Project Report

Project Title: Car Rental System
Course Title: Database Management System Lab
Course Code: CSE 2424
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Submitted By:

Name: Nafija Rahman

Student ID: C233471

Instructor:
Ms. Mysha Sarin Kabisha
Assistant Lecturer
Department of Computer Science and Engineering
International Islamic University Chittagong

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1. Abstract

The Car Rental System is a database management project that helps automate the rental process of cars. The system aims to keep track of customers, available cars, reservations, and payments efficiently. By using Oracle 10g and a structured relational schema, this system ensures minimal redundancy and maximized data integrity. The project includes ERD modeling, normalization to BCNF, structured SQL implementation (DDL & DML), and relevant queries for operations and analysis.

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3. Introduction

3.1 Background

Car rental businesses require a structured and reliable way to manage rentals, customers, vehicle availability, and payments. Manual systems are prone to errors and inefficiencies. A database-backed system solves these challenges by enabling accurate and quick access to data.

3.2 Objective

- To manage customer, car, reservation, and rent records
- To ensure normalization and relational integrity
- To provide meaningful queries for data analysis
- To support UI-based query execution

3.3 Scope

Includes: customer records, car inventory, reservation system, and rent details.
Excludes: staff management, car servicing, advanced analytics.

4. Requirement Analysis

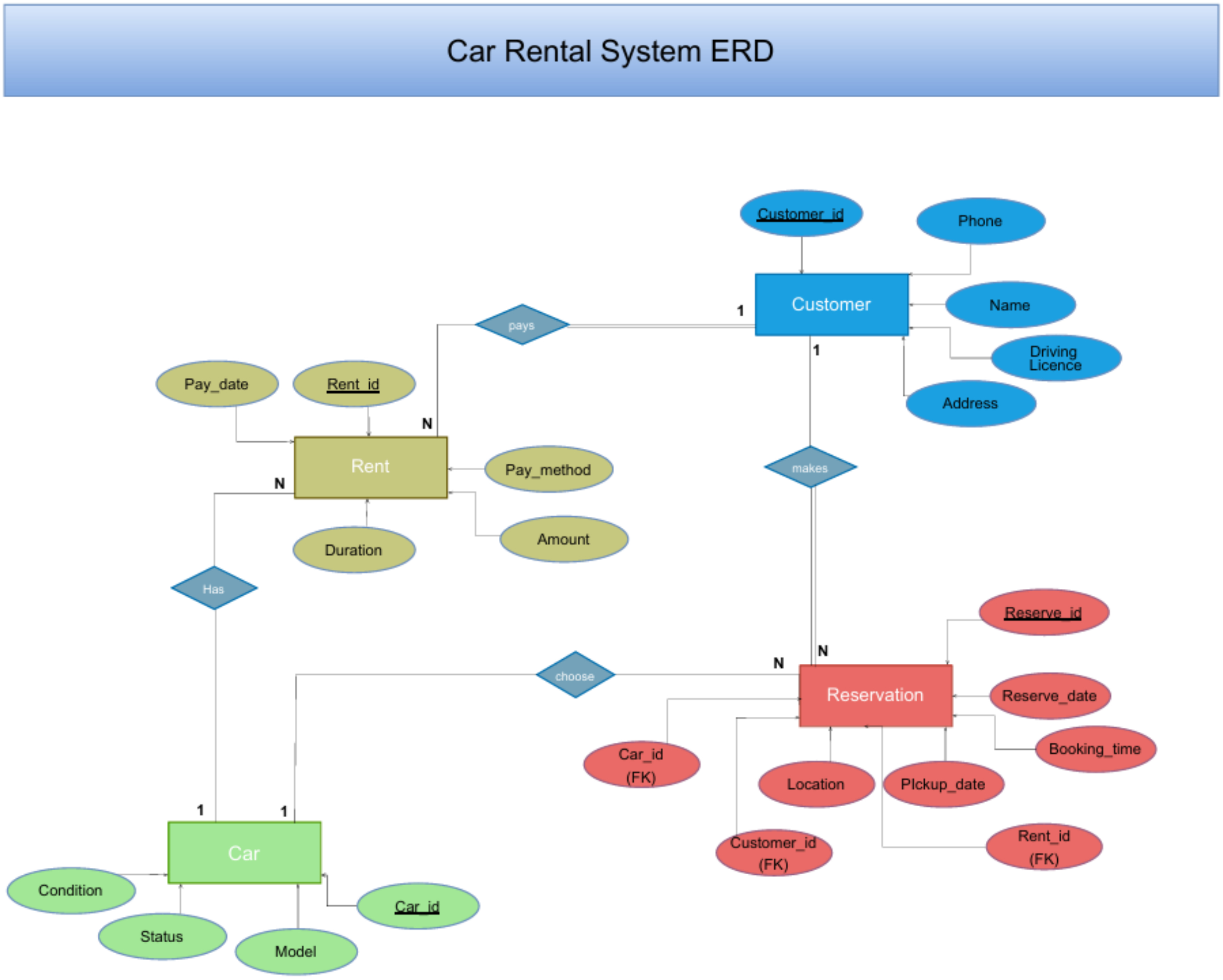
4.1 Functional Requirements

- Add/View/Edit customer, car, reservation, and rent data
- Track reservations and rent payments
- Query available cars, customer history, payment analysis

4.2 Non-Functional Requirements

- Easy-to-use interface (HTML + PHP optional)
- Data integrity via foreign key constraints
- Performance optimized through normalization

5. Conceptual Model (ERD)



Entities:

- Customer(customer_id, name, phone, address, driving_license)
- Car(car_id, model, status, condition)
- Rent(rent_id, pay_date, duration, pay_method, amount)
- Reservation(reserve_id, reserve_date, booking_time, pickup_date, location, customer_id, car_id, rent_id)

Relationships:

- One customer can make many reservations
- One car can be used in many reservations
- One rent per reservation

6. Normalization Process

Step 1: UNF to 1NF
Split repeating groups: one reservation per row.

Step 2: 1NF to 2NF
Move partial dependencies (e.g., rent amount depends on rent_id, not full row).

Step 3: 2NF to 3NF/BCNF
Remove transitive dependencies: all non-key attributes depend only on the primary key.

