



جامعة السلطان قابوس
Sultan Qaboos University

College of Economics and Political Science

INFS4416 - Database Management

Section 01

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Database Management Final Report

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Table of Contents

1. Introduction & Users' Requirements.....	3
1.1 Organization, its business environment and problems.....	3
1.2 Database system users: details description of their access levels.....	3
1.3 Users' Data Requirements:.....	4
2. Conceptual Design.....	7
2.1 Entities and their attributes.....	8
2.2 Relationships & Related Business Rules.....	11
2.3 Other Business rules on Data.....	12
2.4 Security and Access Levels.....	13
2.5 Data Model Diagram.....	14
3. Logical Design.....	15
3.1 Relational (Mapped) Tables with Referential Integrity Constraints.....	15
3.2 Normalization of Relations.....	16
4. Physical Design.....	18
4.1 Tables' structure and Data.....	18
4.2 Create, insert, update, alter commands :.....	20
5. Queries.....	25
6. Summary and Conclusion.....	29
6.1 Database system benefits.....	29
6.2 Limitations of the developed system.....	30
6.3 Recommendations.....	30
6.4 Your Experience.....	30
7. Group Member Tasks.....	31
8. References.....	31

1. Introduction & Users' Requirements

1.1 Organization, its business environment and problems

RA Motors is a car dealership located in Maabela, Muscat, operating in the new car market. The company specializes in the sale of new fuel-powered, electric and hybrid vehicles. RA Motors operates in a competitive business environment, facing competition from other local dealerships and car importers. The operations it goes through day by day are based on effective inventory management, sales tracking, communication with customers, management of employees and coordination with suppliers.

Today, RA Motors operates in the area of managing a large amount of data, i.e., vehicle details, customer records, employee details, and supplier data, through manual or semi-manual procedures. This method has led to a number of problems in managing data as the amount of data keeps on growing. They are the inability to properly monitor inventory of vehicles, resulting in overstocking or selling cars that are not available, loss or misrepresentation of customer and employee information due to the repetitive keying in by hand, and creation of accurate sales and performance reporting. Also, information redundancy and delays in information changes are negative influences to the speed and quality of decision making.

In order to overcome such problems, RA Motors is interested in creating an integrated platform that includes a database management system to facilitate efficient, accurate and centralized data management. The suggested database system will assist in the decrease of data redundancy and inaccuracy, enhancement of inventory and sales tracking, and assist in the facilitation of the daily operations of all departments.

1.2 Database system users: details description of their access levels

RA Motors database system contains various types of users with assigned responsibilities and privileges of access. These security levels are intended to uphold secrecy, avoid unauthorized manipulations and to have smooth running operations.

- 1. System Administrator:** System administrator is in charge of maintenance of the entire database and he ensures smooth running of the system. Their responsibilities include establishing the user accounts, granting of rights, backup creation and error correction.
- 2. Sales Employee:** The salespeople will be tasked with their responsibility of dealing with customers and making vehicle purchases. The only thing they desire is the access to purchase transactions, automobile availability and client records. They are not able to alter prices of cars, employee details or supplier data.
- 3. Inventory Manager:** The inventory manager will monitor information about the suppliers and the cars and oversee the inventory of the vehicles. They do not have access to customer records, employee records or purchase records.
- 4. HR/Administrator Staff:** HR and administrative staff handle recruitment, employment records and internal paperwork. They do not require sensitive sales or supplier information but they would require access to personnel information.
- 5. General Manager:** Even though their rights to editing are limited, all operations are under the supervision of the general manager who has to have access to all information to make decisions.

1.3 Users' Data Requirements:

Cars, customers, employees, suppliers, and purchases will be tracked by the RA Motors database. The various user types will enter and access data as per their duties.

1. Car information

Attribute	Description	Data Type	Example
VIN	Vehicle Identification Number	VARCHAR(17)	FJ502JSD03LEH2166
Make	Car manufacturer	VARCHAR(20)	Toyota
Model	Car model name	VARCHAR(20)	Corolla
Year	year of manufacture	NUMBER(4)	2023

Colour	Car colour	VARCHAR(15)	Black, Grey, Blue
Distance Traveled	car mileage	NUMBER	6000
Price	car selling price	NUMBER	25500
Status	availability status	VARCHAR(10)	available/sold
Type	car type (gas, electric, hybrid)	CHAR(1)	G

2. Customer information

Attribute	Description	Data Type	Example
CustomerID	Unique customer identifier	CHAR(4)	C101
Name	Customer's name	VARCHAR(30)	Salim
Phone Number	Customer contact number	Number(8)	98765432
Address	Customer address (Street, City, Postal Code)	VARCHAR(30)	Muscat, Oman

3. Employee information

Attribute	Description	Data Type	Example
EmployeeID	Unique employee identifier	CHAR(4)	E001
Name	Employee's name	VARCHAR(30)	Sarah Ali

Phone Number	Contact number	NUMBER(8)	98765432
Address	Employee address	VARCHAR(30)	Muscat
Date Employed	Employment start date	DATE	1/12/2023
Salary	Employee salary	NUMBER	800

4. Supplier information

Attribute	Description	Data Type	Example
SupplierID	Unique supplier identifier	CHAR(3)	S01
Trading Name	Supplier company name	VARCHAR(30)	AutoParts Co.
Country	Supplier country	VARCHAR(20)	Oman
Address	Supplier address	VARCHAR(30)	Muscat
Phone Number	Supplier contact number	NUMBER (8)	99887766

5. Purchase information

Attribute	Description	Data Type	Example
PurchaseID	Unique purchase identifier	CHAR(4)	P001

CustomerID	Reference to the buying customer	CHAR(4)	C101
EmployeeID	Reference to the salesperson	CHAR(4)	E001
VIN	Reference to the purchased car	VARCHAR(17)	FJ502JSD03LEH 2166
Purchase Date	Date of purchase	Date	27/2/2021
Remarks	Any additional notes	VARCHAR(40)	Price was lower than expected
Sold Price	The sold price of the purchased car	NUMBER	6579

Outputs:

Sales Employees: As a list of all available cars, customer information, and sales that have been made. Sales summary daily or weekly.

