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Homework 1

1. Define instances of all relations that might be found as part of the Library Management System (LMS), and indicate the following (remember to use proper formatting with no exceptions): 1.1. The attributes of each relation. 1.2. The relation schema for each relation. 1.3. A suitable domain for each attribute.

After contemplating what needs an LMS might have, I decided to specify 5 different tables which I felt were enough for the task at hand, without making it complicated. It's easy to add more sources such as Videos and CDs since I have the table Media, which will hold all different kinds of media.

I decided to group all users into one table, instead of one for students and one for admins, and use accessLevel as an attribute as a way of knowing which ones are admins. The user's access is set with an integer value, where 1 indicates that a user is an admin, and 0 for a student.

LMS (See attached pdf for easier understanding).

Media(mediaID:integer, title:string)

Books(mediaID:integer, ISBN:string, title:string, authorName:string, edition:integer, language:string, publisher:string, dateOfPublication:string, prequels:string)

Users(userID:integer, fullName:string, emailAccount:string, address:string, phoneNum:string, program:string, department:string, accessLevel:integer, borrowedItemsNum:integer)

Fines(fineID:integer, borrowingID:integer, amount:integer, paid:integer, fineDate:date)

BorrowList(borrowID:integer, mediaID:integer, userID:integer, borrowDate:Date, expireDate:date, returnDate:date)

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2. For two main relations, you have defined in question 1: 2.1. Identify and describe at least two realistic referential integrity constraints for each relation selected such as primary keys, foreign keys, etc... For the tables and attributes, etc... 2.2. Express your keys in relational algebra (where they are called referential integrity constraints).

2.1:

I chose to explain the tables Fines and BorrowList. Each fine has borrowingID as a foreign key since it is the primary key of borrowList. The primary key in fines is fineID.

Fines:
Primary Key: fineID
Foreign Key: borrowingID

Borrowlist has two foreign keys, mediaID, which is the primary key of the Media relation, and userID which is found in the Users relation, where they are primary keys. borrowingID is the primary key of BorrowList.

Borrowlist
Primary key: borrowingID
Foreign keys: mediaID, userID.

2.2:

$Fines[borrowID_1,...borrowID_n] \subseteq BorrowList[borrowID_1,...borrowID_n]$

3. Write a relational algebra expression representing the following:

***3.1. List the titles of all the books that are currently checked out*:**

$\pi_{title} (\sigma_{returnDate = '0'} (BorrowList \bowtie Books))$

3.2. Retrieve a list of all borrower id's and the book id's they checked out

$\pi_{userID} (BorrowList)) (\pi_{title} (\sigma_{returnDate <> 0} (BorrowList \bowtie Books)))$

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3.3. Retrieve a list of the phone numbers of all overdue book owners, together with the number of days they are overdue.

$$\pi_{\text{phoneNum, daysPassed}} (\sigma_{\text{returnDate = '0'} \ \wedge \ \text{fines.borrowingID = fines.borrowingID}} (\text{BorrowList} \bowtie \text{Users}))$$