**Jerry Perez**

**CS3431 A20 Wong**

**Assignment 3: Relational Algebra and More SQL**

Due Date: T 9/15 at 11:59pm.

Late Policy: **No late assignments** will be accepted because solutions will be posted Wednesday morning so everyone can properly prepare for Thursday’s Exam 1. Maximum grade is 100 points.

Submission: In PDF or Word format using the Assignment 3 Submission button. Be aware that Canvas will be applying late penalties automatically! As a result, the Canvas deadline is set for Wednesday at 1am to give you a little extra time if you have problems with your submission but technically the actual deadline is T 9/15 at 11:59pm.

This assignment is to be typed. The following relational algebra symbols are provided for your use in the assignment:

σ, π, γ, **δ,** ⋈, 🡨, ∩, **∪**

**Part 1: Science Fiction and Literature Books[50 Points (5 points for each part)]**

Given the relations given below

**A 🡨 Author**(authorName, address, URL)

**SF 🡨 SFBook**(ISBN, title, year, price, publisherName)

**NF 🡨 NFBook**(ISBN, title, year, price, publisherName)

**WB 🡨 WrittenBy**(authorName, address, ISBN)

**P 🡨 Publisher**(pName, address, phone, URL)

**W 🡨 Warehouse**(code, phone, address)

**S 🡨 Stocks**(ISBN, WH\_code, numberOfBooks)

Note 1: SF stands for science fiction books and NF stands for non-fiction books.

Note 2: The ISBN field in the WB relation does not reference another field. You can still create theta joins with other tables based on the ISBN. Note: We do not have to worry about a science fiction book having the same ISBN number as a non fiction book because the US Library of Congress assigns unique numbers to books.

For the following problems,

1. in the relational algebra, use the **abbreviations** for the tables in the relational algebra or 5 points off
2. in the SQL code, use the full names of the tables along with table aliases where feasible

For example,

σprice > 10(SF)

select \*

from SFBook SF join Publisher P

on SF.publisherName = P.pName;

1. Based on the given primary keys, specify below the foreign key relationships that exist between the tables that would make sense.
   1. Using the table abbreviations, write the constraints using the following format:   
      Table1.ID1, Table1.ID2 References Table2.ID1, Table2.ID2

**Professor Wong’s Comment Mentions to create every foreign key with the exception of ISBN numbers. The below are the foreign keys that I think would be useful.**

~~SF.ISBN references NF.ISBN~~

SF.publisherName references P.pName //publisher name for book needs to know which publisher

NF.publisherName references P.pName //same goes for non-fiction books

WB.authorName references A.authorName //WB needs to know information about the author

P.URL references A.URL //publisher needs to know the URL of the author

S.WH\_code references W.code //stocks needs to know information about warehouse

* 1. Create new named SQL constraints for the foreign keys using the ALTER TABLE command and the full table names. Note that if a publisher goes out of business, all of the books published by that publisher should automatically be deleted. Otherwise, tuples in referring tables are not deleted. Do not create the tables, just the constraints.

~~alter Table SFBook ADD CONSTRAINT SFBook\_ISBN\_FK foreign key (ISBN) references NFBook (ISBN)~~

alter Table SFBook ADD CONSTRAINT SFBook\_publisher\_FK foreign key (publisherName) references Publisher(pName) on delete set null

alter Table NFBook ADD CONSTRAINT NFBook\_publisher\_FK foreign key (publisherName) references Publisher (pName) on delete set null

alter Table WrittenBy ADD CONSTRAINT WrittenBy\_author\_FK foreign key (authorName) references Author (authorName) on delete set null

alter Table Publisher ADD CONSTRAINT Publisher\_URL\_FK foreign key (URL) references Author (URL)

alter Table Stocks ADD CONSTRAINT Stocks\_code\_FK foreign key (WH\_code) references Warehouse(code) on delete set null

1. Report the author name and address, and how many ~~unique~~ science fiction books written by the author (ISBN) in 1990 and afterwards. Just for this problem, you must write **efficient** relational algebra and SQL code by projecting only those fields that are needed and applying selection conditions as early as possible (often results in subqueries).
   1. Write relational algebra

σ year > 1990 (π authorName, address, γ(E.ISBN,authorName,address) count(\*)((SF)⋈SF.ISBN = E.ISBN( π ISBN,A.address, A.authorName ((WB) ⋈WB.authorName = A.authorName(A) as E)))))

* 1. Based on your efficient answer in part a, use a nested query to write SQL code for the above, but also sorted by author names

select authorName, address, count(\*)

from SFBook join (

select ISBN, Author.address,Author.authorName

from WrittenBy join Author

on WrittenBy.authorName = Author.authorName) S

on SFBook.ISBN = S.ISBN

where year>1990

group by S.ISBN, authorName,address;

1. For authors who published science fiction but not non-fiction (MINUS), list how many books each author published with each publishing company. (author union publisher on URL), then by pName
   1. Write the relational algebra