Inventory Manager: Inventory status report: cars in stock, cars sold, supplier deliveries. Weekly/monthly inventory reporting.

HR reports on personnel employment information.

System Administrator: User activity logs, database backups, access logs, and system audit reports.

General Manager: Sales trends, inventory reports, employee performance summaries are reports of the management. Monthly strategic report.

2. Conceptual Design.

The conceptual design is the design that forms the entities attributes, relationships, constraints and access rules of the database of RA Motors. It gives an overview of the information at a

high level and its relation to one another, without digging into the specifics of the implementation of the SQL.

2.1 Entities and their attributes

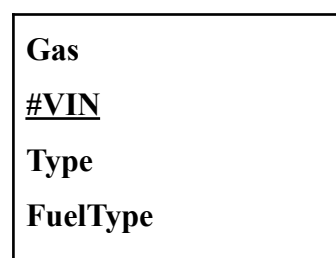
1. Car (Supertype with Subtypes)

This indicates all the Vehicles in the dealership. It will also be generalized supertype where there will be three subtype:

- **Gas:** Gasoline-powered cars
- **Electric:** Electric cars
- **Hybrid:** Hybrid cars



Subtypes:



Electric <u>#VIN</u> Type BatteryCapacity
--

Hybrid <u>#VIN</u> Type FuelType BatteryCapacity

2. Employee

A table that contains the list of all employee records such as the contact information of each employee.

Employee <u>#Employee ID</u> Name PhoneNumber Address (street, city, postal code) DateEmployed Salary
--

3. Customer

A list of all the individuals who have purchased one or more cars in the dealership.

Customer

<u>#CustomerID</u>
Name
PhoneNumber
Address (street, city, postal code)

4. Supplier

A list of all the suppliers that provide vehicles to the dealership.

Supplier
<u>#SupplierID</u>
TradingName
Country
Address (street, city, postal code)
PhoneNumber

5. Purchase

An associative table between the customer, car and employee.

Purchase
<u>#PurchaseID</u>
#CustomerID
#EmployeeID
#VIN
PurchaseDate
Sold Price
Remarks

2.2 Relationships & Related Business Rules

This part explains how the key entities in the RA Motors database are related to each other, their cardinalities, and business rules that govern those entities.

1. SUPPLIER – CAR Relationship

Type: One-to-Many (1:M)

Description: It is possible that a supplier provides one or more cars, and only one supplier provides cars.

Business Rules:

A CAR is supposed to be connected to a SUPPLIER.

A SUPPLIER must supply at least one CAR.

2. CAR – PURCHASE Relationship

Type: One-to-One (1:1)

Description: Every car can be purchased once, and a purchase can only include a single car.

Business Rules:

A Sold car must have a PURCHASE record attached to it.

A car with the mark of Available should not be included in any PURCHASE record.

3. CUSTOMER- PURCHASE Relationship.

Type: One-to-Many (1:M)

Description: A single customer is able to make numerous purchases at different moments in time, but each purchase belongs to one customer only.

Business Rules:

No PURCHASE will exist without a CUSTOMER.

A CUSTOMER needs to be a purchaser.

4. Purchase RelationshipEMPLOYEE.

Type: One-to-Many (1:M)

Description:

Each purchase, on the other hand, has to be attended to by only one employee, although the number of purchases that an employee makes can be zero or large.

Business Rules:

All PURCHASEs have to be done by an EMPLOYEE.

An EMPLOYEE may have zero or many PURCHASEs.

5. CAR Supertype Relationship Subtype.

Type: Specialization

Description: CAR is a super type and has three disjoint subtypes, namely GAS, ELECTRIC and HYBRID.

Business Rules:

Any CAR should only be a member of one subtype.

The Type attribute is the discriminator whose values are:

‘G’ for Gas

‘E’ for Electric

‘H’ for Hybrid

2.3 Other Business rules on Data

This section gives an explanation of constraints that are applied to the attributes of the RA Motors database to assure accuracy and consistency, as well as integrity of data.

A. Attributes Business rules-CHECK CONSTRAINTS

Status of car should be either available or sold.

Car Type: should be one of the following:

‘G’ for Gas

‘E’ for Electric

‘H’ for Hybrid

Car Year should not be less than 1990.

Distance Traveled has to be zero or positive number.

Price and SoldPrice should not be below zero.

Employee Salary should not be equal to zero.

PurchaseDate should not be less than the year of manufacture of the car.

B. Attribute Business Rules- UNIQUE Constraints.

VIN should be unique to each automobile.

EmployeeID must be unique.

CustomerID must be unique.

