COMP9120 Database Management Systems

Assignment 1: Conceptual Modelling & Logical DB Design

Group assignment (16%)

Introduction

The purpose of this assignment is to provide you with experience in conceptual and relational database modelling. You are given a domain description for the Sydney Automotive Group. There are 2 high level tasks in this assignment:

- Create an Entity Relationship Diagram (ERD) that captures the business concepts and requirements conveyed in this description,

- Translate your ER diagram into a logical database design including relational database schema creation, key constraints and integrity constraints.

This is a group assignment for teams of 3 people per group. You must be enrolled in an assignment group on Canvas.

Please also keep an eye on your email and Ed for any related announcements or posts.

Submission Details

The submission of your solution is due at 11:59pm on Sunday 06/04/2025 (Week 6). You must submit the items for submission (detailed below) via Canvas.

NO AI (generative or otherwise) tools may be used to generate the solution for this assignment. This is strictly prohibited.

Items for submission

Please submit your solution to Assignment 1, in the 'Assignment' section of the unit's Canvas site by the deadline, including the following four files:

1. Firstly, you should submit an assignment coversheet as a PDF document (.pdf file suffix) which is available for download from **this link** on Canvas.

2. Secondly, you are required to submit your conceptual model in the form of an E-R diagram using the lecture notation, formatted as a PDF document (.pdf file suffix). **Please justify your choices for entity types, relationship types, attributes, primary keys, constraints and design specialities, including any further assumptions made.**

3. Thirdly, you should submit an SQL file (.sql file suffix) containing all DDL statements (including any constraints) necessary to fully instantiate a working database based upon your ER diagram, and DML statements to populate each relation. Your file should run without errors in **PostgreSQL v16.2**. You can annotate your statements using

'--' at the start of lines for comment. You should group your statements for ease of reading (e.g. by keeping all table constraints within the relevant CREATE TABLE statement rather than declaring them externally, if possible).

4. Lastly, you should submit another pdf document (.pdf file suffix) including the Relational Model (RM) diagram that provides a visual model of your database schema. The following figure summarises the syntax you must use for the RM diagram:

Domain Description

As one of Sydney's premier automotive dealerships since 1995, Sydney Automotive Group (SAG) has built a reputation for offering an extensive range of new and pre-owned vehicles at competitive prices. The company is about to design a database system and has employed you as their database consultant. Your task is to design a conceptual ER model to capture the description of their business operations.

The primary focus of SAG is to help customers find and purchase vehicles that meet their needs. Each vehicle in the system, whether *new* or *pre-owned*, is uniquely identified by the Vehicle Identification Number (VIN) and includes detailed information such as make, model, build year, odometer reading (mileage), colour, transmission type and listed price. In addition, pre-owned has a previous owner and their name stored. The previous owner may or may not be a customer of SAG. To help attract potential buyers, each vehicle listing is accompanied by a detailed description, and still images of the car, providing customers with access to comprehensive details before deciding.

When a customer expresses interest in a vehicle, a test drive of that vehicle is scheduled with a salesperson. The customer will test drive at least one vehicle during a visit to the SAG. The system records the date and time of the test drive along with feedback for each vehicle, helping the sales team correlate the customer's test drive to the likelihood of a car sale being achieved. Once the sale is finalized, customers must register their details, including their first name, last name, mobile number, email address, residential address, and unique driver's licence number. As part of the purchase, customers typically negotiate with the salesperson for a discount. Once both parties agree on the terms, the sale is finalized, and the system records the base price, discount price, and final price of the sale, along with the sale date. The customer has also the option of trading in their own vehicle. The final price is derived using the discount price from the base price plus the cost of after-market options and deducing the agreed traded-in vehicle price if applicable. The salesperson for the sale is also recorded, as this information is important for tracking the salesperson performance and calculating their commission. Each salesperson at SAG has their details recorded in the system, including their full name, email, mobile number, annual gross salary, and their commission rate. We assume that a customer can only make one single vehicle purchase per day but may make additional vehicle purchases from SAG any day.

To provide further service to SAG's customers, these can select up to eight aftermarket car options per sale to personalize their vehicle to better match their preferences and needs. These options include accessories, extended warranties, service packages, and insurance add-ons etc. Each aftermarket option is described by a name and description. The cost of these aftermarket options varies based on the vehicle being purchased—for instance, the price of tinted windows may differ between a high-end luxury sedan and an economy hatchback. Note that these aftermarket options are *not* available for pre-owned cars.

