

CPSC 471 - Assignment 3

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Question 1

PUBLISHER(name, phone, city)
BOOK(ISBN, title, color, #pages)
SCHOOL(name, phone, city, director)
DISTRIBUTE(pname, sname, 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.

$BAD_ISBN = \pi_{ISBN}(DISTRIBUTE \bowtie_{sname=name} (\sigma_{city!=\text{'Toronto'}}(SCHOOL)))$

$YELLOW = \sigma_{color=\text{'Yellow'}}(BOOK)$

$GOOD_ISBN = \rho_{(GISBN)}(\pi_{ISBN}(YELLOW) - BAD_ISBN)$

$VANCOUVER = \sigma_{city=\text{'Vancouver'}}(PUBLISHER)$

$DISTRIBUTIONS = (DISTRIBUTE \bowtie_{ISBN=GISBN} GOOD_ISBN) \bowtie_{pname=name} VANCOUVER$

$RESULT = \pi_{ISBN,title,quantity}(BOOK \bowtie_{ISBN=DISBN} (\rho_{(DISBN)}(DISTRIBUTIONS)))$

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

$ISBN = \rho_{(IISBN)}(\pi_{ISBN}(\sigma_{title=\text{'The Lost Tribe'}}(BOOK)))$

$MONTREAL = \sigma_{city=\text{'Montreal'}}(PUBLISHER)$

$RECEIVE = (DISTRIBUTE \bowtie_{pname=name} MONTREAL) \bowtie_{ISBN=IISBN} ISBN$

$EDMONTON = \sigma_{city=\text{'Edmonton'}}(SCHOOL)$

$RESULT = \pi_{name,director}(EDMONTON \bowtie_{name=sname} RECEIVE)$

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

$SAME_CITY = SCHOOL \bowtie_{SCHOOL.city=PUBLISHER.city} PUBLISHER$

$DISTRIBUTED = DISTRIBUTE \bowtie_{sname=SCHOOL.name \text{ and } pname=PUBLISHER.name} SAME_CITY$

$COUNTS = ISBN \ F_{SUM \ quantity} DISTRIBUTED$

$RESULT = \pi_{title,sum_quantity}(BOOK \bowtie_{BOOK.ISBN=COUNTS.ISBN} COUNTS)$

- (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.

$NOT_CALG_SCHOOLS = DISTRIBUTE \bowtie_{sname=name} (\sigma_{city!=\text{'Calgary'}}(SCHOOL))$

$NOT_CALG = \pi_{pname}(NOT_CALG_SCHOOLS \bowtie_{pname=name} (PUBLISHER))$

$PUBS = \pi_{name}(PUBLISHER) - \pi_{name}(PUBLISHER \bowtie_{name=pname} NOT_CALG)$

$ONLY_CALG = \pi_{name,city}(PUBLISHER \bowtie_{PUBLISHER.name=PUBS.name} PUBS)$

$CALG_SCHOOLS = \pi_{name}(\sigma_{city=\text{'Calgary'}}(SCHOOL))$

$ALL_CALG = (\pi_{pname,sname}(DISTRIBUTE)) \div (\rho_{sname}(CALG_SCHOOLS))$

$CALG_P = PUBLISHER \bowtie_{name=pname} ALL_CALG$

$RESULT = ONLY_CALG \cup \pi_{name,city}(CALG_P)$

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

$OTTAWA = \pi_{ISBN}(DISTRIBUTE \bowtie_{sname=name} (\sigma_{city=\text{'Ottawa'}}(SCHOOL)))$

$WINDSOR = \pi_{ISBN}(DISTRIBUTE \bowtie_{sname=name} (\sigma_{city=\text{'Windsor'}}(SCHOOL)))$

$RESULT = \pi_{ISBN,title}(BOOK \bowtie_{ISBN=SISBN} (\rho_{(SISBN)}(OTTAWA - WINDSOR)))$

Question 2

COUNTRY(name, area, population)
BORDER(country – name1, country – name2)
CITY(city – name, country – name, area, population)
STREET(stno, city – name, length)
HOUSE(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 $\exists c \exists b$ (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 $\exists t$ (CITY(t) and t.country-name = c.name
 and $\exists s$ (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 $\exists c \exists b$ (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 $\exists t$ (CITY(t) and t.country-name = c.name
 and $\forall r$ (STREET(r) \rightarrow r.city-name = t.city-name
 and s.length < r.length and s.stno \neq 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 $\exists b$ (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 $\exists c$ (CITY(c) and c.country-name = "USA"
 and $\exists s$ (STREET(s) and s.city-name = c.city-name
 and h.stno = s.stno))

and $\forall c$ ((CITY(c) and c.country-name = "Canada")
 $\rightarrow \forall s$ ((STREET(s) and s.city-name = c.city-name)
 $\rightarrow \forall o$ (HOUSE(o) and o.stno = s.stno
 \rightarrow h.owner-name \neq o.owner-name)))

and $\exists c \exists o$ (CITY(c) and HOUSE(o)
 and c.country-name = "USA" and o.owner-name = h.owner-name
 and $\exists s$ (STREET(s) and o.stno = s.stno and o.hno \neq 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 $\exists s$ (STREET(s) and s.city-name = c.city-name and $\forall h$ (HOUSE(h) \rightarrow h.stno \neq s.stno)) }