π publisherName, authorName, γ(publishername,authorName) count(publisherName)((WB) ⋈ WB.ISBN = S.ISBN (π \* (SF – NF) as S))

* 1. Write the SQL code for the above, but sorted by publisher and then by author names

select publisherName, authorName, count (publisherName)

from WrittenBy join (

select \* from SFBook

minus

select \* from NFBook) S

on WrittenBy.ISBN = S.ISBN

group by publisherName, authorName;

1. Report the warehouse code and phone number for warehouses that stock more than 500 copies of any book by the author ‘Robert Silverberg’.
   1. Write the relational algebra

σ code in(π code, phone (W)) (σ S.numberOfBooks > 400 and WB.authorName = ‘Robert Silverberg’(π WH\_Code(WB) ⋈WB.ISBN =S.ISBN(S)))

* 1. Write the SQL code

select code, phone

from Warehouse

where code IN (

select WH\_Code

from WrittenBy join Stocks

on WrittenBy.ISBN = Stocks.ISBN

where (Stocks.numberOfBooks > 400 and WrittenBy.authorName = 'Robert Silverberg'));

**Part 2: Relational Algebra) [25 Points (5 Points each)]**

Calculate the following output tables and be careful in labeling the attributes.

1. N ⋈A=T ( π A as T (M) - πB as T (N))

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **M** | | | |  | **N** | | |
| **A** | **B** | **Y** | **Z** |  | **A** | **B** | **Q** |
| 3 | 4 | Tom | Jane |  | 1 | 8 | David |
| 6 | 2 | Mary | Susan |  | 7 | 10 | Jane |
| 10 | 8 | David | Paul |  | 4 | 7 | Paul |
| 4 | 3 | Mark | Helen |  | 4 | 10 | Tom |
| 1 | 1 | Lisa | Brian |  | 2 | 3 | Susan |

|  |  |  |  |
| --- | --- | --- | --- |
| **A** | **T** | **Q** | **T** |
| 1 | 8 | David | 1 |
| 4 | 7 | Paul | 4 |
| 4 | 10 | Tom | 4 |

|  |  |  |  |
| --- | --- | --- | --- |
| **B** | **Z** | **Y** | **Q** |
| 2 | 9 | Mary | Jane |
| 3 | 5 | Mark | Susan |

1. πB,Y,Z(M) ⋈ πB,Q, A+B as Z (N)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **M** | | | |  | **N** | | |
| **A** | **B** | **Y** | **Z** |  | **A** | **B** | **Q** |
| 3 | 4 | Tom | 2 |  | 1 | 1 | David |
| 6 | 2 | Mary | 9 |  | 7 | 2 | Jane |
| 4 | 3 | Mark | 5 |  | 4 | 7 | Paul |
| 1 | 1 | Lisa | 4 |  | 4 | 10 | Tom |
|  |  |  |  |  | 2 | 3 | Susan |

1. σA=3 or B=8 (πA,B,Y (M) **∪** N)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **M** | | | |  | **N** | | |
| **A** | **B** | **Y** | **Z** |  | **A** | **B** | **Q** |
| 3 | 4 | Tom | Jane |  | 1 | 8 | David |
| 6 | 2 | Mary | Susan |  | 7 | 10 | Jane |
| 10 | 8 | David | Paul |  | 4 | 7 | Paul |
| 4 | 3 | Mark | Helen |  | 4 | 10 | Tom |
| 1 | 1 | Lisa | Brian |  | 2 | 3 | Susan |

|  |  |  |
| --- | --- | --- |
| **A** | **B** | **Y** |
| 1 | 8 | - |
| 3 | 4 | Tom |
| 10 | 8 | David |

1. σB<5(M) ⋈M.B=N.B and M.Z=N.Z (πB,Q,A+B as Z (N))

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **M** | | |  | **N** | | |
| **B** | **Y** | **Z** |  | **A** | **B** | **Q** |
| 2 | Mark | 3 |  | 3 | 1 | Tom |
| 3 | Lisa | 12 |  | 9 | 3 | Susan |
| 6 | Mary | 5 |  | 1 | 2 | Paul |
|  |  |  |  | 3 | 1 | Jane |
|  |  |  |  | 2 | 3 | David |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **B** | **Y** | **Z** | **B** | **Q** | **Z** |
| 3 | Lisa | 12 | 3 | Susan | 12 |
| 2 | Mark | 3 | 2 | Paul | 3 |

1. γZ, count(B) As G , min(A) As H (M) ⋈H=B or H=Q N

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **M** | | | |  | **N** | | |
| **A** | **B** | **Y** | **Z** |  | **A** | **B** | **Q** |
| 1 | 4 | α | α |  | 2 | 3 | 4 |
| 3 | 5 | β | β |  | 8 | 2 | 13 |
| 7 | 6 | α | β |  | 2 | 5 | 10 |
| 5 | 8 | β | α |  |  |  |  |
| 13 | 10 | β | β |  |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **G** | **H** | **A** | **B** | **Q** |
| 3 | 3 | 2 | 3 | 4 |