SupplierID must be unique.

Employee Phone Number should be unique.

C. Attribute Business Rules- NOT NULL Constraints.

Car attributes: VIN, Make, Model, Year, Price, Status, Type should not be a null.

Attributes of employees: The attributes of the employees must not be RED attributes but have values like: EmployeeID, First Name, Last Name, Date Employed, Salary.

Customer attributes: CustomerID, Name, Phone Number cannot be of the character of null.

Supplier properties: SupplierID, Trading Name, Country, Phone Number should not be empty.

Purchase attributes: PurchaseID, PurchaseDate, SoldPrice shall not be blank.

D. Attribute Business Rules - DEFAULT Constraints

The default in car status is set to available when a new car is added.

In case of no Distance Traveled, it becomes zero.

The default purchase date is the system date.

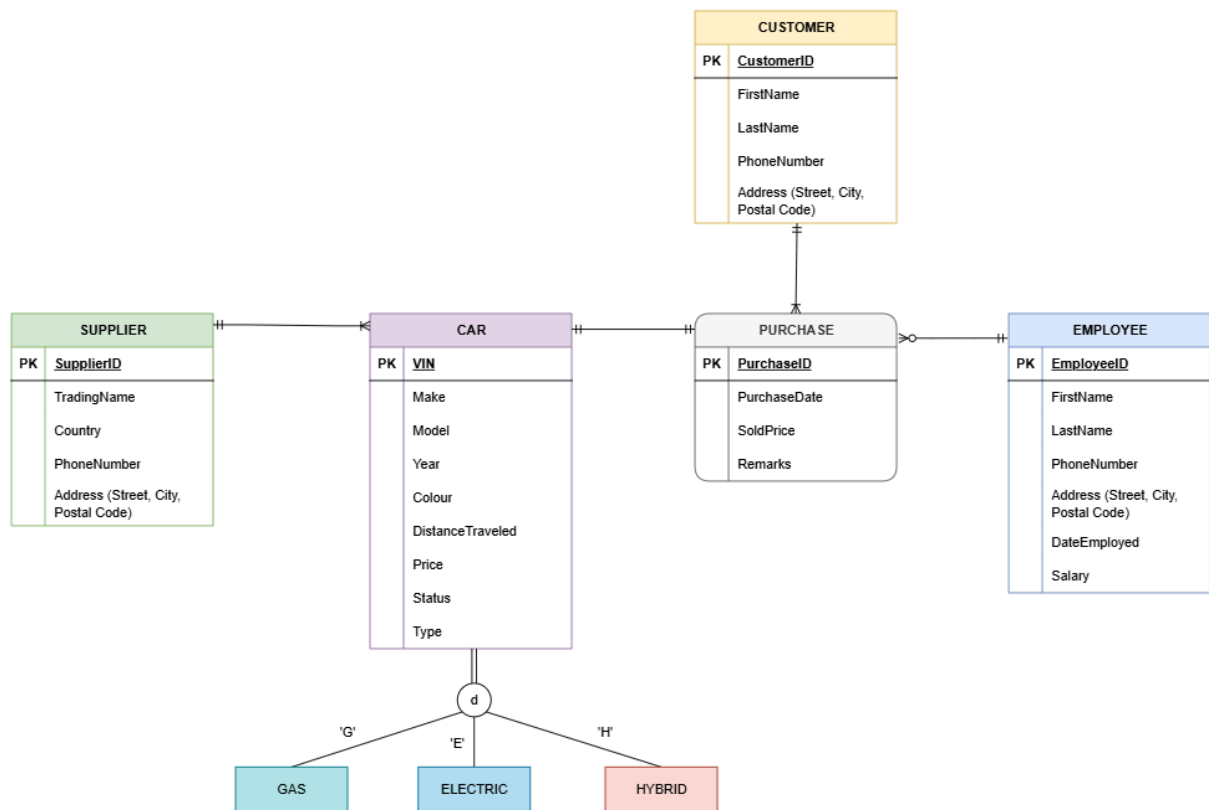
The default of employee Date Employed will be the existing system date.

2.4 Security and Access Levels

Role / Access Level	CAR	CUSTOMER	EMPLOYEE	SUPPLIER	PURCHASE
System Administrator	INSERT, SELECT, UPDATE, DELETE	INSERT, SELECT, UPDATE, DELETE	INSERT, SELECT, UPDATE, DELETE	INSERT, SELECT, UPDATE, DELETE	INSERT, SELECT, UPDATE, DELETE
Sales Employee	SELECT	INSERT	—	—	INSERT
Inventory Manager	SELECT, UPDATE	—	—	SELECT	—
HR / Administrative Staff	SELECT	SELECT	SELECT, INSERT, UPDATE	—	—
General Manager	SELECT	SELECT	SELECT, UPDATE	SELECT	SELECT

2.5 Data Model Diagram

Entity Relationship Diagram (ERD)



3. Logical Design

3.1 Relational (Mapped) Tables with Referential Integrity Constraints

PURCHASE (Associative Entity)

<u>Purchase_ID</u>	Purchase_Date	Sold_Price	Remarks	<u>VIN</u>	<u>Customer_ID</u>	<u>Employee_ID</u>
--------------------	---------------	------------	---------	------------	--------------------	--------------------

Supplier

<u>Supplier_ID</u>	Trading_Name	Country	Phone	Street	City	Postal_Code
--------------------	--------------	---------	-------	--------	------	-------------

