CS 348 - Homework 2

Relational Algebra
(160 Points)

Fall 2020

Due on: 10/02/2020

This assignment is to be completed by individuals. You should only talk to the instructor, and the TA about this assignment. You may also post questions (and not answers) to Campuswire.

There will be a 10% penalty if the homework is submitted 24 hours after the due date, a 15% penalty if the homework is submitted 48 hours after the due date, or a 20% penalty if the homework is submitted 72 hours after the due date. The homework will not be accepted after 72 hours, as a solution will be posted by then.

For questions 1-3, write your answers on the hw2.tex template file (provided with this homework document) and generate a pdf file. Upload the pdf file to **Gradescope**. For questions 4-5, create a sql file named **q45.sql** and write the trigger and procedure there. Upload your **q45.sql** file to **Brightspace**.

1. (70 points) Given below is a relational schema about libraries. Write relational algebra queries for the following questions.

   Book (**BookId**, *Title*, *PublId*)
   Author (**AuthId**, *AuthName*)
   AuthorBook (**AuthId**, **BookId**)
   Publisher (**PublId**, *PublName*, *Address*, *Phone*)
   BookCopies (**BookId, BranId**, *Copies*)
   BookLoans (**BookId, BranId, MembId**, *IssueDate*, *DueDate*)
   Member (**MembId**, *MembName*, *Address*, *Phone*)
   LibraryBranch (**BranId**, *BranName*, *State*)

   A. (5 points) List the names of all branches in Indiana.
      Answer:
      $\pi_{BranName}(\sigma_{State='Indiana'}(LibraryBranch))$

B. (10 points) List book titles for all the books in Indiana branches. Use **theta join** to write this query.

Answer:

$LibrBran \leftarrow \sigma_{State='Indiana'}(LibraryBranch)$ $LibrBookCopi \leftarrow LibrBran \bowtie_{LibrBran.BranId=BookCopie}$ $BookCopies$ $LibrBook \leftarrow LibrBookCopi \bowtie_{LibrBookCopi.BookId=Book.BookId} Book$ $Result \leftarrow \pi_{Title}(LibrBook)$

C. (10 points) List the names of members who **have not** checked out any books.

Answer:

$WithLoans \leftarrow \pi_{MembId}(BookLoans)$ $AllMemb \leftarrow \pi_{MembId}(Member)$ $NoLoans \leftarrow AllMemb - WithLoans$ $Result \leftarrow \pi_{MembName}(NoLoans \bowtie Member)$

D. (15 points) For each author, list their name along with the book title, branch id and number of copies for all of their book copies. Include authors who do not have books.

Answer:

$BAB \leftarrow Book \bowtie_{Book.BookId=AuthorBook.BookId} AuthorBook$ $BookCop \leftarrow BAB \bowtie_{BAB.BookId=BookCopies.B}$ $BookCopies$ $ABC \leftarrow Author \bowtie_{Author.AuthId=BookCop.AuthId} BookCop$ $Result \leftarrow \pi_{AuthName,Title,BranId,C}$

E. (10 points) Retrieve the *bookid* of books that are borrowed at every branch.

Answer:

$EveryBookWithBranch \leftarrow \pi_{BookId}(BookLoans) \times \pi_{BranId}(LibraryBranch)$ $BookNotEveryBranch$ $\pi_{BookId}(EveryBookWithBranch - \pi_{BookId,BranId}(BookLoans))$ $Result \leftarrow \pi_{BookId}(BookLoans) - BookNotEveryBranch$

F. (10 points) List the *bookid* of each book that has not been borrowed even though the book has at least one copy.

Answer:

$NoCopies \leftarrow \sigma_{Copies=0}(BookCopies)$ $Result \leftarrow \pi_{BookId}(Book) - \pi_{BookId}(BookLoans) - \pi_{BookId}(NoCopies)$

G. (10 points) List the *title* of books not written by Bob and borrowed in two branches with one of them being in Illinois and the other in Indiana.

Answer:

$NotBobBooksLoaned \leftarrow \sigma_{AuthName\neq'Bob'}(Author) \bowtie AuthorBook \bowtie Book \bowtie BookLoans$ $IllinoisLoaned \leftarrow \sigma_{State='Illinois'}(LibraryBranch) \bowtie NotBobBooksLoaned$ $IndianaLoaned \leftarrow \sigma_{State='Indiana'}(LibraryBranch) \bowtie NotBobBooksLoaned$ $BothLoaned \leftarrow IllinoisLoaned \cap IndianaLoaned$ $Result \leftarrow \pi_{Title}(BothLoaned)$