As part of the convenience provided to customers, SAG offers options to trade-in the customer's present vehicle (limited to one per purchase). The customer needs to bring in their vehicle for an inspection to determine the final offered price for the trade-in. The trade-in vehicle is also uniquely identified by its Vehicle Identification Number (VIN). The vehicle's condition is assessed based on the make, model, year, odometer reading (mileage), colour, transmission type, mechanical and body conditions. The mechanical condition is assessed by the SAG as either poor, fair, good, or excellent. The same type of assessment is applied to the vehicle body condition. The trade-in value is

computed according to a formula that takes into account all the above information regarding the traded-in vehicle. We assume that once the vehicle is traded in, it will be put on sale immediately. The traded-in vehicle should be registered to the buyer's name. As previously indicated, the agreed final price of the traded-in vehicle will be deducted from the final price of the sold vehicle.

To accommodate different customer needs, SAG offers multiple payment options, including cash, credit card, bank transfer, bank financing or any combination of these forms of payments. SAG records the amount and date of each payment. Once the full outstanding amount is paid, the sale status will be updated from pending to completed. The customer is responsible for arranging and securing bank financing. The sale is not finalized until the full amount is paid which include a proof that the customer has secured bank financing, if applicable. Up to one single bank financing is assumed for each sale transaction. While bank financing related application is independent from SAG operations and is not part of the SAG ERD, SAG still requires basic information for bookkeeping purpose. The system tracks which bank is involved, the date of application, a loan term which ranges from 12 to 50 months, interest rate and loan amount. For recording purposes, the customer should present a bank proof of approval to SAG.

Additional relationship constraints

The following relationship constraints should be applied to your ER diagram:

1. A vehicle can only be sold to one single customer.

2. A vehicle record can only show that it has been sold or is for sale.

3. A customer must be associated with at least one vehicle purchase record.

4. A customer must test drive at least one vehicle.

Additional details

In addition to the model captured through your ER diagram, the following details apply:

1. Fields in a tuple related to dates and/or times should always have values.

2. All attributes in a tuple relating to details about a name should always have values.

3. All attributes in a tuple relating to details about a price should always have positive values.

4. The odometer reading of a vehicle should always have value equal or greater than zero.

5. The salesperson's salary should always be greater than zero.

6. The salesperson's commission rate should always be greater than 0 but less than 10%. The rate is a percentage of the final purchase price.

7. Email must be unique.

8. A customer can only purchase one vehicle per sale per day.

9. *Note that any derived attributes should not appear in the equivalent relational model*.

Further assumptions

If you feel you want to make further assumptions, it is important that you provide a justification as to the reasons behind them. Your assumptions should be rooted in common sense and how most car dealerships in Australia operate. You should avoid any constraints that only apply to specific cases. When in doubt, adhere to what is explicitly stated in this assignment. For example, if you decide to make an attribute as a composite attribute or define a relationship with total participation when it was not clearly described in the domain text as such, you would need to make an argument about your choice.

Task 1: Entity Relationship Diagram (ERD)

In your first task, assume that the SAG has recruited you as a database designer to develop a conceptual model, described in an ER diagram, to represent the database design of their system. You should also document any assumptions you made which justify your design decisions.

Task 2: Relational Database Design & Modelling

Your second task is to design and create a relational database schema based on the Entity Relationship Diagram (ERD) modelled from the first task. In particular, your solution should include:

- A Relational Model mapping (i.e., RM diagram) of the ERD which describes the tables and attributes with appropriate data types to capture all information in the model (please use the same names as in your ER diagram for naming tables and attributes);

- Creation of the database schema using PostgreSQL which include the appropriate PRIMARY KEY, UNIQUE, FOREIGN KEY constraints for all tables;

- Correct foreign key specifications including ON DELETE clauses where suitable;

- Appropriate additional integrity constraints expressed by means of NOT NULL or CHECK clauses or other types of integrity constraint statements;

- INSERT statements to populate each relation with at least one record, to demonstrate a database instance consistent with the ER model.

Escaping PostgreSQL keywords in DDL

If you need to escape PostgreSQL keywords like "Table", you will need to use double quotes.

e.g. CREATE TABLE "Table" (…);

Q&A

Q: How to draw the link from foreign key in a table to its referenced candidate key in another table if the foreign key contains more than one attributes?