CAR

<u>VIN</u>	Make	Model	Year	Colour	Distance_Travelled	Price	Status	Type	<u>Supplier_ID</u>
------------	------	-------	------	--------	--------------------	-------	--------	------	--------------------

CUSTOMER

<u>Customer_ID</u>	First_Name	Last_Name	Phone	Street	City	Postal_Code
--------------------	------------	-----------	-------	--------	------	-------------

EMPLOYEE

<u>Employee_ID</u>	First_Name	Last_Name	Phone	Street	City	Postal_Code	Date_Employed	Salary
--------------------	------------	-----------	-------	--------	------	-------------	---------------	--------

Referential Integrity Constraints (Links)

CAR.SupplierID → SUPPLIER.SupplierID

PURCHASE.VIN → CAR.VIN

PURCHASE.CustomerID → CUSTOMER.CustomerID

PURCHASE.EmployeeID → EMPLOYEE.EmployeeID

3.2 Normalization of Relations

All relations are normalized to Third Normal Form (3NF).

CUSTOMER TABLE (3NF)

Functional Dependencies:

<u>Customer_ID</u>	First_Name	Last_Name	Phone	Street	City	Postal_Code
--------------------	------------	-----------	-------	--------	------	-------------

Explanation:

No multivalued attributes

No partial dependency (PK is single attribute)

No transitive dependency

CUSTOMER is in 3NF

EMPLOYEE TABLE (3NF)

Functional Dependencies:

<u>Employee_ID</u>	First_Name	Last_Name	Phone	Street	City	Postal_Code	Date_Employed	Salary
--------------------	------------	-----------	-------	--------	------	-------------	---------------	--------

All attributes depend on the primary key

No transitive dependency

EMPLOYEE is in 3NF.

SUPPLIER TABLE (3NF)

Functional Dependencies:

<u>Supplier_ID</u>	Trading_Name	Country	Phone	Street	City	Postal_Code
--------------------	--------------	---------	-------	--------	------	-------------

All non-key attributes depend only on SupplierID

SUPPLIER is in 3NF

CAR TABLE (3NF)

Functional Dependencies:

<u>VIN</u>	Make	Model	Year	Colour	Distance_Travelled	Price	Status	Type	<u>Supplier_ID</u>
------------	------	-------	------	--------	--------------------	-------	--------	------	--------------------

VIN uniquely identifies a car

SupplierID is a foreign key, not causing transitive dependency

CAR is in 3NF

PURCHASE TABLE (3NF)

Functional Dependencies:

<u>Purchase_ID</u>	Purchase_Date	Sold_Price	Remarks	<u>VIN</u>	<u>Customer_ID</u>	<u>Employee_ID</u>
--------------------	---------------	------------	---------	------------	--------------------	--------------------

PURCHASE is an associative relation

All attributes depend on PurchaseID only

PURCHASE is in 3NF

4. Physical Design

4.1 Tables' structure and Data

1. Car table

VIN	Make	Model	Year	Colour	Distance	Price	Status	Type	SupplierID
FJ502JSD03LEH2167	Toyota	Camry	2020	White	45000	6500	Available	G	S01
TR839KDL92MNB4581	Tesla	Model 3	2022	Black	12000	14000	Sold	E	S01
HY672PLQ45ZXC9012	Toyota	Corolla	2021	Black	54000	6500	Available	H	S02
AB123CD45EFG67890	Nissan	Altima	2019	Silver	60000	5500	Sold	G	S04
ZX987YU65TRE43210	BMW	X5	2021	Blue	30000	18000	Available	H	S05
LM456OP98QWE12345	Hyundai	Elantra	2020	Red	50000	6200	Sold	G	S06

I. Electric Subtype

VIN	Make	Model	Year	Colour	Distance	Price	Status	Type	SupplierID
TR839KDL92MN84581	Tesla	Model 3	2022	Black	12000	14000	Sold	E	S01

II. Gas Subtype

VIN	Make	Model	Year	Colour	Distance	Price	Status	Type	SupplierID
FJ502JSD03LEH2167	Toyota	Camry	2020	White	45000	6500	Available	G	S01
AB123CD45EFG67890	Nissan	Altima	2019	Silver	60000	5500	Sold	G	S04
LM456OP98QWE12345	Hyundai	Elantra	2020	Red	50000	6200	Sold	G	S06

III. Hybrid Subtype

VIN	Make	Model	Year	Colour	Distance	Price	Status	Type	SupplierID
ZX987YU65TRE43210	BMW	X5	2021	Blue	30000	18000	Available	H	S05
HY672PLQ45ZXC9012	Toyota	Corolla	2021	Black	54000	6500	Available	H	S02

2. Employee table

EmpID	EmpName	Phone	Street	City	PostalCode	DateEmployed	Salary
E001	Sara	91234567	Al Khoud	Muscat	123	12/5/2021	750
E002	Ahmed	92345678	Al Khoud	Muscat	456	20-01-2023	600
E003	Reem	97462736	Al Khoud	Muscat	648	30-06-2022	650
E004	Khalid	91223344	Azaiba	Muscat	321	1/9/2020	700
E005	Aisha	93445566	Seeb	Muscat	654	15-02-2022	680
E006	Hassan	96554433	Bousher	Muscat	789	10/11/2023	580