7. Final Relational Schema

Customer(customer_id, name, phone, address, driving_license)

- PK: customer_id

Car(car_id, model, status, condition)

- PK: car_id

Rent(rent_id, pay_date, duration, pay_method, amount)

- PK: rent_id

Reservation(reserve_id, reserve_date, booking_time, pickup_date, location, customer_id, car_id, rent_id)

- PK: reserve_id
- FK: customer_id → Customer
- FK: car_id → Car
- FK: rent_id → Rent

8. Table Creation and Sample Data

8.1 Table Structures (DDL)

Customer table

```
CREATE TABLE customer (

  customer_id    NUMBER PRIMARY KEY,

  name           VARCHAR2(100),
  phone           VARCHAR2(20),
  address         VARCHAR2(150),
  driving_license VARCHAR2(50)
);
```

Car table

```
CREATE TABLE car (
    car_id    NUMBER PRIMARY KEY,
    model     VARCHAR2(100),
    status    VARCHAR2(20),
    condition VARCHAR2(50)
);
```

Rent table

```
CREATE TABLE rent (
    rent_id    NUMBER PRIMARY KEY,
    pay_date   DATE,
    duration   NUMBER,
    pay_method VARCHAR2(30),
    amount     NUMBER );
```

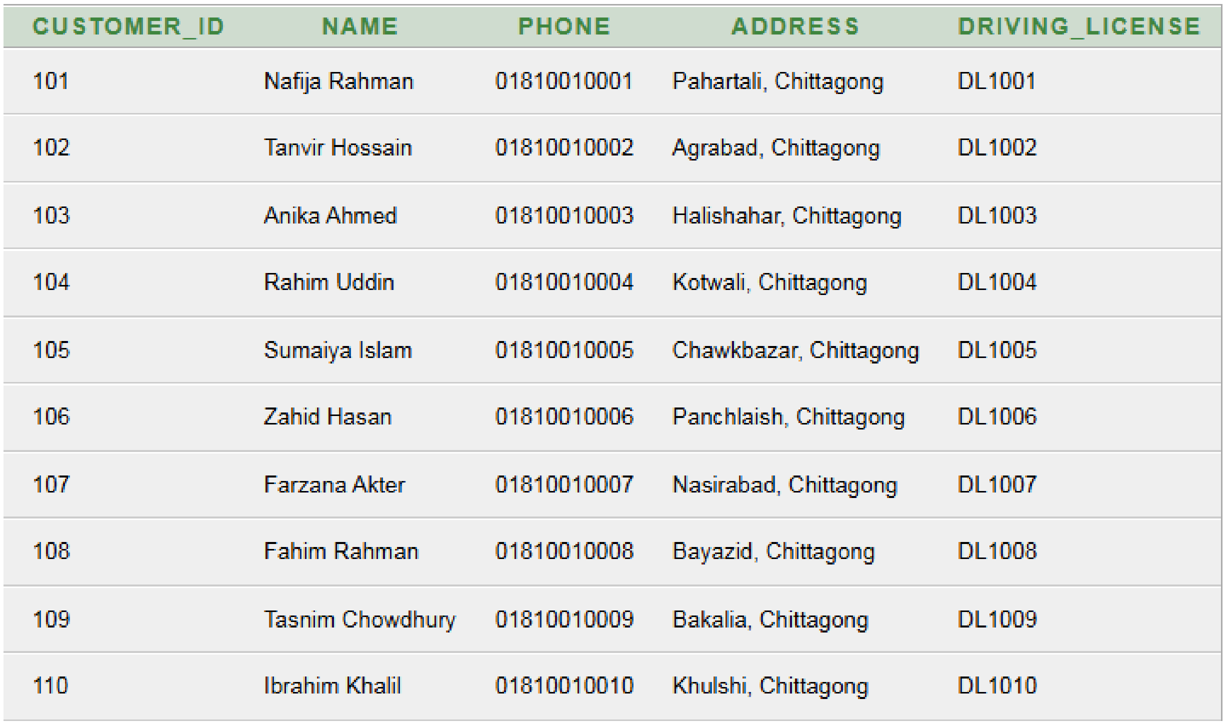
Reservation table

```
CREATE TABLE reservation (
    reserve_id    NUMBER PRIMARY KEY,
    reserve_date  DATE,
    booking_time  TIMESTAMP,
    pickup_date   DATE,
    location      VARCHAR2(100),
    customer_id   NUMBER,
    car_id        NUMBER,
    rent_id       NUMBER,
    CONSTRAINT fk_reservation_customer FOREIGN KEY (customer_id) REFERENCES customer(customer_id),
    CONSTRAINT fk_reservation_car FOREIGN KEY (car_id) REFERENCES car(car_id),
    CONSTRAINT fk_reservation_rent FOREIGN KEY (rent_id) REFERENCES rent(rent_id)
);
```

8.2 Sample Data (DML)

Customer Data

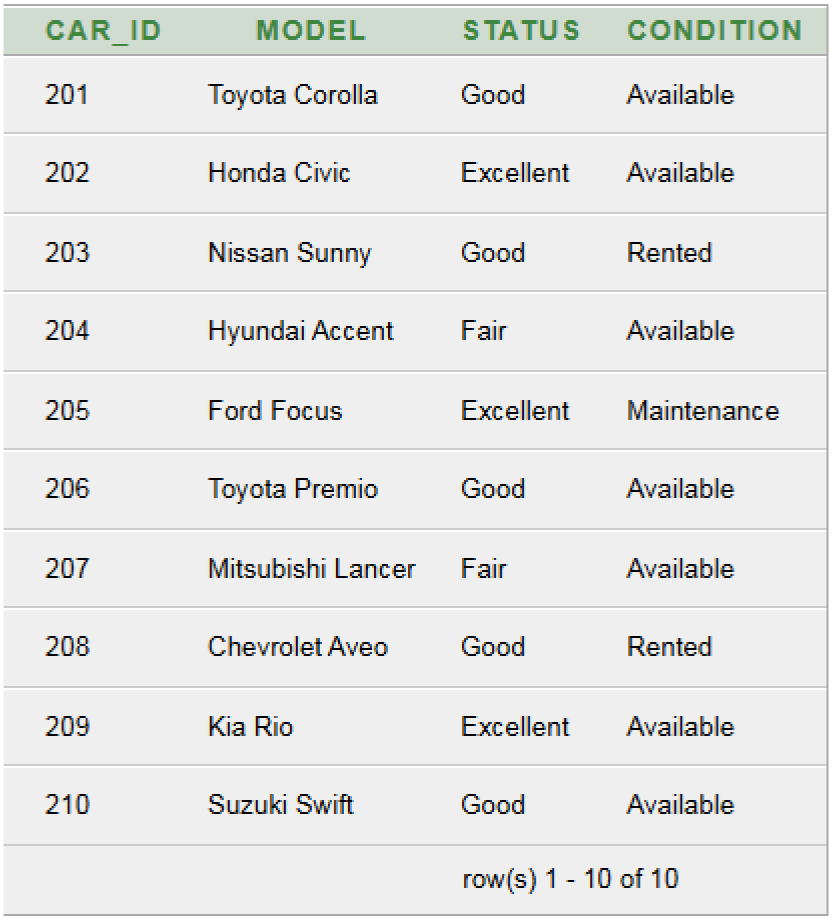
```
INSERT ALL
  INTO customer VALUES (101, 'Nafija Rahman', '01810010001', 'Pahartali, Chittagong', 'DL1001')
  INTO customer VALUES (102, 'Tanvir Hossain', '01810010002', 'Agrabad, Chittagong', 'DL1002')
  INTO customer VALUES (103, 'Anika Ahmed', '01810010003', 'Halishahar, Chittagong', 'DL1003')
  INTO customer VALUES (104, 'Rahim Uddin', '01810010004', 'Kotwali, Chittagong', 'DL1004')
  INTO customer VALUES (105, 'Sumaiya Islam', '01810010005', 'Chawkbazar, Chittagong', 'DL1005')
  INTO customer VALUES (106, 'Zahid Hasan', '01810010006', 'Panchlaish, Chittagong', 'DL1006')
  INTO customer VALUES (107, 'Farzana Akter', '01810010007', 'Nasirabad, Chittagong', 'DL1007')
  INTO customer VALUES (108, 'Fahim Rahman', '01810010008', 'Bayazid, Chittagong', 'DL1008')

  INTO customer VALUES (109, 'Tasnim Chowdhury', '01810010009', 'Bakalia, Chittagong', 'DL1009')

  INTO customer VALUES (110, 'Ibrahim Khalil', '01810010010', 'Khulshi, Chittagong', 'DL1010')

SELECT * FROM dual;
```