A: You should draw it in the same way to the following RM diagram (specifically, see the Sell table). You can use any of the available tools such as draw.io, Visio, Lucidchart, Excalidraw, etc. to draw your diagram.
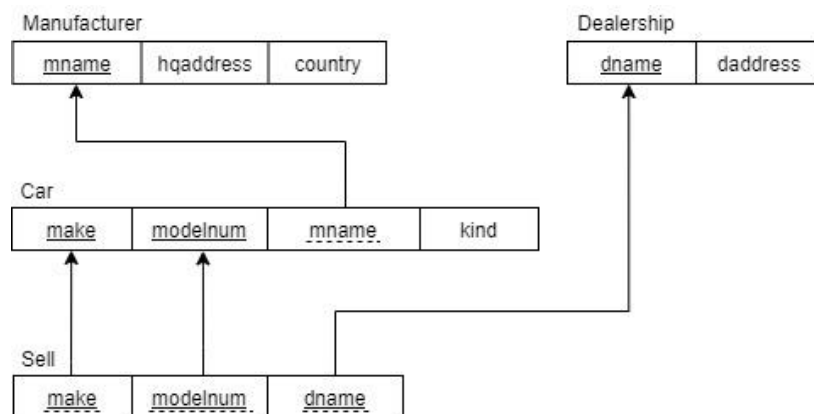
Marking

This assignment is worth **16%** of your final grade for the unit of study. Your group's submission will be marked according to the attached rubric (see last section of this assignment description).

Group member participation

If members of your group do not contribute sufficiently, you should alert the unit coordinator as soon as possible. The course instructor has the discretion to scale the group's mark for each member as follows:

Percentage of contribution	Proportion of final grade received
< 5% contribution	0%
5 - 10% contribution	20%
11 - 15% contribution	40%
16 - 20% contribution	50%
21 - 24% contribution	60%
25 - 28% contribution	80%
29 - 30% contribution	90%
> 30% contribution	100%

Note: The above table assumes that each group will have 3 members, so, on average, around 33% contribution is expected from each member of the group. In special case, if a group has less than 3 members then the contribution percentage will be adjusted accordingly. You must justify your contribution percentage by providing a detailed explanation of your individual contribution on the assignment coversheet mentioned before. **You must also regularly record and maintain a diary of your group meetings and discussions on Canvas.** Furthermore, we may run random face-to-face interviews to understand and justify your contribution, if needed.

Marking Rubric

Your submissions will be marked according to the following rubric, with a maximum possible score of 16 points.

	Novice (0 – 1 pt)	Competent (1.5 – 2 pts)	Proficient (2.5 pts)
ERD Notation & Core Model	Major mistakes in the usage of ER notation. Less than competent model of the given scenario. Many entities, relationships, or attributes were not correctly captured by the model.	Good usage of E-R notation with a few mistakes. Entities, relationships, or attributes were correctly captured by the model, but with minor mistakes.	Proficient usage of the E-R notation. The core model was very well designed, and all the main entities, relationships and attributes were correctly captured by the model.
ERD Constraints	Many constraints were incorrectly captured in the model, or no constraints captured at all.	Constraints (key / total participation constraints on relationship types, etc.) were correctly included in the model, but with minor mistakes.	All appropriate constraints were modelled correctly.

ERD Design Specialities	Majority of design specialities used were inappropriate or incomplete, or no design specialities were used.	At least one useful ISA, weak entity or aggregation used appropriately. Minor or no mistakes on design specialities used.	All design specialities were used appropriately.
Relational Mappings	Less than competent relational schema of the given scenario.	All main entities and relationships were mapped correctly to relations, with appropriate choice of data types for most attributes.	The core model was very well mapped to a relational schema and appropriate choice of data types for all attributes.
Key Constraints & Semantic Constraints	Major issues with key constraints, or no key constraints captured at all. Major issues with integrity constraints, or no integrity constraints given.	Primary keys and foreign keys were defined appropriately, but with minor mistakes. Integrity constraints such as CHECK or NOT NULL were defined correctly, but with minor mistakes.	All the necessary primary keys and foreign keys were defined correctly, including appropriate ON DELETE clauses. All the necessary integrity constraints for the model were defined correctly.
Example Data & RM Diagram	No example data given or yielded multiple errors. No RM diagram submitted, or major issues with the RM diagram.	Some table example data missing or generated an error. RM diagram does not exactly match the relational schema created by the submitted SQL file.	Database fully populated with a consistent and correct set of data. RM diagram is correct and exactly matches the relational schema created by the submitted SQL file (*Note: semantic constraints and example data are not required on the RM diagram*).

	No Marks (0 pt)	**Full Marks (1 pt)**
Record Keeping of Group Discussions	One or more issues reported or found with group member contribution, or with maintaining records of group meetings and discussions regularly on Canvas.	No issue reported or found with group member contribution. All group members participate and regularly maintain a diary of group meetings and discussions on Canvas.