3. Customer table

CustomerID	CustName	Phone	Street	City	PostalCode
C100	Maryam	99887766	Bowsher	Muscat	123
C101	Omar	99776655	Seeb	Muscat	456
C102	Noor	99735274	Al Khoud	Muscat	635
C103	Salim	91112233	Maabela	Muscat	741
C104	Fatma	92223344	Qurum	Muscat	852
C105	Yusuf	93334455	Amerat	Muscat	963

4. Supplier table

SupplierID	TradingName	Country	Street	City	PostalCode	Phone
S01	AutoParts	Oman	Al Khuwair	Muscat	111	24556677
S02	Gulf Cars	UAE	Jebel Ali	Dubai	100	92333444
S03	Gulf Auto Parts	KSA	King Fahd Road	Riyadh	115	12345678
S04	Desert Motors	Oman	Al Ghubrah	Muscat	112	24667788
S05	Arabian Auto	Qatar	West Bay	Doha	234	44112233
S06	Elite Cars	Bahrain	Seef District	Manama	323	97334455

5. Purchase table

PurchaseID	PurchaseDate	Amount	Remarks	CustomerID	EmpID	VIN
P001	10/2/2024	6300	Good condition	C100	E001	FJ502JSD03LEH2167
P002	15-03-2024	13800	Electric car	C101	E003	TR839KDL92MNB4581
P003	2/4/2024	7200	Hybrid model	C102	E002	HY672PLQ45ZXC9012
P004	18-04-2024	5400	Negotiated price	C103	E004	AB123CD45EFG67890
P005	25-04-2024	6100	Urgent sale	C104	E005	LM456OP98QWE12345
P006	5/5/2024	17500	Luxury SUV	C105	E006	ZX987YU65TRE43210

4.2 Create, insert, update, alter commands :

Supplier Table

```
CREATE TABLE SUPPLIER (
```

```
    SupplierID CHAR(3) PRIMARY KEY,
```

```
    TradingName VARCHAR(30),
```

```
    Country VARCHAR(20),
```

```
    Street VARCHAR(30),
```

```
    City VARCHAR(20),
```

```
    PostalCode NUMBER(3),
```

```
    Phone NUMBER(8)
```

```
);
```

```
INSERT INTO SUPPLIER VALUES ( 'S01', 'AutoParts', 'Oman', 'Al Khuwair',  
'Muscat', 111, 24556677 );
```

```
INSERT INTO SUPPLIER VALUES ( 'S02', 'Gulf Cars', 'UAE', 'Jebel Ali', 'Dubai',  
100, 92333444 );
```

```
INSERT INTO SUPPLIER VALUES ( 'S03', 'Gulf Auto Parts', 'KSA', 'King Fahd Road',  
'Riyadh', 115, 12345678 );
```

```
INSERT INTO SUPPLIER VALUES ( 'S04', 'Desert Motors', 'Oman', 'Al Ghubrah',  
'Muscat', 112, 24667788 );
```

```
INSERT INTO SUPPLIER VALUES ('S05', 'Arabian Auto', 'Qatar', 'West Bay', 'Doha',
234, 44112233);
```

```
INSERT INTO SUPPLIER VALUES ('S06', 'Elite Cars', 'Bahrain', 'Seef District',
'Manama', 323, 97334455);
```

Car table

```
CREATE TABLE CAR (
VIN VARCHAR(17) PRIMARY KEY,
Make VARCHAR(20),
Model VARCHAR(20),
Year NUMBER(4),
Colour VARCHAR(15),
Distance NUMBER,
Price NUMBER,
Status VARCHAR(10) CHECK (Status IN ('Available', 'Sold')),
Type CHAR(1) CHECK (Type IN ('G', 'E', 'H')),
SupplierID CHAR(3),
CONSTRAINT CAR_FK FOREIGN KEY (SupplierID) REFERENCES SUPPLIER (SupplierID));
```

```
INSERT INTO CAR VALUES ('FJ502JSD03LEH2167', 'Toyota', 'Camry', 2020, 'White', 45000,
6500, 'Available', 'G', 'S01');
```

```
INSERT INTO CAR VALUES ('TR839KDL92MNB4581', 'Tesla', 'Model 3', 2022, 'Black',
12000, 14000, 'Sold', 'E', 'S01');
```

```
INSERT INTO CAR VALUES ('HY672PLQ45ZXC9012', 'Toyota', 'Corolla', 2021,
'Black', 54000, 6500, 'Available', 'H', 'S02');
```

```
INSERT INTO CAR VALUES ('AB123CD45EFG67890', 'Nissan', 'Altima', 2019, 'Silver',
60000, 5500, 'Sold', 'G', 'S04');
```

```
INSERT INTO CAR VALUES ('ZX987YU65TRE43210', 'BMW', 'X5', 2021, 'Blue', 30000,
18000, 'Available', 'H', 'S05');
```

```
INSERT INTO CAR VALUES ('LM456OP98QWE12345', 'Hyundai', 'Elantra', 2020, 'Red',
50000, 6200, 'Sold', 'G', 'S06');
```