CUSTOMER_ID	NAME	PHONE	ADDRESS	DRIVING_LICENSE
101	Nafija Rahman	01810010001	Pahartali, Chittagong	DL1001
102	Tanvir Hossain	01810010002	Agrabad, Chittagong	DL1002
103	Anika Ahmed	01810010003	Halishahar, Chittagong	DL1003
104	Rahim Uddin	01810010004	Kotwali, Chittagong	DL1004
105	Sumaiya Islam	01810010005	Chawkbazar, Chittagong	DL1005
106	Zahid Hasan	01810010006	Panchlaish, Chittagong	DL1006
107	Farzana Akter	01810010007	Nasirabad, Chittagong	DL1007
108	Fahim Rahman	01810010008	Bayazid, Chittagong	DL1008
109	Tasnim Chowdhury	01810010009	Bakalia, Chittagong	DL1009
110	Ibrahim Khalil	01810010010	Khulshi, Chittagong	DL1010

Car Data

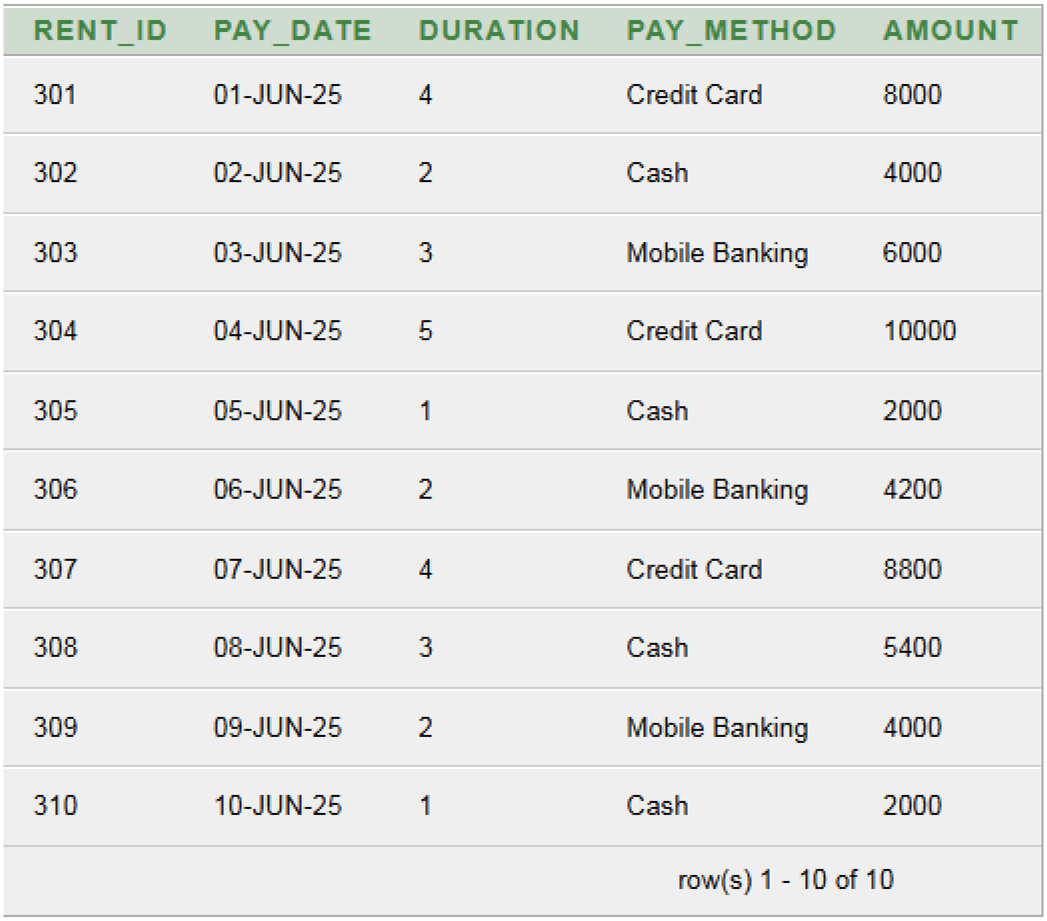
```
INSERT ALL

  INTO car VALUES (201, 'Toyota Corolla', 'Good', 'Available')

  INTO car VALUES (202, 'Honda Civic', 'Excellent', 'Available')

  INTO car VALUES (203, 'Nissan Sunny', 'Good', 'Rented')

  INTO car VALUES (204, 'Hyundai Accent', 'Fair', 'Available')

  INTO car VALUES (205, 'Ford Focus', 'Excellent', 'Maintenance')

  INTO car VALUES (206, 'Toyota Premio', 'Good', 'Available')

  INTO car VALUES (207, 'Mitsubishi Lancer', 'Fair', 'Available')
  INTO car VALUES (208, 'Chevrolet Aveo', 'Good', 'Rented')
  INTO car VALUES (209, 'Kia Rio', 'Excellent', 'Available')
  INTO car VALUES (210, 'Suzuki Swift', 'Good', 'Available')
SELECT * FROM dual;
```



CAR_ID	MODEL	STATUS	CONDITION
201	Toyota Corolla	Good	Available
202	Honda Civic	Excellent	Available
203	Nissan Sunny	Good	Rented
204	Hyundai Accent	Fair	Available
205	Ford Focus	Excellent	Maintenance
206	Toyota Premio	Good	Available
207	Mitsubishi Lancer	Fair	Available
208	Chevrolet Aveo	Good	Rented
209	Kia Rio	Excellent	Available
210	Suzuki Swift	Good	Available
		row(s) 1 - 10 of 10	

Rent Data

```
INSERT ALL
  INTO rent VALUES (301, TO_DATE('2025-06-01', 'YYYY-MM-DD'), 4, 'Credit Card', 8000)
  INTO rent VALUES (302, TO_DATE('2025-06-02', 'YYYY-MM-DD'), 2, 'Cash', 4000)
  INTO rent VALUES (303, TO_DATE('2025-06-03', 'YYYY-MM-DD'), 3, 'Mobile Banking', 6000)
  INTO rent VALUES (304, TO_DATE('2025-06-04', 'YYYY-MM-DD'), 5, 'Credit Card', 10000)
  INTO rent VALUES (305, TO_DATE('2025-06-05', 'YYYY-MM-DD'), 1, 'Cash', 2000)
  INTO rent VALUES (306, TO_DATE('2025-06-06', 'YYYY-MM-DD'), 2, 'Mobile Banking', 4200)
  INTO rent VALUES (307, TO_DATE('2025-06-07', 'YYYY-MM-DD'), 4, 'Credit Card', 8800)
  INTO rent VALUES (308, TO_DATE('2025-06-08', 'YYYY-MM-DD'), 3, 'Cash', 5400)
  INTO rent VALUES (309, TO_DATE('2025-06-09', 'YYYY-MM-DD'), 2, 'Mobile Banking', 4000)
  INTO rent VALUES (310, TO_DATE('2025-06-10', 'YYYY-MM-DD'), 1, 'Cash', 2000)
SELECT * FROM dual;
```

