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ECS165 HW3

1a)

R(city) := πcity(Car)

R:

City
33
38
30
40

1b)

R(city) := πcity(Car)

R:

City
33
38
30
33
40
30
33

1c)
AVG(city)
= (33+38+30+40)/4
= 35.25

1d)
AVG(city)
= (33+38+30+33+40+30+33)/7
≈ 33.8571429
≈ 33.86

2)
As Prof. Nitta said on piazza, do full outer join.

Car ⟗ Product:

model	city	highway	msrp	maker	year
1001	33	36	26000	A	2011
1002	38	43	27600	A	2015
2001	33	38	23000	B	2014
3001	30	34	23000	C	2007
1003	30	34	22500	⊥	⊥
2002	40	42	33200	⊥	⊥
3002	33	36	25600	⊥	⊥
1101	⊥	⊥	⊥	A	2014
2003	⊥	⊥	⊥	B	1999
2101	⊥	⊥	⊥	B	2005
2102	⊥	⊥	⊥	B	2011
2201	⊥	⊥	⊥	B	2007
3201	⊥	⊥	⊥	C	2016

3a)
Ans(model) <--- EV(model, range, __ , __ , __) AND range < 35

3b)

Ans(model) <--- Pickup(model, __ , highway, __ , cargo, __ , __)
AND cargo $\geq$ 75 AND highway < 25

3c)

V(model, msrp) <--- Car(model, __ , __ , __ , __ , __ , msrp)
V(model, msrp) <--- Pickip(model, __ , __ , __ , __ , __ , msrp)
V(model, msrp) <--- EV(model, __ , __ , __ , msrp)

Ans(maker) <--- Product(maker, model, __) AND Product(maker,model2)
AND V(model, msrp) AND V(model2, msrp2)
AND model ≠ model2 AND msrp < 25000 AND msrp2 > 60000

3d)
V(m, p) <--- Car(m, __ , __ , __ , p, __ , __)
V(m, p) <--- Pickup(m, __ , __ , p, __ , __ , __)
V(m, p) <--- EV(m, __ , __ p, __)
Ans(p) <--- V(m1, p1) AND V(m2, p2) AND m1 ≠ m2 AND p1 = p2

3e)

CV(m, c, h) <--- Car(m, c, h, __ , __ , __ , __)

CV(m, c, h) <--- Pickup(m, c, h, __ , __ , __ , __)

Low(m1) <--- CV(m1, c1, h1) AND CV(m2, c2, h2)
AND m1 ≠ m2 AND c1*0.55+h1*0.45 < c2*0.55+h2*0.45

High(m) <--- CV(m, __ , __) AND NOT Low(m)

Ans(maker) <--- High(m) AND Product(maker, m, __)

3f)

CV(m, c, h) <--- Car(m, c, h, __ , __ , __ , __)

CV(m, c, h) <--- Pickup(m, c, h, __ , __ , __ , __)

EEV(m, r, b) <--- EV(m, r, b, __ , __)

LowCV(m1, c1, h1) <--- CV(m1, c1, h1) AND CV(m2, c2, h2)
AND m1 ≠ m2 AND 0.55*c1+0.45*h1 < 0.55*c2+0.45*h2

HighCV(m, c, h) <--- CV(m, c, h) AND NOT LowCV(m, c, h)

LowEV(m1, r1, b1) <--- EEV(m1, r1, b1) AND EEV(m2, r2, b2)
AND m1 ≠ m2 AND r1/(b1/33.1) < r2/(b2/33.1)

HighEV(m, r, b) <--- EEV(m, r, b) AND NOT LowEV(m, r, b)

Low_HighCV(m1) <--- HighCV(m1, c, h) AND (m2, r, b)
AND m1 ≠ m2 AND 0.55*c+0.45*h < r/(b/33.1)

Low_HighEV(m1) <--- HighCV(m1, c, h) AND (m2, r, b)
AND m1 ≠ m2 AND r/(b/33.1) < 0.55*c+0.45*h

Ans(m) <--- HighCV(m, __ , __) AND NOT Low_HighCV (m)

Ans(m) <--- HighEV(m, __ , __) AND NOT Low_HighEV (m)

3g)

HighCar(maker,model1) <--- Product(maker,model1, __)
AND Product(maker, model2, __)
AND Car(model1, city1, __ , __ , __ , __ , __)
AND Car(model2, city2, __ , __ , __ , __ , __)
AND city1 > city2

LowCar(maker, model) <--- Product(maker, model, __)
AND Car(model, __ , __ , __ , __ , __)
AND NOT HighCar(maker, model)

Ans(maker) <--- AND LowCar(maker, model1) AND Car(model1, c1, __ , __ , __ , __ , __)
AND Product(maker, model2)
AND Pickup(model2, c2, __ , __ , __ , __ , __) AND c1 > c2

3h)

CV(maker, msrp) <--- Product(maker, model, __)
AND Car(model, __ , __ , __ , __ , __ , msrp)

