Question 1 (10 points). Create an ER diagram to capture the following requirements. Note that the requirements are loosely based on the micromobility example from earlier in the semester. Your diagram must have cardinality constraints for each end of your relationship sets, and must include weak entity sets as appropriate, role names as appropriate, relationship attributes as appropriate, and identifying attributes for each entity set clearly marked.

- Vehicle Types are identified by a vehicle-type id. Each vehicle type has a form factor, a make, a model, a trim level, a maximum speed in mph, a maximum range on a full charge in miles, and a weight in pounds.

- Vehicles are identified by a vehicle code. Each vehicle has a circulation date (i.e., the date the company started allowing it to be rented), an initial cost (what the company paid for it), and whether it is was purchased new or used. Each vehicle has a vehicle type, and depending on the current stock levels, there can be many vehicles of a particular type in circulation. It is possible that there is a vehicle type without any corresponding vehicles in stock.

- The state of the vehicle (called the “Vehicle Status”) is tracked in real-time for each vehicle. The vehicle status includes its circulation status, reservation status, disabled status (e.g., due to damage), latitude, longitude, fuel percentage level, and range left in miles. Different status updates are generated at different times (where a vehicle’s status update can be identified by a date-time stamp). Each vehicle can have many different status updates, but any particular status update is for a specific vehicle. Is is possible for vehicles to have no status updates, e.g., when they are just obtained by the company but haven’t been made available for rental yet.

- Customers are identified by a customer id. The company tracks customer first and last names, their email addresses, and their payment information (a card type, card number, and card expiration date).

- Price plans are identified by a unique code. Each plan can be used for any vehicle type (thus, all plans can be used for all vehicle type and so there isn’t a relationship between a plan and a vehicle type). Each plan has a plan name, a price per minute in cents, an unlock price in cents, and the minute after the unlock even when the price-per-minute charge starts (e.g., 0 implies immediately after unlock, 1 implies one minute after unlock, and so on).

- Each rental is tracked by the company. Customers rent a vehicle under a given price plan. Each rental is assigned a unique rental number. The start and end location (in latitude and longitude), the start time, the duration, and the total amount charged for the rental is tracked.

- Each customer can have a list of preferred vehicle types. This list helps the company rank vehicles when customers are searching for nearby vehicles. Customers can provide zero or more preferred vehicle types. Any vehicle type may or may not be preferred by any particular customer. The date when the customer added a vehicle to its preference list is recorded.
Question 2 (10 points). Use the translation from ER diagrams to relational schemas from class to convert your ER diagram in Question 1 to a corresponding relational schema. Your relational schema must include primary keys and foreign keys as appropriate. Note that you can use the $R(x, y, z)$ notation to define your relations (with foreign keys stated separately). Alternatively, you can draw a schema diagram. You do not need to use SQL CREATE TABLE statements.

Question 3 (10 points). Create an ER diagram to capture the following requirements. Note that the requirements are related to information concerning the music industry. Your diagram must have cardinality constraints for each end of your relationship sets, and must include weak entity sets as appropriate, role names as appropriate, relationship attributes as appropriate, and identifying attributes for each entity set clearly marked.

- A record label (company) consists of a label name (e.g., “AMI”, “SubPop”, “CBS”), the year the label was founded, and the type of the label (e.g., “indie”, “rock”, “major”, and so on). Each record label is identified by their label name.

- An artist consists of an artist number, a first and last name, a birth year, and a birth location given as a city and a state. Each artist is assigned a unique artist number.

- An album consists of a title, the year it was recorded, and a collection of zero or more song recordings (called “tracks”). Each album is assumed to be recorded by exactly one musical group and produced by one record label. Each album is assigned a unique catalog number. Record labels and musical groups can be associated with zero or more albums.

- A song recording has a title, a length in seconds, and is associated with zero or more artists that contributed to its recording. Each artist that contributed to the recording has a part (e.g., “vocals”, “guitar”, “drums”, and so on). Each song recording is identified by a song recording number. Note that the same song recordings can appear on multiple albums. There can also exist recordings that are “unreleased”, i.e., haven’t been part of any albums.

- A music group has a name, a year the group was first formed, and zero or more members. Each member of the group is an artist. Each group is assumed to be identified by its name. Because artists can come and go from a group, membership in the group is for a particular period of years (start and end year). However, we assume each artist can be a part of a group only once. Note that an artist can be a member of zero or more groups. Finally, in cases where a record album is recorded under the name of an individual artist, assume that the album is recorded by a group whose name is the name of the artist.

- Music groups can be associated with zero or more music genres. Examples of genres include “jazz”, “rock”, “pop”, “rap”, and so on. Each group can also be influenced by zero or more other music groups.

Question 4 (10 points). Use the translation from ER diagrams to relational schemas from class to convert your ER diagram in Question 3 to a corresponding relational schema. Your relational
schema must include primary keys and foreign keys as appropriate. Note that you can use the $R(x, y, z)$ notation to define your relations (with foreign keys stated separately). Alternatively, you can draw a schema diagram. You do not need to use SQL CREATE TABLE statements.

**Submission.** Submit your answers to the above questions to GitHub repo for HW-5 as a single PDF file named `hw5.pdf`. Be sure your answers are clearly marked. Note that your ER diagrams must be professional looking and created digitally (hand-drawn is okay if completed on a tablet and are professional looking). In particular, the diagrams should be organized, labels should be clear, lines should be straight, and there should be no crossing lines. Pictures of hand-drawn diagrams will not be accepted. Note that there are a number of tools available for drawing ER Diagrams, however, some of these incorrectly conflate ER diagrams with schema diagrams. If you turn in a schema diagram (also known as a table diagram) for this assignment, you will not receive any points for the work.