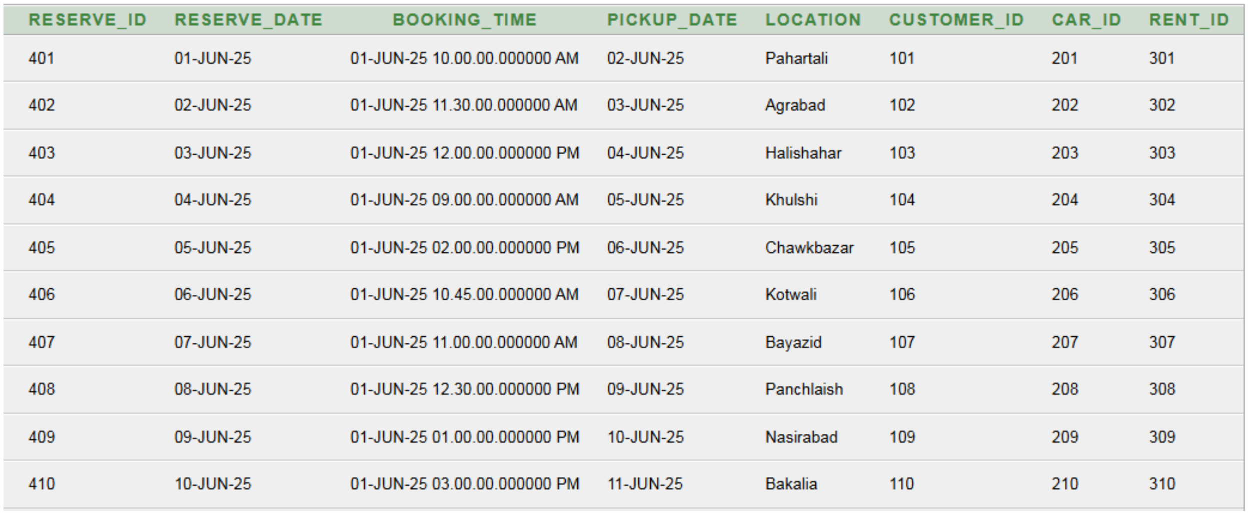


RENT_ID	PAY_DATE	DURATION	PAY_METHOD	AMOUNT
301	01-JUN-25	4	Credit Card	8000
302	02-JUN-25	2	Cash	4000
303	03-JUN-25	3	Mobile Banking	6000
304	04-JUN-25	5	Credit Card	10000
305	05-JUN-25	1	Cash	2000
306	06-JUN-25	2	Mobile Banking	4200
307	07-JUN-25	4	Credit Card	8800
308	08-JUN-25	3	Cash	5400
309	09-JUN-25	2	Mobile Banking	4000
310	10-JUN-25	1	Cash	2000

row(s) 1 - 10 of 10

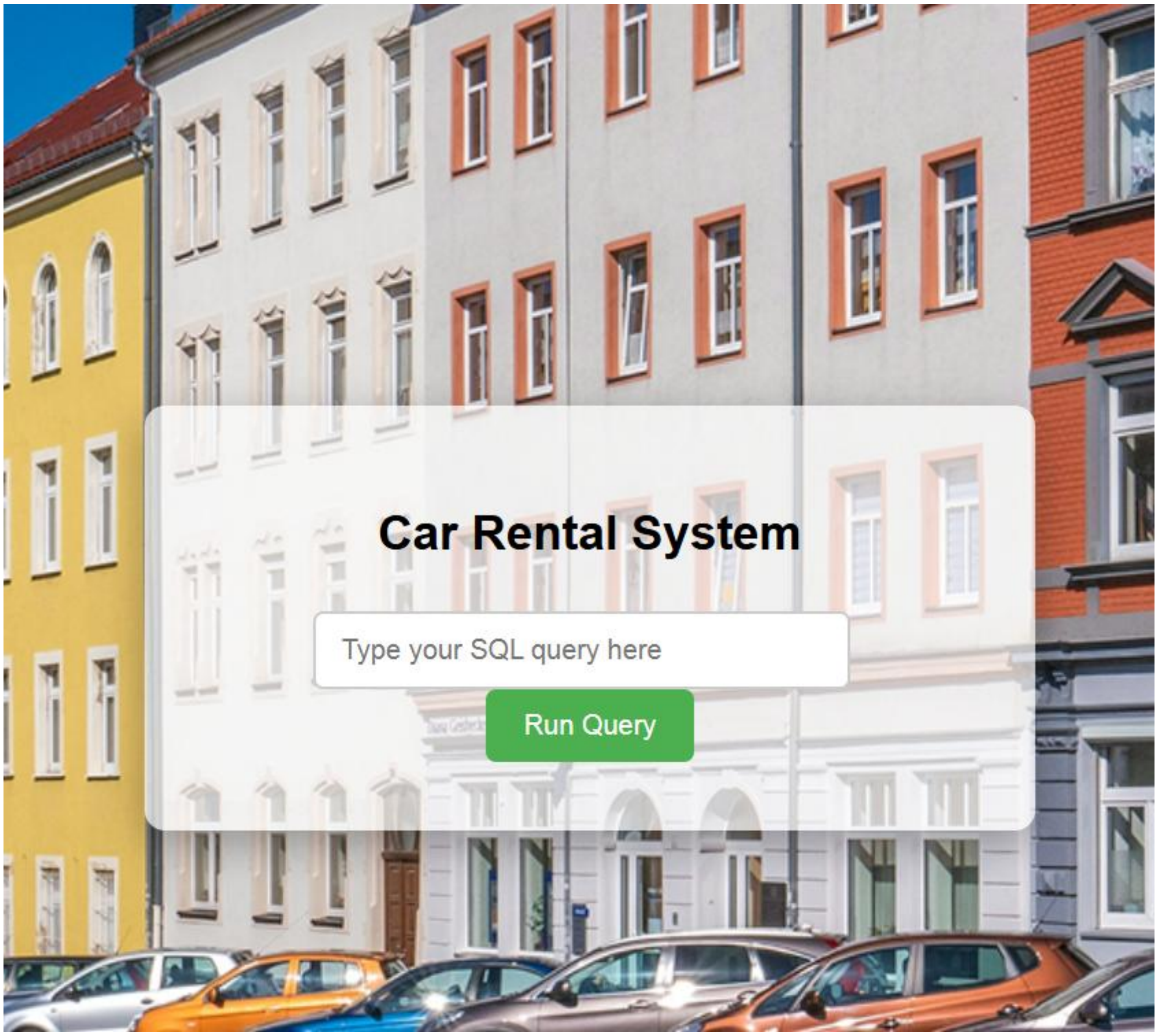
Reservation Data

```
INSERT ALL
  INTO rent VALUES (301, TO_DATE('2025-06-01', 'YYYY-MM-DD'), 4, 'Credit Card', 8000)
  INTO rent VALUES (302, TO_DATE('2025-06-02', 'YYYY-MM-DD'), 2, 'Cash', 4000)
  INTO rent VALUES (303, TO_DATE('2025-06-03', 'YYYY-MM-DD'), 3, 'Mobile Banking', 6000)

  INTO rent VALUES (304, TO_DATE('2025-06-04', 'YYYY-MM-DD'), 5, 'Credit Card', 10000)

  INTO rent VALUES (305, TO_DATE('2025-06-05', 'YYYY-MM-DD'), 1, 'Cash', 2000)

  INTO rent VALUES (306, TO_DATE('2025-06-06', 'YYYY-MM-DD'), 2, 'Mobile Banking', 4200)

  INTO rent VALUES (307, TO_DATE('2025-06-07', 'YYYY-MM-DD'), 4, 'Credit Card', 8800)

  INTO rent VALUES (308, TO_DATE('2025-06-08', 'YYYY-MM-DD'), 3, 'Cash', 5400)

  INTO rent VALUES (309, TO_DATE('2025-06-09', 'YYYY-MM-DD'), 2, 'Mobile Banking', 4000)

  INTO rent VALUES (310, TO_DATE('2025-06-10', 'YYYY-MM-DD'), 1, 'Cash', 2000)

SELECT * FROM dual;
```



