \right)_{screensize}$

3c) $\gamma_{screensize} \left(\pi_{screensize, AVG(price)} (PC) \right)$

4) $a = \pi_{ram > 100} (PC)$

$b = G_{min(Price), max(Price)}$

$\gamma_{manufra, screensize} \ b(a)$

5) $COUNT (Product \times PC)$

6) $COUNT \left(\delta_{manufacturers} \right)$

7) $COUNT \left(\sigma_{PC.model \, != \, Product.model} \right)$