

# ASSIGNMENT 1 - 600.315/415 - Database Systems

**Due date:** Thursday, September 29, 2011 in class

## Part 1: Database Schema Design

Your task is to design a database to support the needs of *SoSueMe Car Insurance Company*, including information about drivers, their tickets and accidents, their cars and available options on their cars, their policies and agents, and other information that could support the determination of car insurance rates.

Please design a database using the E-R and relational table representations that is capable of providing answers to the following questions. You *should* include other attributes and relationships that are not explicitly required by the questions below if you think that they are appropriate for a good and complete database design. Completeness and good design principles will be rewarded.

Although not all of the queries below would be asked by (ethical) insurance agents, almost all of this information *is* available on-line to large insurance companies for real-time policy rate determination.

- (a) List the date, location and cause of all accidents that Paris Hilton was responsible for, including the:
  1. make and model of the car she was driving,
  2. the percentage responsibility that Paris Hilton had for the accident
  3. the cost of the physical damage that Paris Hilton's car received in the accident
- (b) List the name, birthdate and state of residence of all drivers who have been victims in an accident in which Paris Hilton was the responsible driver. In the same result table, list the make and models of the cars that the victims were driving, the percentage responsibility each victim had for the accident, and the cost of bodily injury to the victims of the accident.
- (c) List the VIN number of all white Fiat Uno's manufactured before 2011 owned by a driver licensed in the state of Texas.
- (d) List the names and ages of all female drivers who hold insurance policies sold by agent James Carey of the Rockville, MD office.
- (e) For all drivers who hold an insurance policy sold by agent James Carey of the Rockville, MD office, list the date and location of all accidents they were responsible for, including the make, model and year of the car they were driving.
- (f) List all of the options that have been installed on VIN number 1KAL989BC319216DA7, including the name of the option, its base cost, its insurance discount rate, and whether the option is factory-installed or dealer-installed on this car.
- # (g) List the name and option-ID-number of all options that are available for the make, model and year of car 1KAL989BC319216DA7, but have not been installed on this car.

- (h) List the VIN numbers of all cars sold by Apple Ford of Columbia with dealer-installed anti-lock brakes that have been involved with an accident with the cause of “brake failure”.
- (i) List the names of all drivers who own a Volkswagen Beetle manufactured before 1982 *and* a Volkswagen Beetle manufactured after 2011.
- #\* (j) List the names of all drivers who own *both* a Ferrari and Lamberghini and do not live in Los Angeles or Dallas.
- (k) List the names of all drivers who own both a Ferrari (any model) and Ford Pinto and have received a ticket in the Pinto but not in the Ferrari.
- (l) List all tickets that Martin O’Malley received in Maryland between 12-28-2005 and 09-08-2011, including the color, make and model of the car she was driving, the date of the ticket and the type of violation she was cited for.
- (m) List the names and SSN of all insurance agents who have sold an insurance policy to themselves (state any assumptions that you need to make here).
- \* (n) List the names and ages of all drivers who own a car that is the same make, model and color of a car that Bill Gates owns.
- (o) List the date, location, time, cause and the name of the responsible driver of all accidents that VIN number 1KAL989BC319216DA7 has been involved in (either as the responsible party’s vehicle or a victim’s vehicle).
- #\* (p) List the name of all drivers who have received a ticket in a car they do not own.
- # (q) List the name of all drivers who have received a ticket in every car that they own.
- (r) List the name of all drivers who have received a ticket in every car that they own and have been responsible for an accident in every car that they own.
- (s) List the VIN numbers of all cars that do not have anti-lock brakes installed, but are of a make, model and year of a car where anti-lock brakes are an available option.
- (t) List the names and ages of owners of red sportscars with sunroofs who who have never had a ticket in their red sportscar with a sunroof.

*Assumptions:*

You should assume that drivers can own more than one car and that cars can have more than one owner. You should also assume that all car insurance policies have exactly one vehicle and one primary driver, and that being the primary driver on a vehicle is not necessarily correlated with owning the vehicle.

