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Project Report: Pharmacy Management System

A Practical activity Report submitted for DATABASE MANAGEMENT SYSTEM

(UCS310) by

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Introduction

Pharmacies are essential component of healthcare in our country and handle the function of selling medical drugs. These provide direct patient care services that optimize the use of medication and promotes health, wellness, and disease prevention. Even though the pharmacies do not seem different than any other shop, their functioning is very different due to various laws regarding drugs.

For example, most of the drugs available in a pharmacy cannot be purchased without a prescription. Even with a signed prescription, there is a limit on the quantity that can be purchased. Additionally, pharmacist can do a background check on customer's medical history to ensure that they are not involved in drug abuse.

Thus, preparing a Database Management System for a pharmacy not only requires study of how things are handled from a customer or employee point of view but also the relevant laws. With this project, our aim was to develop a comprehensive system that could deal with challenges faced in day to day operation of a modern pharmacy. We studied the relevant laws and prepared a system that complies with the required Federal and State laws.

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Requirements

During research phase, we arrived at following requirements based on the pharmacy flow:

Customer

When a customer arrives in the pharmacy, we identify them based on their SSN. If they are a new customer, they are asked for their name, date of birth, phone number, gender and address. The address and date of birth are required to be recorded for drug control purposes.

Insurance

Approximately 514 million people across India were covered under health insurance schemes in 2021, which merely covers 37% of the people in the country. The major part of the population has limited access to quality medical services and health care professionals like doctors, specialists, nurses, etc. Around 74% of India's medical professionals are serving a mere 28% of the population.

Low funding is another factor that results in a lack of medical infrastructure in rural areas. Privatisation is so prominent in the healthcare sector that only one-fifth of healthcare is financed publicly. Health insurance premium collections saw a growth of 40% in 2020, during the pandemic.

As per the General Industry Council, health insurance was the most important sector under general insurance in the first wave of COVID-19 from April-September 2020.

If a customer has health insurance, we store the insurance ID (unique for each customer), company name, start date, end date and Co-Insurance. Co-Insurance is a percentage amount that insurance company pays for a medicinal purchase (Managing your healthcare costs, n.d.).

Given the customer SSN and insurance ID, the system should be able to automatically calculate the amount paid by insurance company and customer.

Employee

An employee has same details as a customer but they are also given a company ID, that is unique for them. An employee has to have one of the following roles:

1. Pharmacy Technician
2. Pharmacy Assistant
3. Pharmacy Consultant
4. Cashier
5. Pharmacy Manager
6. Analyst

Apart from cashier, all other roles require a license from State Pharmacy Councils which oversee the registration and regulation of pharmacists at the state level.

Prescription

Most of the drugs in the pharmacy can only be sold with a prescription. A prescription contains customer's SSN, the prescribing Doctor's ID (required by law) and when the prescription was prescribed.

Each prescription contains a number of prescribed drugs with drug name, quantity and refill limit of each of them. By law, a pharmacy cannot sell more than prescribed quantity or anything that is not listed on prescription.

Order

An order is created from the prescription. This data has to be stored separately because customer may:

1. Buy less medicine than prescription specifies
2. Come back for refills based on same prescription

Each order has a unique Order ID that is automatically assigned by the system. Each order can have multiple drugs, each with their ordered quantity and price. We also record batch number of the drug.

Bill

Once an order has been completed, a bill is generated by the system. This bill is handed over to the customer and contains order information, insurance information as well as breakdown of amount paid.

The breakdown should be automatically calculated by the system based on insurance, customer and medicine data.

Medicine (Inventory)

Drugs are divided into "over the counter", "restricted" and "prescription only".

While not needed by law everywhere, it is beneficial to store an up to date inventory for record keeping as well knowing when we run out of stock.

Laws Affecting Pharmacies

Since drugs are highly regulated, a system designed to manage a pharmacy has to follow all the required laws. The following are most important laws that we discovered during course of our research for the project:

1. Drugs and Cosmetics Act, 1940: The Drugs and Cosmetics Act, 1940, is the primary legislation governing pharmaceuticals in India. It regulates the import, manufacture, distribution, and sale of drugs and cosmetics. The Act provides provisions related to licensing, labelling, and quality control of pharmaceutical products.

