CS348: Introduction to Database Systems

(Fall 2013)

Assignment 3 (due on Tuesday, November 26th)

Overview: This assignment consists of six questions. As an aid to scheduling your work on this assignment, you should plan on spending five to eight hours total on the questions.

Assignment submission: Either hand-written or printed copies of your answers must be submitted by 5pm on the assignment due date in the assignment boxes. The first page of your submission must include this cover page with your name and student number indicated in the space provided below.

Student name: _____

Student number: _____

Question 1.

Assume your company is developing a digital camera online purchasing system for sale to camera stores. An initial analysis phase of the project has resulted in the following description of relevant data for the system.

- A store will be selling a variety of digital cameras with a combination of the following features.

  1. The ability to replace lenses.
  2. Cameras with an electronic viewfinder.
  3. Cameras with an optical viewfinder.
  4. Cameras with a "through the lens" optical viewfinder.
  5. Cameras with an optical rangefinder.

  Note that no camera will have more than one feature from the following set: {3, 4, 5}.

- Properties of all cameras that are relevant include the manufacturer, model number, date of product release, sensor size, pixel number, retail price and the number currently in stock.

- Properties of cameras without an ability to replace lenses that are relevant include a focal length range and an aperture range.

- Cameras with an ability to replace lenses are related to at least two or more lenses.

- Properties of a lens that are relevant include the manufacturer, model number, date of product release, focal length range, aperture range, retail price and the number currently in stock.

- A prime lens is any lens with only one possible value for a focal length range.

- Online customers are either domestic customers or foreign customers.

- Properties of customers that are relevant include a unique customer number, a customer name, an email address and a shipping address.

- Each customer has any number of purchase orders (including possibly none at all). A subset of the purchase orders are in the process of being prepared for shipment and are therefore outstanding.
- Each purchase order is for either a camera or a lens, and will also have a selling price.
- Each camera or lens with have at least one customer evaluation.
- A customer evaluation is given by an individual customer and consists of a score between 1 and 5 (from bad to good) and a customer comment.

Specify a conceptual design with an ER diagram that is capable of storing this information.

Question 2.
Translate the ER diagram you produced for the previous question into a set of relational DDL commands (e.g., **create table**) that define a relational schema. The commands should include primary and foreign key constraints where appropriate. Include comments to (a) clarify any unusual translation decisions, and (b) indicate any parts of your ER specification that are not enforced by your relational schema.

Question 3.
Do Exercise 19.4 part 1 and 2 and Exercise 19.7 (leaving out the case of 2NF) on Pages 643 and 644 of the course textbook.

Question 4.
Determine whether or not each of the following four transaction execution histories is serializable. If a history is serializable, specify a serial order of transaction execution to which it is equivalent.

$H_1 = r_1[x]\ r_2[y]\ w_2[x]\ r_1[z]\ r_3[z]\ w_3[z]\ w_1[z]$
$H_2 = w_1[x]\ w_1[y]\ r_2[u]\ w_2[x]\ r_2[y]\ w_2[y]\ w_1[z]$
$H_3 = w_1[x]\ w_1[y]\ r_2[u]\ w_1[z]\ w_2[x]\ r_2[y]\ w_1[u]$
$H_4 = w_1[x]\ w_2[u]\ w_2[y]\ w_1[y]\ w_3[x]\ w_3[u]\ w_1[z]$

Question 5.

Consider the following sequence of requests. If the database system uses strict two-phase locking, will any of these requests cause a transaction to block? If so, indicate which will block. Will deadlock occur? Taking blocking into account, give an execution order which could result from these requests. Is your execution order serializable?

T_1: read x
T_2: read x
T_3: write x
T_2: read y
T_1: read y
T_1: read z
T_1: commit
T_4: write z
T_2: commit
T_5: write z
T_4: abort
T_3: commit
T_5: commit

Question 6.

Suppose that after a system failure, the transaction log looks as shown below (the log tail is at the bottom). A log entry (T_i,X,a,b) indicates that transaction T_i updated object X, changing its value from a to b.

Describe what the database system must do to recover from the system failure. Indicate which objects must be modified, and in what order those modifications occur. Indicate which transactions are committed and which are aborted after the failure recovery is complete.

(T_1,begin)
(T_1,X,0,10)
(T_2,begin)
(T_2,Y,10,20)
(T_3,begin)
(T_1,commit)
(T_3,X,10,400)
(T_4,begin)
(T_3,Z,0,100)
(T_5,begin)
(T_4,A,0,1)
(T_6,begin)
(T_4,abort)
(T_5,A,0,2)
(T_3,commit)
(T_6,X,400,0)
(T_5,commit)
(T_6,A,2,3)