

Assignment 3

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Question 1

a

$$\begin{aligned} R_0 &\leftarrow Publisher \bowtie_{name=pname} Distribute \\ R_1 &\leftarrow \rho_{publisher_name, school_name, distribute_ISBN}(\pi_{name, sname, ISBN}(R_0)) \\ R_2 &\leftarrow \sigma_{color='red'}(R_1 \bowtie_{distribute_ISBN=ISBN} Book) \\ R_3 &\leftarrow School - \sigma_{city='Calgary'}(School) \\ R_4 &\leftarrow \pi_{publisher_name}(R_2 \bowtie_{school_name=name} R_3) \\ R_5 &\leftarrow R_4 \bowtie_{publisher_name=name} Publisher \\ RESULT &\leftarrow \pi_{name, city}(R_5) \end{aligned}$$

b

$$\begin{aligned} R_0 &\leftarrow \sigma_{city='Paris'}(School) \\ R_1 &\leftarrow R_0 \bowtie_{name=sname} Distribute \\ R_2 &\leftarrow \pi_{director, pname}(R_1) \\ R_3 &\leftarrow R_2 \bowtie_{pname=name} Publisher \\ RESULT &\leftarrow \pi_{director}(\sigma_{city='London'}(R_3)) \end{aligned}$$

c

$$\begin{aligned}
R_0 &\leftarrow \sigma_{city='Roma'}(Publisher) \\
R_1 &\leftarrow R_0 \bowtie_{name=pname} Distribute \\
R_2 &\leftarrow \pi_{pname}(R_1) \\
R_3 &\leftarrow Distribute \bowtie_{sname=name} School \\
R_4 &\leftarrow \pi_{pname}(\sigma_{city='Toronto'}(R_3)) \\
R_5 &\leftarrow R_2 \cap R_4 \\
R_6 &\leftarrow \rho_{(publisher_name)} R_5 \\
R_7 &\leftarrow R_6 \bowtie_{publisher_name=pname} Distribute \\
RESULT &\leftarrow \pi_{sname}(R_7)
\end{aligned}$$

d

$$\begin{aligned}
R_0 &\leftarrow \pi_{name}(\sigma_{city='Calgary'}(School)) \\
R_1 &\leftarrow \rho_{(sname)}(R_0) \\
R_2 &\leftarrow \pi_{ISBN}(Distribute \div R_1) \\
R_3 &\leftarrow \pi_{name}(School) - R_0 \\
R_4 &\leftarrow R_3 \bowtie_{name=sname} Distribute \\
R_5 &\leftarrow \pi_{ISBN}(R_4) \\
R_6 &\leftarrow \rho_{(R6_ISBN)}(R_2 - R_5) \\
R_7 &\leftarrow \pi_{R6_ISBN, quantity}(R_6 \bowtie_{R6_ISBN=ISBN} Distribute) \\
R_8 &\leftarrow R_7 \bowtie_{R6_ISBN=ISBN} Book \\
RESULT &\leftarrow title \mathcal{F}_{SUM} quantity(R_8)
\end{aligned}$$

e

$$\begin{aligned}
R_0 &\leftarrow \rho_{(publisher_name, publisher_city)}(\pi_{name, city}(Publisher)) \\
R_1 &\leftarrow (R_0 \bowtie_{publisher_name=pname} Distribute) \bowtie_{sname=name} School \\
R_2 &\leftarrow \pi_{publisher_name, sname}(\sigma_{city=publisher_city}(R_1)) \\
R_3 &\leftarrow \pi_{publisher_name, sname}(R_0 \bowtie_{publisher_city=city} School) \\
R_4 &\leftarrow \pi_{publisher_name}(R_0) - \pi_{publisher_name}(R_3 - R_2) \\
R_5 &\leftarrow \pi_{pname, ISBN}(\sigma_{city=publisher_city}(R_1)) \\
R_6 &\leftarrow R_4 \bowtie_{publisher_name=pname} R_5 \\
R_7 &\leftarrow R_6 \bowtie_{R6.ISBN=Book.ISBN} Book \\
RESULT &\leftarrow title \mathcal{F}_{SUM} quantity(R_7)
\end{aligned}$$

Question 2

a

$$\{s.stno \mid Street(s) \wedge (\forall x)(Street(x) \wedge x.stno \neq s.stno \wedge x.city - name = s.city - name \implies s.length \geq x.length)\}$$

b

$$\{h.owner - name \mid House(h) \wedge (\forall x)((City(x) \wedge x.country - name = 'Canada') \implies (\exists y)(\exists z)(House(y) \wedge Street(z) \wedge y.owner - name = h.owner - name \wedge y.stno = z.stno \wedge z.city - name = x.city - name))\}$$

c

$$\{h.owner - name \mid House(h) \wedge (\exists h_1)(\exists h_2)(\exists h_3)(\exists s_1)(\exists s_2)(\exists s_3)(\exists c_1)(\exists c_2)(\exists c_3) \\ (House(h_1) \wedge Street(s_1) \wedge City(c_1) \wedge s_1.stno = h_1.stno \wedge c_1.city - name = s_1.city - name \wedge c_1.country - name \neq 'USA' \wedge \\ House(h_2) \wedge Street(s_2) \wedge City(c_2) \wedge s_2.stno = h_2.stno \wedge c_2.city - name = s_2.city - name \wedge c_2.country - name \neq 'USA' \wedge \\ h_1.owner - name = h.owner - name \wedge h_2.owner - name = h.owner - name \wedge h_1.hno \neq h_2.hno \wedge \\ House(h_3) \wedge Street(s_3) \wedge City(c_3) \wedge s_3.stno = h_3.stno \wedge c_3.city - name = s_3.city - name \wedge c_3.country - name = 'USA' \wedge \\ h_3.owner - name = h.owner - name)\}$$

d

$$\{c.name \mid Country(c) \wedge (\exists b)(Border(b) \wedge ((b.country - name1 = c.name \wedge b.country - name2 = 'Germany') \vee (b.country - name1 = 'Germany' \wedge b.country - name2 = c.name)))\}$$

e

$$\begin{aligned} \{h. owner - name \mid & House(h) \wedge (\forall c)(Country(c) \wedge (\exists b)(Border(b) \wedge \\ & ((b.country - name1 = c.name \wedge b.country - name2 = 'Spain') \vee \\ & (b.country - name1 = 'Spain' \wedge b.country - name2 = c.name))) \implies \\ & (\exists h_1)(\exists s_1)(\exists c_1)(House(h_1) \wedge Street(s_1) \wedge City(c_1) \wedge \\ & h_1.owner - name = h.owner - name \wedge \\ & s_1.city - name = c_1.city - name \wedge \\ & h_1.stno = s_1.stno \wedge \\ & c_1.country - name = c.name))\} \end{aligned}$$