2. Pharmacy Council of India (PCI) and State Pharmacy Councils: The Pharmacy Council of India (PCI) is a statutory body established under the Pharmacy Act, 1948. It regulates the education and practice of pharmacy in India. The PCI sets standards for pharmacy education and grants registration to qualified pharmacists. State Pharmacy Councils oversee the registration and regulation of pharmacists at the state level.

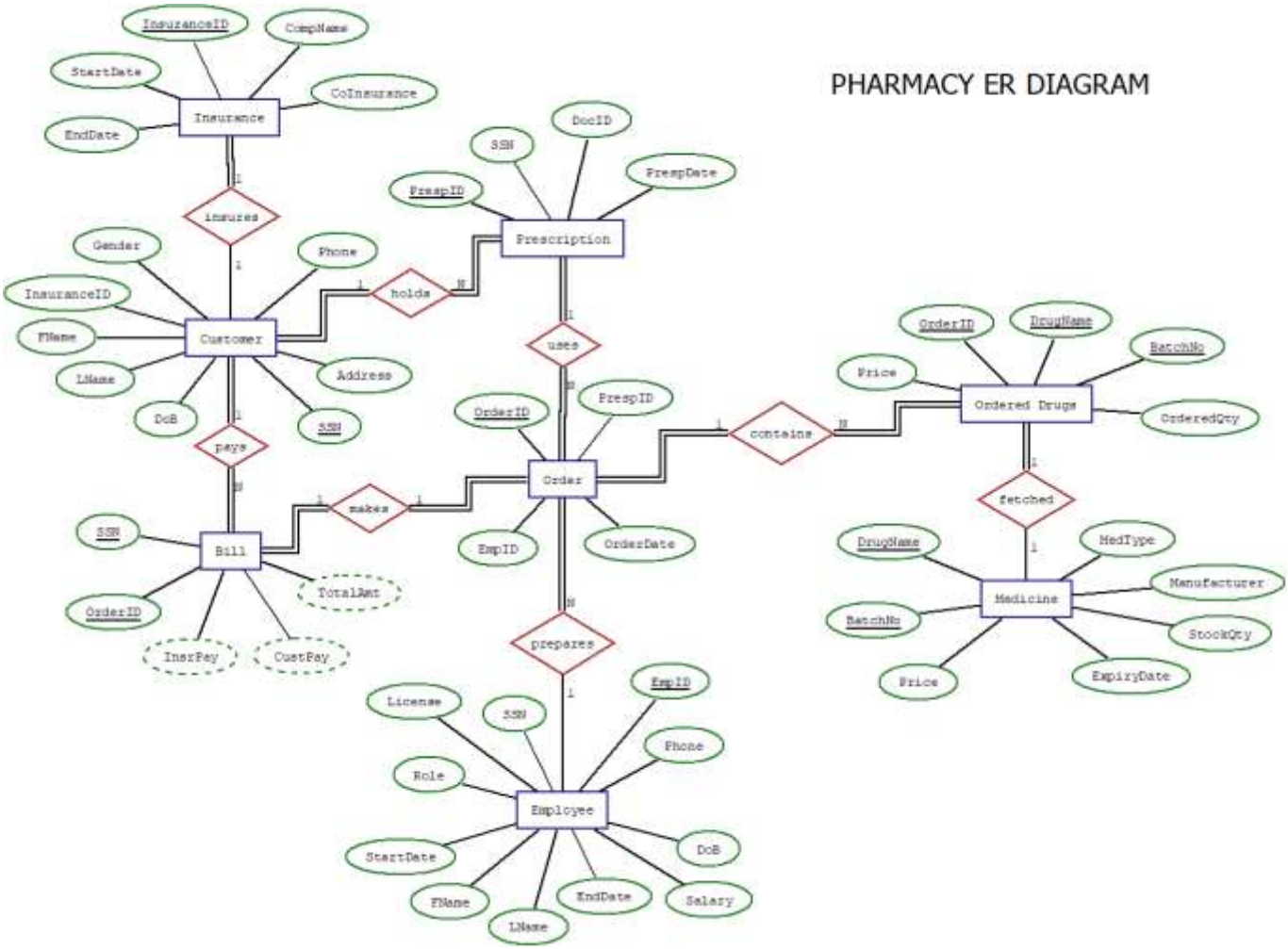
3. Schedule H and H1 Drugs: The Central Drugs Standard Control Organization (CDSCO) has classified certain drugs as Schedule H and Schedule H1 drugs. These drugs require a prescription from a registered medical practitioner and cannot be sold over the counter without a prescription. This classification aims to ensure the rational use of drugs and prevent their misuse.