Subtype tables

```
CREATE TABLE GAS (
VIN VARCHAR(17) PRIMARY KEY,
FuelType VARCHAR(20),
```

```

        CONSTRAINT GAS_FK FOREIGN KEY (VIN) REFERENCES CAR (VIN)

);

CREATE TABLE ELECTRIC (

    VIN VARCHAR(17) PRIMARY KEY,

    BatteryCapacity NUMBER(3),

    CONSTRAINT E_FK FOREIGN KEY (VIN) REFERENCES CAR (VIN)

);

CREATE TABLE HYBRID (

    VIN VARCHAR(17) PRIMARY KEY,

    FuelType VARCHAR(20),

    BatteryCapacity NUMBER(3),

    CONSTRAINT H_FK FOREIGN KEY (VIN) REFERENCES CAR (VIN)

);

INSERT INTO GAS VALUES ('FJ502JSD03LEH2167','Regular');

INSERT INTO GAS VALUES ('AB123CD45EFG67890','Premium');

INSERT INTO GAS VALUES ('LM456OP98QWE12345','Diesel');

INSERT INTO ELECTRIC VALUES ('TR839KDL92MNB4581',40);

INSERT INTO HYBRID VALUES ('HY672PLQ45ZXC9012','Regular',20);

INSERT INTO HYBRID VALUES ('ZX987YU65TRE43210','Diesel',30);

```

Employee table

```

CREATE TABLE EMPLOYEE (

    EmpID CHAR(4) PRIMARY KEY,

    EmpName VARCHAR(30),

    Phone NUMBER(8),

    Street VARCHAR(30),

```

```

City VARCHAR(20),

PostalCode NUMBER(3),

DateEmployed DATE,

Salary NUMBER );


INSERT INTO EMPLOYEE VALUES ( 'E001', 'Sara', 91234567, 'Al Khoud',
'Muscat',123, TO_DATE('12-05-2021','DD-MM-YYYY'), 750);

INSERT INTO EMPLOYEE VALUES ( 'E002', 'Ahmed',92345678, 'Al Khoud',
'Muscat',456, TO_DATE('20-01-2023','DD-MM-YYYY'), 600 );

INSERT INTO EMPLOYEE VALUES ( 'E003', 'Reem', 97462736, 'Al Khoud',
'Muscat',648, TO_DATE('30-06-2022','DD-MM-YYYY'), 650 );

INSERT INTO EMPLOYEE VALUES ('E004', 'Khalid', 91223344, 'Azaiba', 'Muscat', 321,
TO_DATE('01-09-2020','DD-MM-YYYY'), 700);

INSERT INTO EMPLOYEE VALUES ('E005', 'Aisha', 93445566, 'Seeb', 'Muscat', 654,
TO_DATE('15-02-2022','DD-MM-YYYY'), 680);

INSERT INTO EMPLOYEE VALUES ('E006', 'Hassan', 96554433, 'Bousher', 'Muscat', 789,
TO_DATE('10-11-2023','DD-MM-YYYY'), 580);

```

Customer table

```

CREATE TABLE CUSTOMER (

CustomerID CHAR(4) PRIMARY KEY,

CustName VARCHAR(30),

Phone NUMBER(8),

Street VARCHAR(30),

City VARCHAR(20),

PostalCode NUMBER(3));


INSERT INTO CUSTOMER VALUES ('C100', 'Maryam', 99887766, 'Bowsher',
'Muscat',123);

INSERT INTO CUSTOMER VALUES ( 'C101', 'Omar', 99776655, 'Seeb', 'Muscat', 456);

INSERT INTO CUSTOMER VALUES ( 'C102', 'Noor', 99735274, 'Al Khoud', 'Muscat',
635);

```

```

INSERT INTO CUSTOMER VALUES ('C103', 'Salim', 91112233, 'Maabela', 'Muscat', 741);

INSERT INTO CUSTOMER VALUES ('C104', 'Fatma', 92223344, 'Qurum', 'Muscat', 852);

INSERT INTO CUSTOMER VALUES ('C105', 'Yusuf', 93334455, 'Amerat', 'Muscat', 963);

```

Purchase table

```

CREATE TABLE PURCHASE (

    PurchaseID CHAR(4),

    PurchaseDate DATE,

    SoldPrice NUMBER,

    Remarks VARCHAR(40),

    CustomerID CHAR(4),

    EmpID CHAR(4),

    VIN VARCHAR(17),

    CONSTRAINT purchase_pk PRIMARY KEY (PurchaseID, VIN),

    CONSTRAINT purchase_customer_fk FOREIGN KEY (CustomerID) REFERENCES
CUSTOMER(CustomerID),

    CONSTRAINT purchase_employee_fk FOREIGN KEY (EmpID) REFERENCES EMPLOYEE(EmpID),

    CONSTRAINT purchase_car_fk FOREIGN KEY (VIN) REFERENCES CAR(VIN)

);

```

```

INSERT INTO PURCHASE VALUES ('P001', TO_DATE('10-02-2024','DD-MM-YYYY'), 6300,
'Good condition', 'C100', 'E001', 'FJ502JSD03LEH2167' );

INSERT INTO PURCHASE VALUES ('P002', TO_DATE('15-03-2024','DD-MM-YYYY'), 13800,
'Electric car', 'C101', 'E003', 'TR839KDL92MNB4581' );

INSERT INTO PURCHASE VALUES ( 'P003', TO_DATE('02-04-2024','DD-MM-YYYY'), 7200,
'Hybrid model', 'C102', 'E002', 'HY672PLQ45ZXC9012' );

INSERT INTO PURCHASE VALUES ('P004', TO_DATE('18-04-2024','DD-MM-YYYY'), 5400,
'Negotiated price', 'C103', 'E004', 'AB123CD45EFG67890');

INSERT INTO PURCHASE VALUES ('P005', TO_DATE('25-04-2024','DD-MM-YYYY'), 6100,
'Urgent sale', 'C104', 'E005', 'LM456OP98QWE12345');

