

# CS 348: Assignment 4 (Spring 2024)

Assigned on July 2 and due by 5:00pm EDT on July 15

## Overview

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

## Assignment Submission

Assignment submission should be two files uploaded to Crowdmark. The file sizes and contents are as follows:

1. A two page PDF file containing your answer to the two parts of Question 1, each on a separate page. This file may be computer generated or a scan/photo of a handwritten solution, as long as it is legible.
2. A three page typed PDF file containing SQL source code containing your answer to Question 2.
3. A two page PDF file code containing your answer to the two parts of Question 3, each on a separate page.

## 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 informal description of relevant data for the system.

- A store will be selling a variety of digital cameras and lenses. The digital cameras can have a combination of the following features.
  1. An 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 any subset of the feature set  $\{1, 2, 3, 4, 5\}$  is a possible combination (including the empty set) with the constraint that the combination will not have more than one of the features 3, 4 or 5. For example, feature sets  $\{1, 4\}$ ,  $\{2, 3\}$  or  $\{1, 2, 5\}$  are possible while feature set  $\{1, 3, 5\}$  is not possible.

- 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, 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, i.e., will have the low end of the range equal to the high end of the 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 (but not both), and will also have a selling price.
- Each camera or lens will have at least one customer evaluation.
- A customer evaluation is given by an individual customer and consists of an integer score between 1 and 5 (from bad to good) and a customer comment.

Do each of the following two parts:

1. Specify a conceptual design with an ER diagram that is capable of storing such information that formalizes as much of the informal description as possible.
2. Clarify any parts of the above informal description that are not captured by your ER diagram.

### Question 2

Do each of the following two parts. **Note:** You are only required to compose commands in syntactically correct SQL DDL.

1. Translate your ER diagram into a logical design for a relational database schema consisting of `CREATE TABLE` commands. The commands should include primary and foreign key constraints where appropriate.
2. Compose integrity constraints as `CREATE ASSERTION` commands in SQL to capture any parts of your ER specification or the informal description above for which this is possible and that are not otherwise enforced by your `CREATE TABLE` commands.

### Question 3.

Each of the following two parts is a question about normal forms and their computation.

1. Exhibit a sequence of binary lossless join decompositions of relation schema  $R/(A, B, C, D, E)$  that obtains a decomposition for which each relation is in BCNF, assuming the FDs  $\{A \rightarrow BC, CD \rightarrow E, B \rightarrow D, E \rightarrow A\}$  hold on  $R$ . Argue that each relation in your decomposition is indeed in BCNF.
2. Exhibit a lossless join and dependency preserving decomposition of relation schema  $R/(A, B, C, D, E, F)$  by algorithm *Compute3NF*, assuming the FDs  $\{A \rightarrow BCD, BC \rightarrow DE, B \rightarrow D, D \rightarrow A\}$  hold on  $R$ .