NYU Tandon School of Engineering **March 26, 2018**
Computer Science and Engineering
CS6083, Spring 2018

Problem Set #3 (due 4/9)

Problem 1:

Consider a database modeling a library checkout system, where a member can search available copies of books and reserve them for pickup. It is given by the following highly simplified database schema:

Member(mid, mname, phone, address)
Book(bookid, booktitle, category, author, publishdate)
BookCopy(copyid, bookid)
CheckedOut(copyid, mid, checkoutDate, dueDate, status)

Each member of the library has a unique cid, along with a name, a phone number and an address. Each book has a unique bookid (say, the ISBN number), along with a book title, category, author, and publication date. For each book, the libraries can hold several copies that can be checked out (i.e., reserved and then picked up) by members. When members check out books from the library, the checkout date will be recorded. There is also a due date when the book needs to be returned. Each checkout also has a status, which can be "Holding", "Returned", or "Overdue".

In this problem, you have to design a simple web frontend with PHP, which allows people to access some of the information by using a web browser. Your web application should support the following:

(i) On a start page, there are boxes where users can type their member id (a simplified signin) and a keyword, and a search button. The keyword can be part of a book title or category.

(ii) After the button is pressed, your PHP code should provide a list of all **available** books which have the keyword in their title or category, along with detailed information about each book. If no keyword is entered, all available books (and their information) should be displayed.

(iii) On this page, the user should be able to click a button to check out a book. After that, your code should add a record into the checkout table and turn to another page that shows all books currently checked out by this member.

Test your application using data provided on the course page to populate your database. You will have to meet with a grader to give a quick demo. (Details on scheduling demos will be announced later, and demos will be a few days after the deadline for the other problems.)

Problem 2:

Consider a relational schema R = (A, B, C, D, E, F, G) satisfying the functional dependencies F = {E -> BG, A -> BC, AC -> F, C->DB, CD -> F, CF -> G}.

a) Derive all candidate keys for this schema.
b) Derive a canonical cover of the functional dependencies in F
c) Is the above schema in BCNF? Prove or disprove. If it is not in BCNF, convert it into BCNF.
d) Is the BCNF schema from c) dependency-preserving? Prove or disprove. If not, convert it into 3NF.

Problem 3:

Consider the following single-table database schema modeling ticketing in a chain of movie theaters:

TicketInformation(cid, cname, email, phone, tid, tname, taddress, mid, mname, mtype, mgenre, mtime, screennum, capacity, ticketnum, price, discount)

This table has information about customers who purchased a ticket. A customer has an id, name, email, and phone. Also, a theater has an id, name, and address. A theater can have several screens where movies are shown, with each screen having a number and a capacity (number of seats). Each showing of a movie on a particular screen in a theater has an id, type, genre, and scheduled time. The type can be Imax, 2D, 3D and so on. For example, the customer can buy a ticket for a 3D showing of the movie “Peter Rabbit” at 11:30 am, March 25, 2018, which is a comedy. For each ticket, there is a ticket number that is unique for this showing (this could be 1 to c where c is the capacity of the screen). For each ticket, there is an official price, and maybe a percentage discount that was received (say, 10% or 20% off the official price).

a) Explain why the above is not a good relational design. Name several reasons.
b) Identify the set F of non-trivial functional dependencies for this schema. (It is enough to identify a subset E such that the closures of E and F are the same.)
c) Derive all candidate keys for this table.
d) Derive a canonical cover of the functional dependencies in F.
e) Is the above schema in BCNF? Prove or disprove. If it is not in BCNF, convert it into BCNF.
f) Is the BCNF schema from e) dependency-preserving? Prove or disprove. If not, convert it into 3NF.
g) Suppose we add an additional constraint that the cost must be the same for all tickets for the same showing. Or assume that the discount must be the same for all tickets for movies in the same genre that are on the same day – e,g,, all showings for science fiction movies on October 29, 2017 must have the same discount. For each of these two cases, how would this change your answers for parts b) through f)?

Problem 4:

In this problem, you are asked to explore the metadata querying facilities in your database system. Thus, the answers may depend on which system you have installed. So remember to state which system you are using! Try to write the following queries using the book checkout database supplied as part of Problem 1. Please submit screenshots of the result.

a) List all tables in the schema, and for each table its number of attributes.
b) List all tables with more than one attribute of type datetime.
c) List the table that has the largest number of attributes of type varchar.
d) List all pairs of tables that have at least two attributes with the same data type.
e) List all pairs of tables that have a foreign-key relationship.