```



```
INSERT INTO PURCHASE VALUES ('P006', TO_DATE('05-05-2024','DD-MM-YYYY'), 17500,
'Luxury SUV', 'C105', 'E006', 'ZX987YU65TRE43210');
```

Change a specific car's status from Available to Sold:

```
UPDATE CAR
SET Status = 'Sold'
WHERE VIN = 'FJ502JSD03LEH2167';
```

Increase salary of employees by 10% if they were hired in 2020:

```
UPDATE EMPLOYEE
SET Salary = Salary * 1.1
WHERE DateEmployed BETWEEN '1-JAN-2020' AND '1-JAN-2021';
```

Change the employee ID of E004 to E001 in Purchase:

```
UPDATE PURCHASE
SET EmpID = 'E001'
WHERE EmpID = 'E004';
```

Add a row in Purchase named ExpectedPrice:

```
ALTER TABLE PURCHASE
ADD ExpectedPrice NUMBER NULL;
```

Rename Phone in Customer to CPhone:

```
ALTER TABLE CUSTOMER
RENAME COLUMN Phone TO CPhone;
```

Remove the column PostalCode in Supplier:

```
ALTER TABLE SUPPLIER
DROP COLUMN PostalCode;
```

5. Queries

1. Show Available Cars:

```
SELECT * FROM CAR
WHERE Status = 'Available';
```

	VIN	MAKE	MODEL	YEAR	COLOUR	DISTANCE	PRICE	STATUS	TYPE	SUPPLIERID
1	HY672PLQ45ZXC90	Toyota	Corolla	2021	Black	54000	6500	Available	H	S02
2	ZX987YU65TRE432	BMW	X5	2021	Blue	30000	18000	Available	H	S05

2. Show Sold Cars:

```
SELECT * FROM CAR
WHERE Status = 'Sold';
```

	VIN	MAKE	MODEL	YEAR	COLOUR	DISTANCE	PRICE	STATUS	TYPE	SUPPLIERID
1	FJ502JSD03LEH216	Toyota	Camry	2020	White	45000	6500	Sold	G	S01
2	TR839KDL92MNB45	Tesla	Model 3	2022	Black	12000	14000	Sold	E	S01
3	AB123CD45EFG678	Nissan	Altima	2019	Silver	60000	5500	Sold	G	S04
4	LM456OP98QWE12	Hyundai	Elantra	2020	Red	50000	6200	Sold	G	S06

3. Select employees (ID, name, date employed) who were hired before 2023:

```
SELECT EmpID, EmpName, DateEmployed FROM EMPLOYEE
WHERE DateEmployed < '01-JAN-2023';
```

	EMPID	EMPNAME	DATEEMPLOYED
1	E001	Sara	5/12/2021, 12:00:00
2	E003	Reem	6/30/2022, 12:00:00
3	E004	Khalid	9/1/2020, 12:00:00
4	E005	Aisha	2/15/2022, 12:00:00

4. Show employees and their monthly salary, ordered by highest salary:

```
SELECT EMPLOYEE.EmpID, EmpName, Salary
FROM EMPLOYEE
ORDER BY Salary DESC;
```

	EMPID	EMPNAME	SALARY
1	E004	Khalid	770
2	E001	Sara	750
3	E005	Aisha	680
4	E003	Reem	650
5	E002	Ahmed	600
6	E006	Hassan	580

5. Show Revenue by Car Type:

```
SELECT Type, SUM(SoldPrice) AS TotalRevenue
FROM CAR, PURCHASE
WHERE CAR.VIN=PURCHASE.VIN
GROUP BY Type;
```

	TYPE	TOTALREVENUE
1	G	17800
2	H	24700
3	E	13800

6. Show Customers, Number of Purchases, and Total Purchase Cost, ordered by the highest purchase cost:

```
SELECT CUSTOMER.CustomerID, CustName, COUNT(PurchaseID) AS NumberOfPurchases,
SUM(SoldPrice) AS TotalPurchaseCost
FROM CUSTOMER, PURCHASE
WHERE CUSTOMER.CustomerID = PURCHASE.CustomerID
GROUP BY CUSTOMER.CustomerID, CustName
ORDER BY SUM(SoldPrice) DESC;
```

	CUSTOMERID	CUSTNAME	NUMBEROFPURCHASES	TOTALPURCHASECOST
1	C105	Yusuf	1	17500
2	C101	Omar	1	13800
3	C102	Noor	1	7200
4	C100	Maryam	1	6300
5	C104	Fatma	1	6100
6	C103	Salim	1	5400

7. Select the car colours, order by colour with greatest number of cars:

```
SELECT Colour, COUNT(Colour) AS NumberOfCars
FROM CAR
GROUP BY Colour
ORDER BY COUNT(Colour) DESC;
```

	COLOUR	NUMBEROFCARS
1	Black	2
2	Red	1
3	Blue	1
4	White	1
5	Silver	1

8. Create a view of expensive cars, showing cars that cost more than 10000:

```
CREATE VIEW ExpensiveCars AS
SELECT VIN, Make, Model, Price, Status, Type
FROM CAR
WHERE Price > 10000;
```