4. Good Pharmacy Practice (GPP) Guidelines: The Pharmacy Practice Regulations, 2015, issued by the PCI, provide guidelines for Good Pharmacy Practice (GPP). These guidelines define the professional responsibilities of pharmacists, including dispensing prescriptions, patient counselling, record-keeping, and maintaining a pharmacy's physical infrastructure and facilities.

Pharmacy laws in India, including the recent regulations concerning e-pharmacies, are essential for ensuring the safe and ethical distribution of pharmaceutical products and services. The laws aim to protect patient health, maintain professional standards, and prevent the misuse of drugs. Compliance with these regulations by both traditional pharmacies and e-pharmacies is crucial to maintain public trust and ensure the availability of quality healthcare for all.

ER DIAGRAM

The final ER diagram is shown below with explanation:



1. A single customer can have multiple prescriptions. Thus, the relation between them is one to many.
2. A single customer can have only one insurance. Thus, the realationship between them is one to one.
3. A prescription consists of multiple drugs. In case of refills, a prescription can generate multiple orders. So, this relation is one to many as well.
4. A single order can contain multiple drugs, thus relationship is one to many.
5. One order, however, can generate only one bill. Thus, the relation between bill and order is one to one.
6. A customer can make multiple purchases and hence, the relation between customer and bill is one to many. This is due to the fact that every bill has only one customer.
7. In medicine table (stock), drug name and batch number can uniquely identify every drug we have in inventory. Batch number is assumed to be unique among manufacturers.
8. One employee can prepare multiple orders. However, a specific order can only be prepared by one employee. Thus, relationship is one to many.

Relations

The final relations are listed below:

Customers

SSN	First_Name	Last_Name	Phone	Gender	Address	Date_of_Birth	Insurance_ID

Primary Key: SSN

Foreign Key: Customers(Insurance_ID) → Insurance(Insurance_ID)

Insurance

Insurance_ID	Company_Name	Start_Date	End_Date	Co-Insurance

Primary Key: Insurance_ID

Employee

ID	SSN	License	First_Name	Last_Name	Start_Date	End_Date	Role
Salary	Phone_Number	Date_of_Birth					

Primary Key: ID

Prescription

Prescription_ID	SSN	Doctor_ID	Prescription_Date

Primary Key: Prescription_ID

Foreign Key: Prescription(SSN) → Customer(SSN)

Orders

Order_ID	Prescription_ID	EmployeeID	Order Date

Primary Key: Order_ID

Foreign Key: Orders(Prescription_ID) → Prescription(Prescription_ID), Orders(Employee_ID) → Employee(ID)

Ordered_Drugs

Order_ID	Drug_Name	Batch_Number	Quantity	Price

Primary Key: Order_ID, Drug Name, Batch Number

Foreign Key: Ordered_Drugs(Order_ID) → Orders(Order_ID), Ordered_Drugs(Drug_Name, Batch _Number) → Medicine(Drug_Name, Batch _Number)

Bill

Order ID	CustomerSSN	Total_Amount	Customer_Payment	Insurance_Payment

Primary Key: Order_ID, CustomerSSN
Foreign Key: Bill(Order_ID) → Orders(Order_ID), Bill(CustomerSSN) → Customers(SSN)

