

# ASSIGNMENT 1 - 600.315/415 - Database Systems

**Due date:** Tuesday, October 6, 2009 in class

## Part 1: Database Schema Design (55 points)

Your task is to design a database for an airline dispatch office that keeps records on the flights, crews, airports and airplane operations but not on passenger reservations. To save costs, all the information of several cooperating airlines is in the system.

From the database, it should be possible to answer the following questions:

- (a) List the city, airport-code and miles-from-the-city of all airports in Iowa.
- (b) For each AirTran airline flight that is scheduled to depart BWI weekdays before 0900 hours, list the scheduled arrival time and arrival city code.
- (c) List the actual arrival time, arrival city code, and airplane ID number (unique one for every physical plane) of all flights on 17-JUL-09.
- (d) List the airport code, city and state of the destinations of all flights that are scheduled to depart BWI on weekends.
- (e) List the name, SSN, birthdate and position working (e.g. captain, first-officer, flight attendant) of all flights on 14-AUG-09 that actually arrived in BWI before 2200 hours.
- (f) List all flight crew members that are certified to fly Boeing 747's that actually flew Boeing 737's yesterday (29-SEP-09).
- (g) List the types of aircraft (manufacturer, model, weight and seating capacity) that are small enough to land in some airport in Delaware.
- (h) List the airlines that have nonstop flights from some city in Maryland to some city in California.

### *Simplifying assumptions:*

The database only contains domestic flights. All flights only have one leg (no stops or connections). No plane is in the air at midnight. Flights either fly *daily*, *weekdays*, or *weekends*. The basic information about a flight (city codes served, scheduled arrival and departure times, etc.) does not change from day to day, but information such as actual arrival time does change. Flight crew members can potentially work in different roles (captain, 1st officer, flight attendant) on different flights - the flight attendants are striking and need other employees to fill in for them. Flight crew certifications of ability to work on a given aircraft type do not change over time. In the information about a flight, you may only store airport codes (e.g. BWI, JFK, LAX), not cities or states.

- 1.1 (*20 points*) Design the database using the entity-relationship database model and draw it. Your design should minimize repetitions of information. and should compartmentalize the permanent attributes of a flight/thing and the attributes that change on different dates, etc. Be sure to mark the primary keys, as well as mapping constraints

( $\leftrightarrow$ ,  $\rightarrow$ ,  $\leftarrow$ ) and participation constraints ( $\rightarrow$  or  $\Rightarrow$ ). Mapping constraints and participation constraints may also be expressed in the alternative notation using  $(0,1)$  or  $(1,N)$ , for example.

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 (25 points) Write relational algebra expressions to answer all of the queries above. You may use assignment to intermediate relations to make your expressions clearer. *Students in 600.315 only need to do 6 of these queries.*

## Part 2: Relational Algebra and Relational Calculus (45 pts.)

Consider the following hypothetical database schema. Suppose all bars in the US have a unique bar license number (BNO) and each drinker is identified by a unique drivers' license number (DLicNo). Every time a drinker represented by DLicNo goes to a bar represented by BNO, the information is recorded in the database. The number of times a drinker visits a particular bar can be obtained by examining the VISIT relation. The VISIT relation has the DLicNo and the BNO pair only if the drinker represented by DLicNo has visited the bar represented by BNO at least once, i.e. *the attribute NumberOfTimes in VISIT is never zero*. The relation LIKES represents all the beers that a particular drinker likes and the relation SERVES represents all the beers a particular bar serves.

| BAR | <u>BNO</u> | BarName  | BCity       | BState |
|-----|------------|----------|-------------|--------|
|     | L22174     | Murphy's | Towson      | MD     |
|     | L31927     | Joe's    | Lutherville | MD     |
|     | L59871     | BatBar   | Georgetown  | DC     |

| DRINKER | <u>DLicNo</u> | DName             | DCity      | Age |
|---------|---------------|-------------------|------------|-----|
|         | AK117229      | Barak Obama       | Honolulu   | 48  |
|         | UU761326      | Michelle Obama    | Chicago    | 45  |
|         | ZM193312      | Joe Biden         | Wilmington | 63  |
|         | MD891129      | Henry Louis Gates | Cambridge  | 59  |
|         | YU134618      | James Crowley     | Cambridge  | 41  |

| VISIT | <u>DLicNo</u>   | <u>BNO</u>    | NumberOfTimes |
|-------|-----------------|---------------|---------------|
|       | <i>AK117229</i> | <i>L22174</i> | <i>7</i>      |
|       | <i>MD891129</i> | <i>L59871</i> | <i>1</i>      |
|       | <i>AK117229</i> | <i>L59871</i> | <i>2</i>      |

| LIKES | <u>DLicNo</u>   | <u>BeerName</u>     |
|-------|-----------------|---------------------|
|       | <i>AK117229</i> | <i>Bud Lite</i>     |
|       | <i>AK117229</i> | <i>Rolling Rock</i> |
|       | <i>MD891129</i> | <i>Sam Adams</i>    |

| SERVES | <u>BNO</u>    | <u>BeerName</u>     |
|--------|---------------|---------------------|
|        | <i>L22174</i> | <i>Bud Lite</i>     |
|        | <i>L59871</i> | <i>Bud Lite</i>     |
|        | <i>L59871</i> | <i>Rolling Rock</i> |

For queries 2.1, 2.2, 2.3, 2.4 and 2.9 *all* students should give equivalent expressions in **both** the relational algebra and the relational calculus.

For queries 2.5, 2.6 and 2.7 *all* students should give equivalent expressions in **only** the relational algebra.

For query 2.8 students in 600.415 *only* should give equivalent expressions *only* in the relational algebra.

For queries 2.10 students in 600.415 *only* should give equivalent expressions in *both* the relational algebra and relational calculus.

For query 2.11 students in 600.315 should give the expressions *only* in the relational algebra.

For query 2.11 students in 600.415 should give the expressions in the relational algebra and relational calculus.

- 2.1 List the name of every bar that Joe Biden has visited more than once.
- 2.2 List the names of bars in Maryland that are *not* in Baltimore **and** do not serve Bud Lite.
- 2.3 List the names of all people under 30 who have visited at least one bar in Georgetown and like Bud Lite *and* do not like Miller Lite.
- 2.4 List the name and age of everyone who has visited at least one bar that Joe Biden has visited.
- 2.5 List the names and ages of all people who have visited every bar in Towson.
- 2.6 List the names and ages of people who have visited at least every bar that Barak Obama has visited, and has visited all of these bars the identical number of times that Barak Obama has visited the bar.

- 2.7 List the names and ages of people who have visited every bar that Henry Louis Gates has visited and have never visited a bar that James Crowley has visited.
- 2.8 List the names of people who have never drunk a beer named for them (e.g. “Sam Adams” drinking a beer called “Sam Adams”), but have visited at least 1 bar named for them.
- 2.9 List the name of every bar that serves a beer that Joe Biden doesn’t like.
- 2.10 List the name of every bar in Toswon that serves no beer that is served in a Bar in Timonium.
- 2.11 List the name of all beers that both James Crowley and Henry Louis Gates like and are served at the same bar in the database (i.e. a bar where both people could order a beer that they like).