	VIN	MAKE	MODEL	PRICE	STATUS	TYPE
1	TR839KDL92MNB4	Tesla	Model 3	14000	Sold	E
2	ZX987YU65TRE43210	BMW	X5	18000	Available	H

9. Create a view of loyal customers, who have bought more than one car or bought for a price of more than 15000:

```
CREATE VIEW LoyalCustomers AS
SELECT CUSTOMER.CustomerID, CustName, COUNT(PurchaseID) AS NumberOfPurchases,
SUM(SoldPrice) AS TotalPurchaseCost
FROM CUSTOMER, PURCHASE
WHERE CUSTOMER.CustomerID = PURCHASE.CustomerID
GROUP BY CUSTOMER.CustomerID, CustName
HAVING COUNT(PurchaseID) > 1 OR SUM(SoldPrice) > 15000;
```

	CUSTOMERID	CUSTNAME	NUMBEROFPURCHASES	TOTALPURCHASECOST
1	C105	Yusuf	1	17500

10. Select employees who have sold more than one car, ordered by employee ID in ascending order:

```
SELECT EMPLOYEE.EmpID, EmpName, COUNT(PurchaseID) AS NumberOfSoldCars
FROM EMPLOYEE, PURCHASE
WHERE EMPLOYEE.EmpID = PURCHASE.EmpID
GROUP BY EMPLOYEE.EmpID, EmpName
HAVING COUNT(PurchaseID) > 1
ORDER BY EMPLOYEE.EmpID;
```

	EMPID	EMPNAME	NUMBEROFSOLDCARS
1	E001	Sara	2

11. Show suppliers and the number of cars they have supplied:

```
SELECT SUPPLIER.SupplierID, TradingName, COUNT(CAR.VIN)
FROM CAR, SUPPLIER
WHERE SUPPLIER.SupplierID = CAR.SupplierID
GROUP BY SUPPLIER.SupplierID, TradingName;
```

	SUPPLIERID	TRADINGNAME	COUNT(CAR.VIN)
1	S01	AutoParts	2
2	S02	Gulf Cars	1
3	S04	Desert Motors	1
4	S05	Arabian Auto	1
5	S06	Elite Cars	1

12. Calculate the profit (SoldPrice - Price) of sold cars, showing the highest profit first:

```

SELECT CAR.VIN, SoldPrice, Price, SoldPrice - Price AS Profit
FROM CAR, PURCHASE
WHERE CAR.VIN=PURCHASE.VIN
ORDER BY SoldPrice - Price DESC;

```

	VIN	SOLDPRICE	PRICE	PROFIT
1	HY672PLQ45ZXC90	7200	6500	700
2	LM456OP98QWE123	6100	6200	-100
3	AB123CD45EFG6789	5400	5500	-100
4	FJ502JSD03LEH216	6300	6500	-200
5	TR839KDL92MNB456	13800	14000	-200
6	ZX987YU65TRE4321	17500	18000	-500

6. Summary and Conclusion

6.1 Database system benefits

This database system will be highly beneficial for the end user (RA Motors). The first benefit is data security, as SQL has built-in security features that help protect data from unauthorized access and sensitive data leakage (*Advantages and Disadvantages of SQL*, 2025). Furthermore, it ensures data integrity and consistency by enforcing constraints like primary keys and foreign keys, and data length and type. Lastly, the database acts as a centralized

storage location of all data, so it solves the initial problem of losing data when it was recorded manually on paper.

6.2 Limitations of the developed system

Despite its benefits, the developed database has some limitations. Firstly, there is the potential threat of SQP injection, an attack that consists of inserting (injecting) an SQL query via the input data from the client to the application. It can read sensitive data, modify database data, recover content, or issue commands to the operating system (Owasp, 2024). Another limitation is ruining the database performance when executing poorly written query commands, especially as the database gets bigger and more complex (Salmany, 2024).

6.3 Recommendations

After considering the nature of the business and the advantages and disadvantages of the new database system, a few recommendations are proposed:

1. **Integrate the database with a web-based or cloud-based application:** This will ensure users (employees) can access records from different locations which helps in convenience. It will also increase flexibility as the business continues to grow and open different branches.
2. **Implement automated features:** These include performance dashboards of employees and suppliers, most selling cars, and others. It helps monitor operations and look for areas of improvement to increase efficiency.
3. **Implement strong security features:** Since the database holds sensitive information about many different parties, it is crucial that data doesn't get leaked. This could be done through role-based access control and regular backups.

6.4 Your Experience

Developing this database was a great opportunity to practically apply the theoretical concepts that were taught in class in a real-life situation. It developed the team's skills in database design and SQL commands writing. It also taught us the importance of having accurate plans and business rules before the actual implementation and coding in order for the next stages of development to run smoothly. For example, the business rule that stated "Every car can be purchased once, and a purchase can only be made of a single car" meant that the car's

primary key (VIN) was a primary and foreign key in the Purchase table. If that wasn't planned and stated in the first part, changing rules later on can be complex and challenging.

7. Group Member Tasks

- Husn Al Maab: Introduction, Conceptual Design
- Aseel: Logical Design
- Raghad: Physical Design
- Al Kawthar: ERD Diagram, Queries, Summary and Conclusion

8. References

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Salmany, Nasim. "The Performance Impact of Writing Bad SQL Queries - Digma." *Digma*,

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