RESERVE_ID	RESERVE_DATE	BOOKING_TIME	PICKUP_DATE	LOCATION	CUSTOMER_ID	CAR_ID	RENT_ID
401	01-JUN-25	01-JUN-25 10.00.00.000000 AM	02-JUN-25	Pahartali	101	201	301
402	02-JUN-25	01-JUN-25 11.30.00.000000 AM	03-JUN-25	Agrabad	102	202	302
403	03-JUN-25	01-JUN-25 12.00.00.000000 PM	04-JUN-25	Halishahar	103	203	303
404	04-JUN-25	01-JUN-25 09.00.00.000000 AM	05-JUN-25	Khulshi	104	204	304
405	05-JUN-25	01-JUN-25 02.00.00.000000 PM	06-JUN-25	Chawkbazar	105	205	305
406	06-JUN-25	01-JUN-25 10.45.00.000000 AM	07-JUN-25	Kotwali	106	206	306
407	07-JUN-25	01-JUN-25 11.00.00.000000 AM	08-JUN-25	Bayazid	107	207	307
408	08-JUN-25	01-JUN-25 12.30.00.000000 PM	09-JUN-25	Panchlaish	108	208	308
409	09-JUN-25	01-JUN-25 01.00.00.000000 PM	10-JUN-25	Nasirabad	109	209	309
410	10-JUN-25	01-JUN-25 03.00.00.000000 PM	11-JUN-25	Bakalia	110	210	310

9. User Interface Design

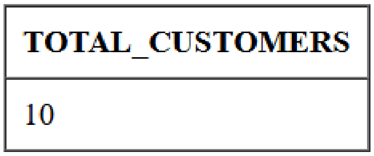


10. DML Queries

10.1 Single Table Queries

1.Total number of customers:

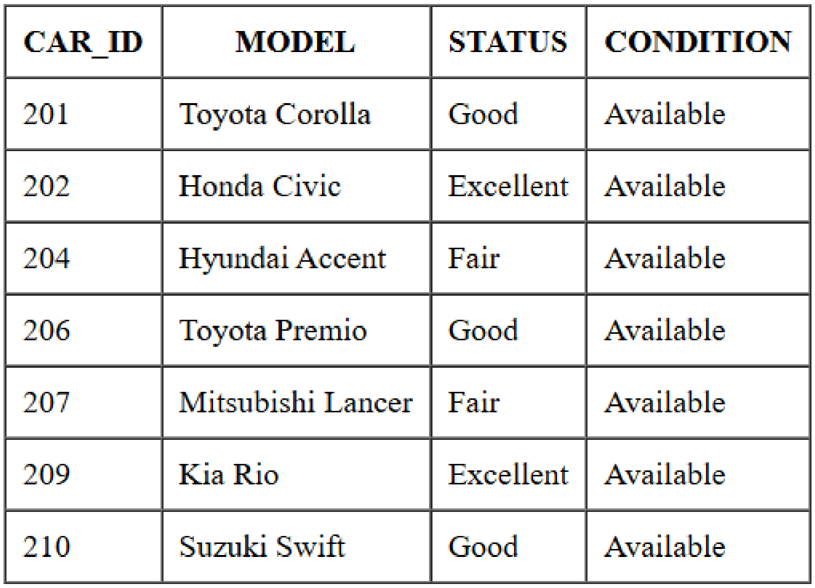
SELECT COUNT(*) AS total_customers FROM customer



TOTAL_CUSTOMERS
10

2.Find all cars that are currently available:

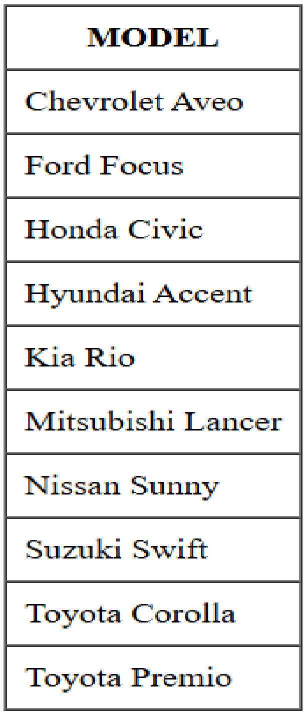
SELECT * FROM car WHERE condition = 'Available'



CAR_ID	MODEL	STATUS	CONDITION
201	Toyota Corolla	Good	Available
202	Honda Civic	Excellent	Available
204	Hyundai Accent	Fair	Available
206	Toyota Premio	Good	Available
207	Mitsubishi Lancer	Fair	Available
209	Kia Rio	Excellent	Available
210	Suzuki Swift	Good	Available

3.List all car models in ascending order:

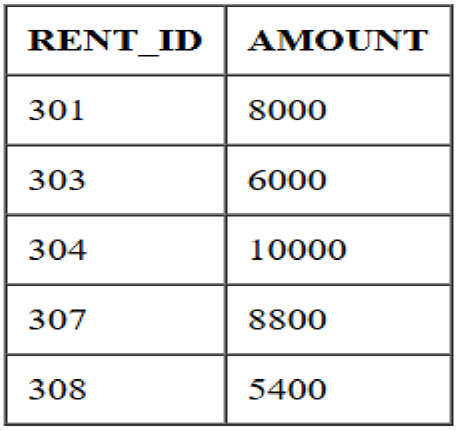
SELECT model FROM car ORDER BY model ASC



MODEL
Chevrolet Aveo
Ford Focus
Honda Civic
Hyundai Accent
Kia Rio
Mitsubishi Lancer
Nissan Sunny
Suzuki Swift
Toyota Corolla
Toyota Premio

4.Get rent records with amount more than 5000:

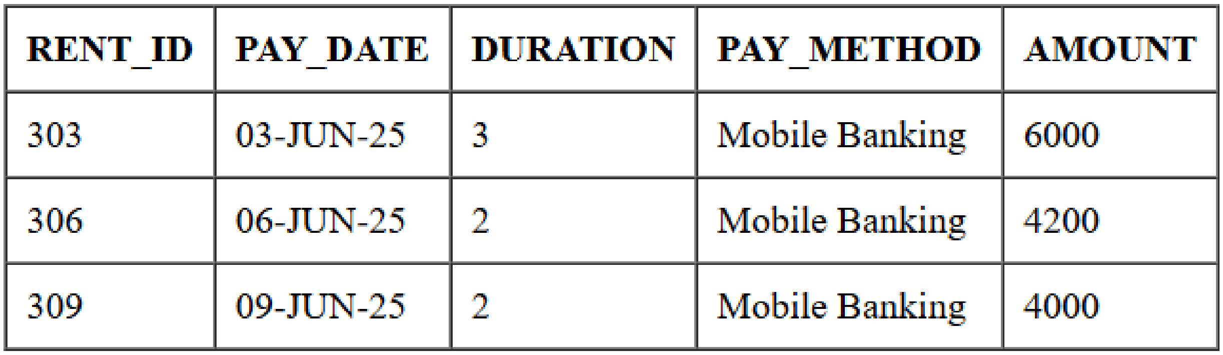
SELECT rent_id, amount FROM rent WHERE amount > 5000



RENT_ID	AMOUNT
301	8000
303	6000
304	10000
307	8800
308	5400

5.List all rents paid using Mobile Banking:

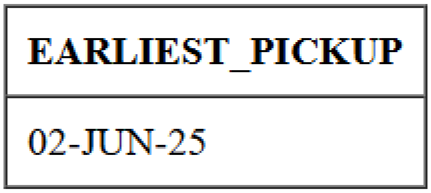
SELECT * FROM rent WHERE pay_method = 'Mobile Banking'



RENT_ID	PAY_DATE	DURATION	PAY_METHOD	AMOUNT
303	03-JUN-25	3	Mobile Banking	6000
306	06-JUN-25	2	Mobile Banking	4200
309	09-JUN-25	2	Mobile Banking	4000

6.Find the earliest pickup date:

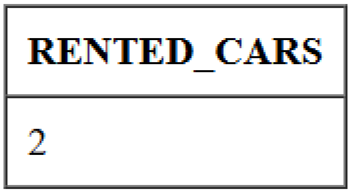
SELECT MIN(pickup_date) AS earliest_pickup FROM reservation



EARLIEST_PICKUP
02-JUN-25

7.Count number of cars currently rented:

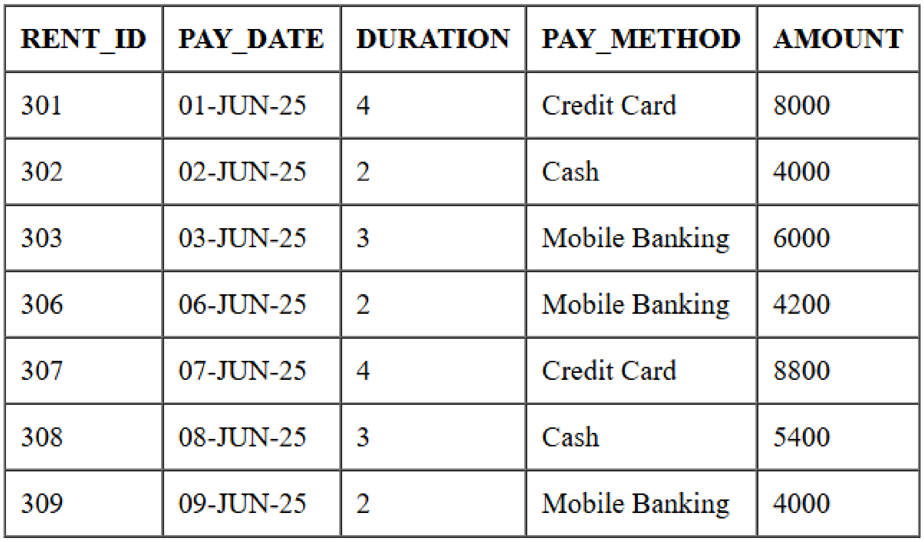
SELECT COUNT(*) AS rented_cars FROM car WHERE condition = 'Rented'



RENTED_CARS
2

8.Get all rent entries where duration is between 2 and 4 days:

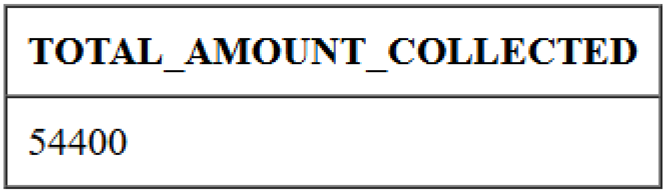
SELECT * FROM rent WHERE duration BETWEEN 2 AND 4



RENT_ID	PAY_DATE	DURATION	PAY_METHOD	AMOUNT
301	01-JUN-25	4	Credit Card	8000
302	02-JUN-25	2	Cash	4000
303	03-JUN-25	3	Mobile Banking	6000
306	06-JUN-25	2	Mobile Banking	4200
307	07-JUN-25	4	Credit Card	8800
308	08-JUN-25	3	Cash	5400
309	09-JUN-25	2	Mobile Banking	4000

9.Total rent amount collected:

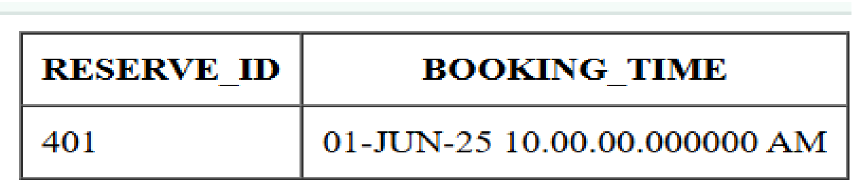
SELECT SUM(amount) AS total_amount_collected FROM rent



TOTAL_AMOUNT_COLLECTED
54400

10.Find reservations made exactly at 10:00 AM:

```
SELECT reserve_id, booking_time FROM reservation
WHERE TO_CHAR(booking_time, 'HH24:MI:SS') = '10:00:00'
```

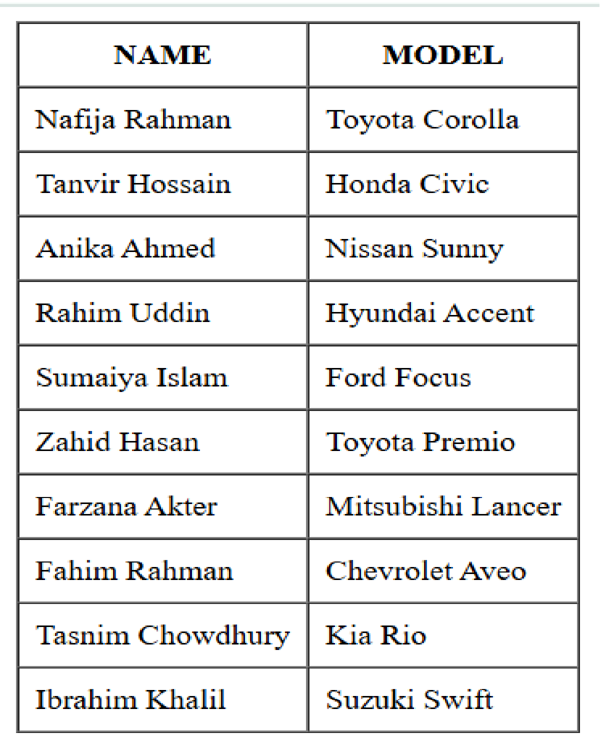


RESERVE_ID	BOOKING_TIME
401	01-JUN-25 10.00.00.000000 AM

10.2 Multi-Table JOIN Queries

1.List customer names and their reserved car models:

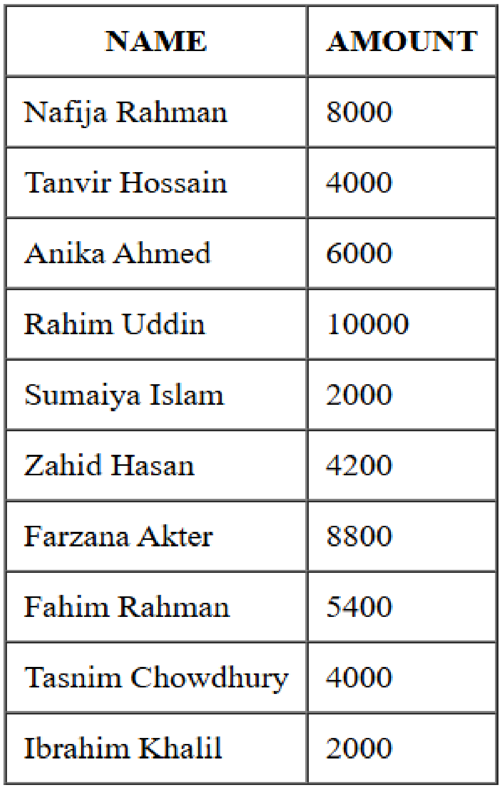
```
SELECT c.name, cr.model
FROM customer c
JOIN reservation r ON c.customer_id = r.customer_id
JOIN car cr ON r.car_id = cr.car_id
```



NAME	MODEL
Nafija Rahman	Toyota Corolla
Tanvir Hossain	Honda Civic
Anika Ahmed	Nissan Sunny
Rahim Uddin	Hyundai Accent
Sumaiya Islam	Ford Focus
Zahid Hasan	Toyota Premio
Farzana Akter	Mitsubishi Lancer
Fahim Rahman	Chevrolet Aveo
Tasnim Chowdhury	Kia Rio
Ibrahim Khalil	Suzuki Swift

2.List customer names and amount paid for each reservation:

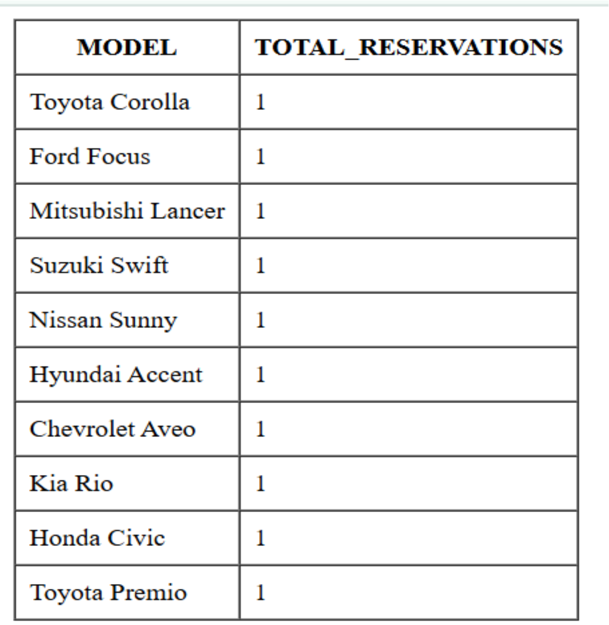
```
SELECT c.name, rt.amount

FROM customer c

JOIN reservation r ON c.customer_id = r.customer_id

JOIN rent rt ON r.rent_id = rt.rent_id
```



NAME	AMOUNT
Nafija Rahman	8000
Tanvir Hossain	4000
Anika Ahmed	6000
Rahim Uddin	10000
Sumaiya Islam	2000
Zahid Hasan	4200
Farzana Akter	8800
Fahim Rahman	5400
Tasnim Chowdhury	4000
Ibrahim Khalil	2000

3.Show car model and total number of times it has been reserved:

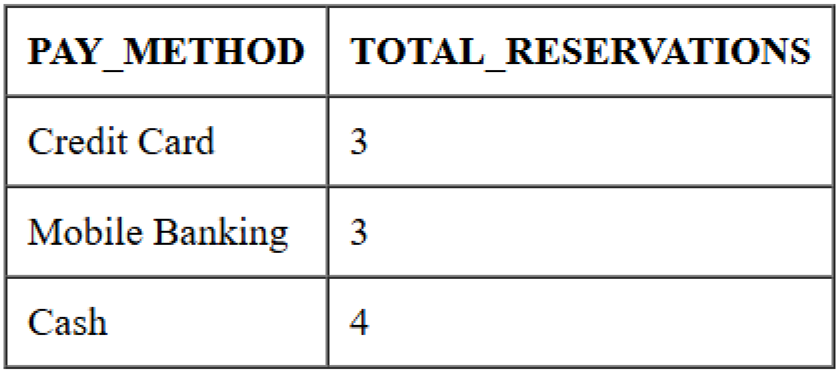
```
SELECT cr.model, COUNT(r.reserve_id) AS total_reservations

FROM car cr

JOIN reservation r ON cr.car_id = r.car_id

GROUP BY cr.model
```



MODEL	TOTAL_RESERVATIONS
Toyota Corolla	1
Ford Focus	1
Mitsubishi Lancer	1
Suzuki Swift	1
Nissan Sunny	1
Hyundai Accent	1
Chevrolet Aveo	1
Kia Rio	1
Honda Civic	1
Toyota Premio	1

4.Show total payment received per payment method:

```
SELECT rt.pay_method, COUNT(*) AS total_reservations

FROM rent rt

JOIN reservation r ON rt.rent_id = r.rent_id

GROUP BY rt.pay_method
```

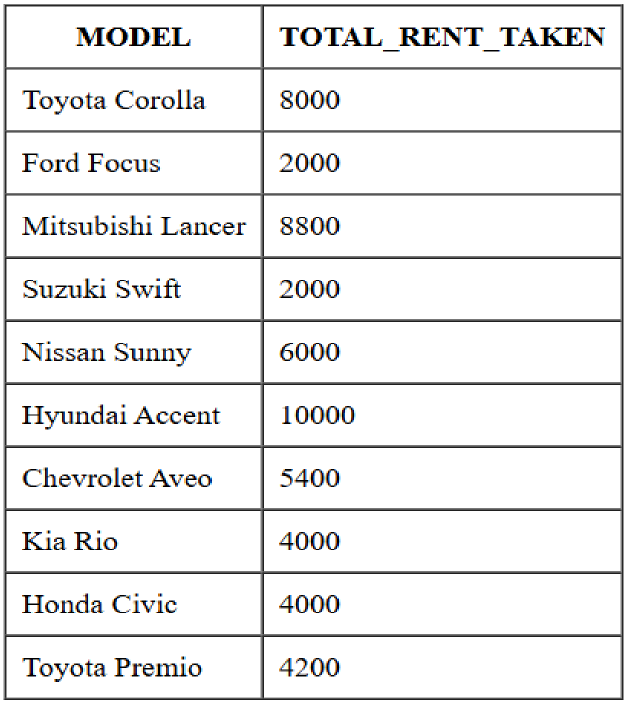


PAY_METHOD	TOTAL_RESERVATIONS
Credit Card	3
Mobile Banking	3
Cash	4

5.Show the total rent amount collected for each car model

```
SELECT c.model, SUM(rn.amount) AS total_rent_taken

FROM car c
```

```
JOIN reservation rs ON c.car_id = rs.car_id

JOIN rent rn ON rs.rent_id = rn.rent_id

GROUP BY c.model
```