CV(maker, msrp) <--- Product(maker, model, __)
AND Pickup(model, __ , __ , __ , __ , __ , msrp)

Ans(maker) <--- CV(maker, msrp1)
AND CV(maker, msrp2)
AND CV(maker, msrp3)
msrp1 < msrp2 AND msrp2 < msrp3

4a)

```
SELECT DISTINCT model
FROM EV
WHERE range < 35
```

4b)

```
SELECT DISTINCT model
FROM Pickup
WHERE cargo >= 75 AND highway < 25
```

4c)

```
SELECT DISTINCT J1.maker FROM
    (SELECT maker, msrp
    FROM Product NATURAL JOIN
        (SELECT model, msrp FROM Car
                UNION
        SELECT model, msrp FROM Pickup
                UNION
        SELECT model, msrp FROM EV) AS S
    )AS J1,
    (SELECT maker, msrp
    FROM Product NATURAL JOIN
        (SELECT model, msrp FROM Car
                UNION
        SELECT model, msrp FROM Pickup
                UNION
        SELECT model, msrp FROM EV) AS S
    )AS J2
WHERE J1.maker = J2.maker AND J1.msrp < 25000 AND J2.msrp > 60000;
```

4d)

```
SELECT DISTINCT J1.passengers FROM
    (SELECT model, passengers FROM Car
            UNION
    SELECT model, passengers FROM Pickup
            UNION
    SELECT model, passengers FROM EV)AS J1,
    (SELECT model, passengers FROM Car
            UNION
    SELECT model, passengers FROM Pickup
            UNION
    SELECT model, passengers FROM EV)AS J2
WHERE J1.model <> J2.model AND J1.passengers = J2.passengers;
```

4e)

```
SELECT DISTINCT maker
FROM Product NATURAL JOIN
(
   (SELECT model FROM CAR
     UNION
   SELECT model FROM Pickup)
   EXCEPT
   (SELECT J1.model FROM
      (SELECT model, city, highway FROM CAR
           UNION
      SELECT model, city, highway FROM Pickup)AS J1,
      (SELECT model, city, highway FROM CAR
           UNION
      SELECT model, city, highway FROM Pickup)AS J2
   WHERE J1.model <> J2.model
   AND J1.city*0.55+J1.highway*0.45 < J2.city*0.55+J2.highway*0.45)
)AS F;
```

4f)

```
SELECT model FROM Car
UNION
SELECT model FROM Pickup
UNION
SELECT model FROM EV
EXCEPT
SELECT J1.model FROM
    (SELECT model, 0.55*city+0.45*highway AS fuel
    FROM (Car NATURAL JOIN Product)
    UNION
    SELECT model, 0.55*city+0.45*highway AS fuel
    FROM (Pickup NATURAL JOIN Product)
    UNION
    SELECT model, range/(battery/33.1) AS fuel
    FROM (EV NATURAL JOIN Product)) AS J1,

    (SELECT model, 0.55*city+0.45*highway AS fuel
    FROM (Car NATURAL JOIN Product)
    UNION
    SELECT model, 0.55*city+0.45*highway AS fuel
    FROM (Pickup NATURAL JOIN Product)
    UNION
    SELECT model, range/(battery/33.1) AS fuel
    FROM (EV NATURAL JOIN Product)) AS J2
WHERE J1.fuel < J2.fuel;
```

4g)

```
SELECT DISTINCT LOWCAR.maker FROM
   (
     (SELECT maker, model,city
     FROM Product NATURAL JOIN
      (SELECT model, city FROM Car)AS A
      EXCEPT
      SELECT J1.maker, J1.model, J1.city FROM
            (SELECT maker, model, city
            FROM Product NATURAL JOIN
                 (SELECT model, city FROM Car) AS Q
            )AS J1,
            (SELECT maker, model,city
            FROM Product NATURAL JOIN
                 (SELECT model, city FROM Car)AS P
            )AS J2
      WHERE J1.city > J2.city
      )
   ) AS LOWCAR,
   (Product NATURAL JOIN Pickup)AS P
WHERE LOWCAR.city > P.city;
```

4h)

```
SELECT DISTINCT J1.maker FROM
    (SELECT maker, msrp FROM (Product NATURAL JOIN Car)
    UNION
    SELECT maker, msrp FROM (Product NATURAL JOIN Pickup)
    ) AS J1,
    (SELECT maker, msrp FROM (Product NATURAL JOIN Car)
    UNION
    SELECT maker, msrp FROM (Product NATURAL JOIN Pickup)
    ) AS J2,
    (SELECT maker, msrp FROM (Product NATURAL JOIN Car)
    UNION
    SELECT maker, msrp FROM (Product NATURAL JOIN Pickup)
    ) AS J3
WHERE J1.msrp < J2.msrp AND J2.msrp < J3.msrp AND J1.maker = J2.maker AND
J2.maker = J3.maker;
```