CPSC 471 - Assignment 3

Name: Alex Stevenson
Student ID: 30073617

Question 1

PUBLISHER($\underline{name}, phone, city$)
BOOK($\underline{ISBN}, title, color, \#pages$)
SCHOOL($\underline{name}, phone, city, director$)
DISTRIBUTE($\underline{pname}, \underline{sname}, \underline{ISBN}, quantity$)

(a) **Find the ISBN, title and total quantity of yellow books that are published by publishers located in Vancouver and distributed only to the schools located in Toronto.**

$BAD\_ISBN = \pi_{\text{ISBN}}(DISTRIBUTE \bowtie_{\text{sname=name}} (\sigma_{\text{city!="Toronto"}}(SCHOOL)))$
$YELLOW = \sigma_{\text{color="Yellow"}}(BOOK)$
$GOOD\_ISBN = \rho_{(\text{GISBN})}(\pi_{\text{ISBN}}(YELLOW) - BAD\_ISBN)$
$VANCOUVER = \sigma_{\text{city="Vancouver"}}(PUBLISHER)$
$DISTRIBUTIONS = (DISTRIBUTE \bowtie_{\text{ISBN=GISBN}} GOOD\_ISBN) \bowtie_{\text{pname=name}} VANCOUVER$
$RESULT = \pi_{ISBN,title,quantity}(BOOK \bowtie_{ISBN=DISBN} (\rho_{(\text{DISBN})}(DISTRIBUTIONS)))$

(b) **Find the names and directors of schools located in Edmonton and receive books titled 'The Lost Tribe' from publishers located in Montreal.**

$ISBN = \rho_{(\text{IISBN})}(\pi_{ISBN}(\sigma_{\text{title="The Lost Tribe"}}(BOOK)))$
$MONTREAL = \sigma_{\text{city="Montreal"}}(PUBLISHER)$
$RECEIVE = (DISTRIBUTE \bowtie_{\text{pname=name}} MONTREAL) \bowtie_{\text{ISBN=IISBN}} ISBN$
$EDMONTON = \sigma_{city="Edmonton"}(SCHOOL)$
$RESULT = \pi_{\text{name, director}}(EDMONTON \bowtie_{\text{name=sname}} RECEIVE)$

(c) **Find the title and total quantity of each book distributed to all schools located in the same city as the publisher.**

THIS WAS WRONG, FIX

(d) **Find the names and cities of the publishers that distribute books only schools located in Calgary and that distributed books to every school in Calgary.**

$NOT\_CALG = \pi_{\text{pname}}(DISTRIBUTE \bowtie_{\text{sname=name}} (\sigma_{\text{city!="Calgary"}}(SCHOOL)) \bowtie_{\text{pname=name}} (PUBLISHE$
$PUBS = \pi_{\text{name}}(PUBLISHER) - \pi_{\text{name}}(PUBLISHER \bowtie_{\text{name=pname}} NOT\_CALG)$
$ONLY\_CALG = \pi_{\text{name,city}}(PUBLISHER \bowtie_{\text{PUBLISHER.name=PUBS.name}} PUBS$
$CALG\_SCHOOLS = \pi_{\text{name}}(\sigma_{\text{city="Calgary"}}(SCHOOL))$
$ALL\_CALG = (\pi_{\text{pname, sname}}(DISTRIBUTE)) \div (\rho_{\text{sname}}(CALG\_SCHOOLS))$
$CALG\_P = PUBLISHER \bowtie_{\text{name=pname}} ALL\_CALG$
$RESULT = ONLY\_CALG \cup \pi_{\text{name,city}}(CALG\_P)$

(e) **Find the ISBN and title of books distributed to schools located in Ottawa and never distributed to schools located in Windsor.**

$OTTAWA = \pi_{\text{ISBN}}(DISTRIBUTE \bowtie_{\text{sname=name}} (\sigma_{\text{city="Ottawa"}}(SCHOOL)))$
$WINDSOR = \pi_{\text{ISBN}}(DISTRIBUTE \bowtie_{\text{sname=name}} (\sigma_{\text{city="Windsor"}}(SCHOOL)))$
$RESULT = \pi_{\text{ISBN, title}}(BOOK \bowtie_{\text{ISBN=SISBN}} (\rho_{(\text{SISBN})}(OTTAWA - WINDSOR)))$

Question 2

$$\textbf{COUNTRY}(\underline{name}, area, population)$$
$$\textbf{BORDER}(\underline{country-name1}, \underline{country-name2})$$
$$\textbf{CITY}(\underline{city-name}, country-name, area, population)$$
$$\textbf{STREET}(\underline{stno}, city-name, length)$$
$$\textbf{HOUSE}(\underline{hno}, \#rooms, stno, owner-name)$$

(a) **Find the names of persons who own at least one house in at least one city of at least one country that has a border with Canada.**

{ h.owner-name | HOUSE(h)
and ∃c ∃b (COUNTRY(c) and BORDER(b)
and ((b.country-name1 = "Canada" and b.country-name2 = c.name)
or (b.country-name1 = c.name and b.country-name2 = "Canada"))
and ∃ t (CITY(t) and t.country-name = c.name
and ∃ s (STREET(s) and s.city-name = t.city-name
and h.stno = s.stno))) }

(b) **Find the street number and city name of the shortest street in each city in every country that is has a border with Canada.**

{ s.stno, s.city-name | STREET(s)
and ∃c ∃b (COUNTRY(c) and BORDER(b)
and ((b.country-name1 = "Canada" and b.country-name2 = c.name)
or (b.country-name1 = c.name and b.country-name2 = "Canada"))
and ∃ t (CITY(t) and t.country-name = c.name
and ∀ r (STREET(r) → r.city-name = t.city-name
and s.length < r.length and s.stno ≠ r.stno))) }

(c) **Find the names and population sizes of all countries that have a border with the USA.**

{ c.name, c.population | COUNTRY(c)
and ∃ b (BORDER(b)
and ((b.country-name1 = "USA" and b.country-name2 = c.name)
or (b.country-name1 = c.name and b.country-name2 = "USA"))) }

(d) **Find the names of persons who do not own any houses in Canada but own more than one house in the USA.**

{ h.owner-name | HOUSE(h)
and ∃ c (CITY(c) and c.ountry-name = "USA"
and ∃ s (STREET(s) and s.city-name = c.city-name
and h.stno = s.stno))

and ∀ c ((CITY(c) and c.country-name = "Canada")
→ ∀ s ((STREET(s) and s.city-name = c.city-name)
→ ∀ o (HOUSE(o) and o.stno = s.stno
→ h.owner-name ≠ o.owner-name)))

and ∃ c ∃ o (CITY(c) and HOUSE(o)
and c.country-name = "USA" and o.owner-name = h.owner-name
and ∃ s (STREET(S) and o.stno = s.stno and o.hno ≠ h.hno)) }

(e) **Find the names and areas of cities with at least one street where no house is located.**

{ c.city-name, c.area | CITY(c)
and ∃ s (STREET(s) and s.city-name = c.city-name and ∀ h (HOUSE(h) → h.stno ≠ s.stno)) }