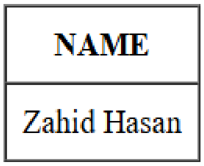
MODEL	TOTAL_RENT_TAKEN
Toyota Corolla	8000
Ford Focus	2000
Mitsubishi Lancer	8800
Suzuki Swift	2000
Nissan Sunny	6000
Hyundai Accent	10000
Chevrolet Aveo	5400
Kia Rio	4000
Honda Civic	4000
Toyota Premio	4200

10.3 Subqueries

Single-row Subquery

1.Get customer name who made reservation ID 406

```
SELECT name

FROM customer

WHERE customer_id = (

   SELECT customer_id

   FROM reservation

   WHERE reserve_id = 406

)
```

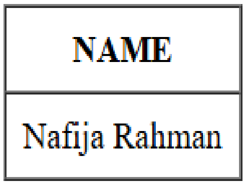


NAME
Zahid Hasan

Multi-row Subquery

2.Customers who reserved from 'Pahartali'

```
SELECT name
FROM customer
WHERE customer_id IN (
   SELECT customer_id
   FROM reservation
   WHERE location = 'Pahartali'
)
```

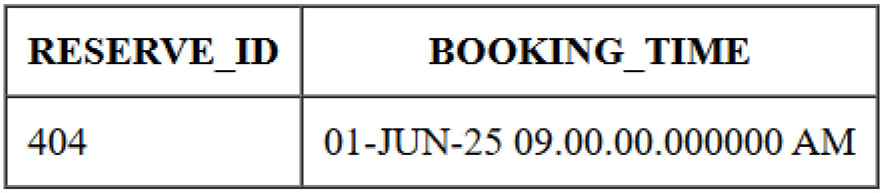


NAME
Nafija Rahman

Multi-column Subquery

3.Reservation info for cars reserved in 'Khulshi'

```
SELECT reserve_id, booking_time
FROM reservation
WHERE (car_id, customer_id) IN (
   SELECT car_id, customer_id
   FROM reservation
   WHERE location = 'Khulshi'
)
```

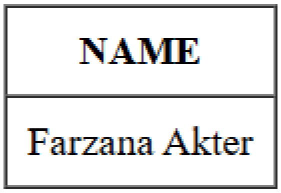


RESERVE_ID	BOOKING_TIME
404	01-JUN-25 09.00.00.000000 AM

Correlated Subquery

4.Customers who reserved from 'Bayazid'

```
SELECT name
FROM customer c
WHERE EXISTS (
   SELECT 1
   FROM reservation r
   WHERE r.customer_id = c.customer_id
   AND r.location = 'Bayazid'
)
```



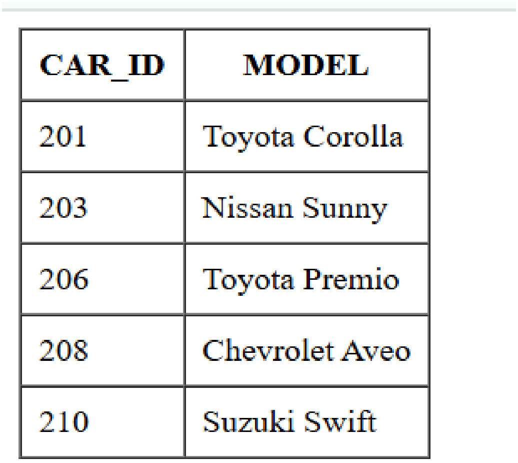
NAME
Farzana Akter

Inline View

5.List all cars that have 'Good' status

```
SELECT *
FROM (
   SELECT car_id, model
   FROM car
```

```
    WHERE status = 'Good'
) good_cars
```

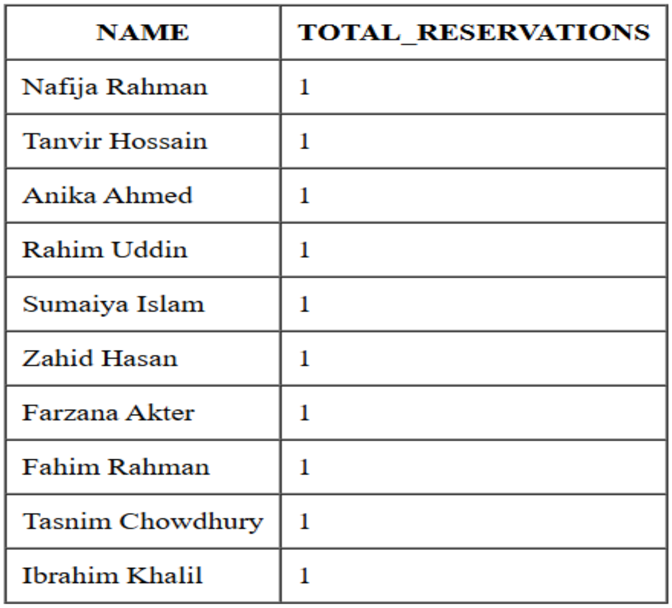


CAR_ID	MODEL
201	Toyota Corolla
203	Nissan Sunny
206	Toyota Premio
208	Chevrolet Aveo
210	Suzuki Swift

Scalar Subquery

6 Show total reservations per customer

```
SELECT name,
       (SELECT COUNT(*)
        FROM reservation r
        WHERE r.customer_id = c.customer_id) AS total_reservations
FROM customer c
```



NAME	TOTAL_RESERVATIONS
Nafija Rahman	1
Tanvir Hossain	1
Anika Ahmed	1
Rahim Uddin	1
Sumaiya Islam	1
Zahid Hasan	1
Farzana Akter	1
Fahim Rahman	1
Tasnim Chowdhury	1
Ibrahim Khalil	1

11. Challenges Faced

- Maintaining foreign key integrity during insertions
- Initial UI connectivity errors (PHP → Oracle setup)

12. Conclusion

The Car Rental System successfully demonstrates how a normalized relational database can simplify real-world operations. It ensures accurate customer tracking, rent summaries, and reservation history. The system is extendable for real-time

13. References

[1] A. Silberschatz, H. Korth, and S. Sudarshan, "Database System Concepts", 6th ed.
[2] Oracle 10g Documentation
[3] XAMPP for PHP and Apache: **https://www.apachefriends.org/**

[4] draw.io for ERD Design

14. Appendix