

Database Design Term Project (CS6360)

Project Description

Dallas Area Road Transport or DART would like one relational database to store the information about their bus transportation system to be able to carry out their work in an organized way. The DART has some major modules such as Bus, Person (Employee and Passenger) and Ticket Sales.

A Person can be an Employee or an A-class Passenger. A person can be both an employee and an A-Class passenger. Details of a person such as Person ID, Name (First, Middle, Last), Address, Gender, Date of Birth (Must be 16 years or older), and Phone number (one person can have more than one phone number) are recorded. The Person ID should have the format “PXXX” where X is a number from 0 to 9. (Hint: you can use `regexp_like()` function).

Employee can only be one of following three types: classified as Bus Drivers, Staff (sells tickets or passes) and Ticket checkers. The start date of the employee is recorded. One bus driver can drive multiple buses and multiple drivers can drive one bus but on different dates. But for each day, a driver can only drive one particular bus. One bus will always have one particular ticket checker.

Payment information such as ID, method (cash or card), amount and other information are recorded. Ticket details such as Ticket ID, Bus ID, seat number and price are stored. The staff sells daily tickets to a person and the staff details, ticket details, person details and payment details are stored.

An A-Star passenger is someone who has some extra privileges than an A-Class passenger. An A-Star Passenger can be an Employee or an A-Class passenger or both. Different passes are issued by DART. An A-Class passenger can buy only one pass in a month, but an A-Star Passenger can buy multiple passes in a month.

Each A-Star Passenger is issued a travel card. The travel card details such as card ID, date of issue and other information are stored. Card ID is not unique, and is associated with A-Star Passenger.

Sometimes promotional discounts are offered on the travel cards and details such promotion ID and promotion description are recorded. The Promotional IDs are not unique and different travel cards may have discounts with the same Promotional IDs.

A-Star passengers can have guests who travel for free with them four times a month. A Guest info log is maintained which stores information such as passenger ID, guest ID, guest name, guest address, and guest contact information. Guest IDs are temporary IDs that a person gets when they travel as a guest of an A-Star passenger. Each guest ID is not unique and cannot be used to identify a guest.

Bus details such as Bus Number, License plate number, number of seats and other information are stored. Each route has many bus stops. One bus stop is part of only one route. The route and

bus stop details are stored. Each bus is parked in a terminal and the information of the terminal such as Terminal ID, Location, Date and Time are stored.

Each bus drives on one particular route and follows a particular time table. The time table information such as day and start time, end time and intervals (15 min, 20 min, 30 min) are recorded. Values for 'day' can be {M,T,W,Th,F,Sat,Sun}. A unique ID in the form of "DTXX" is given to each unique record in the timetable. For example, Day-{M}, StartTime- 10:00, EndTime – 20:00, Interval - 15m can have ID DT01 and so on. A bus may have different StartTime, EndTime or Interval for different days.

Project Questions

1. Is the ability to model superclass/subclass relationships likely to be important in a transportation system environment such as DART? Why or why not?
2. Can you think of 5 more business rules (other than those explicitly described above) that are likely to be used in a shopping mall environment? Describe how your EER will change to represent the rules.
3. Justify using a Relational DBMS like Oracle for this project (Successfully design a relational database system, show the design in final report).

(These Questions are to be answered in Phase IV. You do not need to answer them in Phase I, II, III.)

Project Exercises

Phase I. Draw an EER to accurately represent this set of requirements. This will be your Conceptual Design. Clearly specify any assumptions that you are making. You can use any tools (software) to draw the EER but must use the symbols consistent with our textbook.

Phase II. Logical Database Design. It has been decided to use a relational DBMS to implement the database. Perform the following steps.

- a. Convert your Conceptual model (Phase I, feel free to change your conceptual model if needed and draw EER after your modifications) to an implementation data model that can be implemented in a relational DBMS like Oracle. During this process you replace M-N relationships and multi-valued attributes with constructs that can be implemented in the relational DBMS.
- b. Document your design in Database Schema format like the one we discussed in the class, explain how you obtained your schema.
- c. The output of Phase II is the schema of database derived from your EER design. Please indicate the primary keys and foreign keys of each relation.

Phase III. Now, you are ready for implementation. Use appropriate naming conventions for all your tables and attributes.

- a. Normalize all your tables to third normal form.
- b. Draw a dependency diagram for each table from Phase III a.
- c. Write SQL statements to create database, tables and all other structures. Primary key and foreign keys must be defined as appropriate. Also specify data type and constraints for each attribute and in addition to specify the referential integrity.
- d. Use the Create View statement to create the following views:
 1. Top A-Star Passenger- This view returns the First Name, Last Name and Date of membership enrollment of those passengers who have travelled more than 6 times in the last month.
 2. Popular Bus- This view returns the details of the bus that the passenger has booked the most in the past 2 months.
 3. Top Delayed/Cancelled Bus- This view returns the details of the bus that has been delayed or cancelled the most in the last month.
 4. Potential A-Star Passenger- This view returns the name, phone number and ID of the A-Class Passengers who travelled more than 4 time in the past 2 months.
 5. Top Employee- This view returns the details of the employee who has made the most number of bookings in the past month.
- e. Answer the following Queries. Feel free to use any of the views that you created in part (d.):
 1. For each employee class, list the employees belonging to that class.
 2. Find the names of employees who are also an A-Class Passenger.
 3. Find the average number of bookings made by the top five A-Star Passengers.
 4. Find the Bus ID and Route names of the bus that is booked the most.
 5. Find Bus ID that is cancelled more than 3 times in the past month.
 6. Find the total number bookings for each bus in the system.
 7. Find the driver details who has driven every day of the past week.
 8. Find the count of passengers who booked the most popular bus.
 9. List all the booking details issued after the most current employee was hired.

10. List all the employees that have enrolled as A-Star Passengers within a month of being employed.
11. Find the route with the highest number of bus stops.
12. Find the name of passengers who have been A-Star Passengers for over 5 years.
13. Find the bookings made by the potential A-Star Passengers in the last year.

Phase IV. Document the final term project report. The report includes:

- a. Problem description (Copy it from the description).
- b. Project questions (Answer 3 questions listed in the project).
- c. EER diagram with all assumptions (Solution for Phase II).
- d. Relational Schema after normalization. All relations must be in 3NF. The relational schema should include Primary key as well as foreign keys (if any) for all relations. (Solution for Phase III a).
- e. Dependency diagram (Solution for Phase III-b).
- f. All requested SQL statements (Solution for Phase III-c, d and e).