For all accidents, you should assume that there is exactly one driver that is “responsible for” the accident (with some percentage of liability) and other driver(s) who are “victims” of the accident (but may also have some percentage liability). Responsible drivers and victims in an accident do not always own (or are insured for) the cars they are driving in

the accident. Also, tickets can be given to drivers that do not own (or have insurance for) the cars they are driving at the time.

You may simplify the model by assuming that a driver's address, state of residence and driver's license number does not change with time (i.e. there is exactly one driver's license number per driver). You may also assume that the owner(s) of a car do not change with time. A given generic *make* and *model* of car has a variety of safety options such as anti-lock breaks available, but these do not have to be installed on all physical cars. The available safety options may be required or optional, factory installed or dealer installed.

### To Do:

- 1.1 (*21 points*) Design the database using the entity-relationship database model and draw it. Your design should minimize repetitions of information. Be sure to mark the mapping constraints ( $\leftrightarrow$ ,  $\rightarrow$ ,  $\leftarrow$ ), participation constraints ( $\rightarrow$  or  $\Rightarrow$ ) and underline primary keys.

You should *very* briefly justify any unusual or potentially controversial design decisions you make. Do *not* spend much time on such notes.

This section will be graded on aesthetics and completeness as well as correctness.

- 1.2 (*10 points*) Represent this database design using the relational model. You should use a tabular notation and include at least one row of sample values for each relation.

You should *very* briefly justify any unusual or potentially controversial decisions you make in the conversion process. Do *not* spend much time on such notes.

- 1.3 (*9 points*) Write relational algebra expressions to answer some of the English queries (a) through (t) given on page 1-2 of this assignment.

- Students in 600.315 must answer **all** of the queries marked with a  $\star$ .
- Students in 600.415 must answer **all** of the queries marked with a  $\#$ .

You may use assignment to intermediate relations to make your expressions clearer and simpler.

## Part 2: Relational Algebra and Relational Calculus (60 points)

Consider the following relational database schema (with sample instantiations):

**BOOK:**

<u>BookID</u>	<u>Title</u>	<u>PublisherName</u>
B315514	How to Avoid Publicity	Oxford University Press
B229961	My Foreign Policy Experience	Vanitas Press
B119986	Ethics in Federal and State Government	Baghdad University Press
B462341	The Audacity of Hope	Random House

**PUBLISHER:**

<u>Name</u>	<u>City</u>	<u>Country</u>
Oxford University Press	Oxford	UK
Vanitas Press	Beverley Hills	USA

**BOOK\_AUTHORS:**

<u>BookID</u>	<u>AuthorName</u>
B315514	Paris Hilton
B229961	Sarah Palin
B119986	Ted Stevens
B462341	Barak Obama

**BOOK\_COPIES:**

<u>BookID</u>	<u>BranchID</u>	<u>NumCopies</u>
B315514	1029	2
B315514	1030	1
B315514	1031	4
B119986	1031	37
B229961	1031	6

**BOOK\_LOANS:**

<u>BookID</u>	<u>BranchID</u>	<u>CardNo</u>	<u>DateOut</u>	<u>DateDue</u>
B315514	1029	44112	08-04-2011	08-04-2011
B315514	1031	65771	08-06-2011	08-12-2011
B315514	1030	65771	08-05-2011	08-11-2011
B119986	1031	65771	09-16-2011	10-16-2011
B119986	1031	65771	09-17-2011	10-17-2011
B119986	1031	65771	09-18-2011	10-18-2011
B119986	1031	65771	09-19-2011	10-19-2011
B119986	1031	65771	09-20-2011	10-20-2011

**BORROWER:**

<u>CardNo</u>	<u>Name</u>	<u>Address</u>	<u>City</u>
44112	Martin O'Malley	3901 N. Charles St.	Baltimore
44219	Ben Bernanke	8818 Avenida de Podre	Silver Spring
43769	Henry Paulson	6451 Wisconsin Ave	Bethesda
65771	Linda Tripp	4112 Cricket Pass	Columbia

**LIBRARY\_BRANCH:**

<u>BranchID</u>	<u>BranchName</u>	<u>Address</u>	<u>City</u>	<u>Phone</u>
1029	Charles Village	3301 N. St. Paul St.	Baltimore	410-366-2211
1030	Towson South	11199 York Rd.	Towson	410-317-1166
1031	Columbia	3299 Symphony Woods	Columbia	410-964-8116

- **NOTE:** Students can assume that *every* book/branch pair *is* listed in the BOOK\_COPIES relation. If the branch does not have a copy of a book, then the value of BOOK\_COPIES is 0.