Medicine

Drug Name	Batch Number	Medicine_Type	Manufacturer	Stock_Quantity	Expiry_Date	Price

Primary Key: Drug_Name, Batch_Number →Medicine_Type, Manufacturer, Stock_Quantity, Expiry_Date, Price

Dependencies

The following dependencies exist in our schema:

1. Insurance(Insurance_ID, Company_Name, Start_Date, End_Date, Co-Insurance)
Insurance_ID → Company_Name, Start_Date, End_Date, Co-Insurance

2. Customers(SSN, First_Name, Last_Name, Phone, Gender, Address, Date_of_Birth, Insurance_ID)
SSN → First_Name, Last_Name, Phone, Gender, Address, Date_of_Birth, Insurance_ID

3. Prescription(Prescription_ID, SSN, Doctor_ID, Prescribed_Date)
Prescription ID → SSN, Doctor_ID, Prescribed_Date

4. Orders(Order_ID, Prescription_ID, Employee_ID, Order_Date)
Order_ID → Prescription_ID, Employee_ID, Order_Date

5. Ordered_Drugs(Order_ID, Drug_Name, Batch_Number, Ordered_Quantity, Price)
Order_ID, Drug_Name, Batch_Number→Ordered_Quantity, Price

6. Bill(Order_ID, CustomerSSN, Total_Amount, Customer_Payment, Insurance_Payment)
Order_ID, CustomerSSN → Total_Amount, Customer_Payment, Insurance_Payment

7. Employee(Employee_ID, SSN, First_Name, Last_Name, Start_Date, End_Date, Role, Salary, Phone_Number, Date_of_Birth)
Employee_ID→SSN, First_Name, Last_Name, Start_Date, End_Date, Role, Salary, Phone_Number, Date_of_Birth

8. Medicine(Drug_Name, Batch_Number, Medicine_Type, Manufacturer, Stock_Quantity, Expiry_Date, Price)
Drug_Name, Batch_Number → Medicine_Type, Manufacturer, Stock_Quantity, Expiry_Date, Price

Normalization

None of the above dependencies, except of the Customers table, violate 3NF rules, so above relations are in 3NF. The Customers table has a multivalued attribute, ‘Address’.

