Homework 1

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1.

(a). $Answer(model) := \pi_{model}(\sigma_{city<40}(Car))$

(b). $Answer(model) := \pi_{model}(\sigma_{towing\geq 12000\ AND\ highway\geq 20}(Pickup))$

(c).

$CP(model, price) := \pi_{model,price}(Car)$

$PM(maker, model) := \pi_{maker,model}(Product)$

$NA(maker) := \pi_{maker}(PM \bowtie_{CP.price>25000\ AND\ CP.price<60000}\ CP)$

$Answer(maker) := \pi_{maker}(PM) - \pi_{maker}(NA)$

(d).

$CP(model, price) := \pi_{model,price}(Car)$

$CP1(model, price) := CP$

$Answer(model) := \rho_{(model)}\pi_{CP.model}(CP \bowtie_{CP.model=CP1.mocel\ ANDCP.price\neq CP1.price}\ CP1))$

(e).

$PM(maker, model) := \pi_{maker,model}(Product)$

$CMCH(model, city, highway) := \pi_{model,city,highway}(Car)$

$PMCH(model, city, highway) := \pi_{model,city,highway}(Pickup)$

$R(A, B, C, D) := \rho_{(A,B,C,D)}(PM \bowtie CMCH)$

$R1(A, B, C, D) := R$

$NoMaxOrMin(R.A, R.B, R.C, R.D, R1.A, R1.B, R1.C, R1.D) := R \bowtie_{0.55R.C+0.45R.D>0.55R1.C+0.45R1.D} R1$

$Min(maker) := \rho_{maker}(\pi_A(R) - \pi_{R1.A}(NoMaxOrMin))$

(f). As discussed above, $Max(model) := \rho_{model}(\pi_B(R) - \pi_{R.B}(NoMaxOrMin))$

2.

(a).$\pi_{model}(\sigma_{towing<12000}(Pickup) \cap \pi_{model}(\sigma_{price>25000}(Pickup))) = \emptyset$

(b). $\pi_{model}(\sigma_{range\geq 95}(EV)) - \pi_{model}(EV) = \emptyset$

(c).

$CMCHP(model, city, highway, price) := \pi_{model,city,highway,price}(Car)$

$\pi_{model}(\sigma_{city \geqslant 50\ AND highway<40}(CMCHP)) \cap \pi_{model}(\sigma_{city \geqslant 50\ AND\ price>20}(CMCHP)) = \emptyset$
(d).
$PMM(maker, model) := \pi_{maker,model}(Product)$
$\pi_{maker}(PMM \bowtie Pickup) \cap \pi_{maker}(PMM \bowtie EV) = \emptyset$
(e).
$PMM(maker, model) := \pi_{maker,model}(Product)$
$PC(maker, model, city) := \pi_{maker,model,city}(PMM \bowtie Car)$
$PP(maker, model, city) := \pi_{maker,model,city}(PMM \bowtie Pickup)$
$AMaker(maker) := \rho_{(maker)}(\pi_{PC.maker}(PC \bowtie_{PC.city>PP.city} PP))$
$Amaker(maker) - \pi_{maker}(PC) = \emptyset$
(f).
$PCP(city, price) := \pi_{city,price}(Pickup)$
$CCP(city, price) := \pi_{city,price}(Car)$
$TOTAL(PCP.city, PCP.price, CCP.city, CCP.price) := PCP \times CCP$
$\sigma_{PCP.city>CCP.city\ AND PCP.price<1.5CCP.price}(TOTAL) = \emptyset$

3. (a). $P_x \to V_x$, $P_y \to V_y$, $P_z \to V_z$
(b). $P_x, P_y, {P_z}^+ \to P_x, P_y, P_z, V_x, V_y, V_z$
(c). $P_x, P_y, P_z, {V_x}^+$, $P_x, P_y, P_z, {V_y}^+$, $P_x, P_y, P_z, {V_z}^+$
(d). It is the same with the number of the super sets of $P_x, P_y, {P_z}^+$. Except the key, the number of super keys is $\binom{3}{1} + \binom{3}{2} + \binom{3}{3} = 7$