## QUESTIONS:

600.315 students should give expressions in the *relational algebra* for **all** of the queries between (and including) 2.1 and 2.20, and also 2.27.

600.315 students should give expressions in the *tuple relational calculus* for any 7 of the queries between (and including) 2.1 and 2.20.

600.415 students should give expressions in the *relational algebra* for **all** of the queries between (and including) 2.7 and 2.27.

600.415 students should give expressions in the *tuple relational calculus* for any 10 of the queries between (and including) 2.7 and 2.27.

- 2.1 Retrieve the names of all borrowers who do not have any books checked out.
- 2.2 How many copies of the book titled *How to Avoid Publicity* are owned by the library branch whose name is 'Charles Village'?
- 2.3 List the card numbers and names of all borrowers who have checked out every book in the Charles Village branch at least once.
- 2.4 List the title and publisher of every book that has never been borrowed by someone living in Towson
- 2.5 List the card numbers and names of all borrowers who have checked out the same book more than once.
- 2.6 List all branches that do not have any copies of 'How to Avoid Publicity'.
- 2.7 For each book authored (or coauthored) by 'Paris Hilton', retrieve the title and the number of copies owned by the library branch whose name is 'Towson South'.
- 2.8 List the name of every book that Ben Bernanke has borrowed more than once.
- 2.9 List the name of every book that Ben Bernanke has borrowed exactly once.
- 2.10 For each book that is loaned out from the 'Charles Village' branch and whose Due-Date is today, retrieve the book title, the book author, the publisher's address, the borrower's name, and the borrower's address.
- 2.11 List the names and addresses of branches who have more copies of the book 'Dishwashing for Dummies' than copies of 'Brave New World'. (You can assume only one publisher/author/BID for both of these books).
- 2.12 Print the name of the branch in the database with the most copies of the book "How to Avoid Publicity" (relative to other branches in the database). *If there is a tie, list all branches in the tie. You should **not** use aggregate operators such as Max or Sum.*
- 2.13 List the title and publisher of all books in the database with more than one author.
- 2.14 List the addresses and cities of all libraries that carry books from 'Bob Jones University Press'

- 2.15 List the addresses and cities of all libraries that do not have any books from 'Bob Jones University Press'
- 2.16 List the titles and publishers of every book available in the Charles Village branch but not in the Towson South branch.
- 2.17 List the names, addresses and card numbers of the borrowers who have not yet borrowed any book.
- 2.18 List the name, address and card number of the borrowers who have not yet borrowed a book from a library branch in the same city where they live.
- 2.19 List the name, address and card number of the borrowers who have borrowed at least one book from every branch in the library system.
- 2.20 How many copies of the book titled *My Judicial Experience* are owned by each library branch (give branch name and total copies)?
- 2.21 List the title and publisher of all books in the database with more than two authors.
- 2.22 Restricted to the authors and borrowers included in the database, list the names of authors who have *not* borrowed a book written by someone with the same name as themselves.
- 2.23 - List the card numbers and names of all borrowers who have checked out every book in some branch at least once.
- 2.24 List the title and publisher of every book that has never been borrowed by someone living in Towson but has been borrowed by someone living in Baltimore.
- 2.25 Retrieve the names of all books that have 1 or more more copies in *every* library branch in the database.
- 2.26 Restricted to the authors and borrowers included in the database, list the names of authors have not borrowed a book written by someone with the same name as themselves.
- 2.27 Write an English query of your choice and solve it in the relational algebra. Half of the points will be based on the creativity and complexity of the query.