Table Creation

SQL commands for creating the tables in our database:

```
CREATE TABLE Customers (
    SSN                 NUMBER(10) NOT NULL,
    First_Name          VARCHAR2(255) NOT NULL,
    Last_Name           VARCHAR2(255) NOT NULL,
    Phone               NUMBER(10) NOT NULL UNIQUE,
    Gender              CHAR(1) NOT NULL,
    Address             VARCHAR2(1000) NOT NULL,
    Date_of_Birth       DATE NOT NULL,
    Insurance_ID        NUMBER(10) NOT NULL UNIQUE,
    PRIMARY KEY (SSN)
);
```

```
CREATE TABLE Prescription (
    Prescription_ID   number(10) NOT NULL,
    SSN               number(10) NOT NULL,
    Doctor_ID         number(10) NOT NULL,
    Prescribed_Date   date NOT NULL,

    PRIMARY KEY (Prescription_ID)
);
```

```
CREATE TABLE Orders (
    Order_ID          number(10) NOT NULL,
    Prescription_ID   number(10) NOT NULL,
    EmployeeID        number(5) NOT NULL,
    Order_Date        date NOT NULL,

    PRIMARY KEY (Order_ID)
);
```

```
CREATE TABLE Ordered_Drugs (
    Order_ID            number(10) NOT NULL,
    Drug_Name           char(255) NOT NULL,
    Batch_Number        number(10) NOT NULL,
    Ordered_Quantity    number(10) NOT NULL,
    Price               number(2) NOT NULL,

    PRIMARY KEY (Order_ID, Drug_Name, Batch_Number)
);
```

```
CREATE TABLE Insurance (
    Insurance_ID    number(10) NOT NULL,
    Company_Name    char(255) NOT NULL,
    Start_Date      date NOT NULL,
    End_Date        date NOT NULL,
    Co_Insurance    number(4) NOT NULL,

    PRIMARY KEY (Insurance_ID)
);
```

```
CREATE TABLE Employee (
    ID                number(5) NOT NULL,
    SSN               number(10) NOT NULL UNIQUE,
    License           number(10) UNIQUE,
    First_Name        char(255) NOT NULL,
    Last_Name         char(255) NOT NULL,
    Start_Date        date NOT NULL,
    End_Date          date,
    Role              char(255) NOT NULL,
    Salary            number(4) NOT NULL,
    Phone_Number      number(10) NOT NULL,
    Date_of_Birth     date NOT NULL,

    PRIMARY KEY (ID)
);
```

```
CREATE TABLE Medicine (
    Drug_Name           char(255) NOT NULL,
    Batch_Number        number(10) NOT NULL,
    MedicineType        char(255) NOT NULL,
    Manufacturer        char(255) NOT NULL,
    Stock_Quantity      number(10) NOT NULL,
    Expiry_Date         date NOT NULL,
    Price               number(4) NOT NULL,

    PRIMARY KEY (Drug_Name, Batch_Number)
);
```

```
CREATE TABLE Bill (
    Order_ID            number(10) NOT NULL,
    CustomerSSN         number(10) NOT NULL,
    Total_Amount        number(4) NOT NULL,
    Customer_Payment    number(4) NOT NULL,
    Insurance_Payment   number(4) NOT NULL,

    PRIMARY KEY (Order_ID, CustomerSSN)
);
```

```
ALTER TABLE Customers ADD CONSTRAINT insures FOREIGN KEY (Insurance_ID)
    REFERENCES Insurance (Insurance_ID) ON DELETE Set null;

ALTER TABLE Prescription ADD CONSTRAINT holds FOREIGN KEY (SSN)
    REFERENCES Customers (SSN);

ALTER TABLE Orders ADD CONSTRAINT prepares FOREIGN KEY (EmployeeID)
    REFERENCES Employee (ID);

ALTER TABLE Orders ADD CONSTRAINT uses FOREIGN KEY (Prescription_ID)
    REFERENCES Prescription (Prescription_ID);

ALTER TABLE Bill ADD CONSTRAINT makes FOREIGN KEY (Order_ID)
    REFERENCES Orders (Order_ID);

ALTER TABLE Bill ADD CONSTRAINT pays FOREIGN KEY (CustomerSSN)
    REFERENCES Customers (SSN);

ALTER TABLE Ordered_Drugs ADD CONSTRAINT contains FOREIGN KEY (Order_ID)
    REFERENCES Orders (Order_ID) ON DELETE Cascade;

ALTER TABLE Ordered_Drugs ADD CONSTRAINT Fulfilled FOREIGN KEY (Drug_Name, Batch_Number)
    REFERENCES Medicine (Drug_Name, Batch_Number);
```

Adding data to the tables:

```
select * from Customers;
```

Script Output | Query Result

SQL | All Rows Fetched: 10 in 0.002 seconds

	SSN	FIRST_NAME	LAST_NAME	PHONE	GENDER	ADDRESS	DATE_OF_BIRTH	INSURANCE_ID
1	123456789	John	Doe	1234567890	M	123 Main St, City, State, 12345	01-JAN-90	1
2	987654321	Jane	Doe	9876543210	F	456 Elm St, City, State, 54321	10-MAY-95	2
3	555555555	Bob	Smith	5555555555	M	789 Oak St, City, State, 67890	15-AUG-85	3
4	111111111	Alice	Johnson	1111111111	F	321 Pine St, City, State, 54321	20-APR-88	4
5	222222222	Michael	Brown	2222222222	M	654 Cedar St, City, State, 98765	12-OCT-76	5
6	333333333	Emily	Wilson	3333333333	F	987 Maple St, City, State, 23456	30-DEC-92	6
7	444444444	David	Martinez	4444444444	M	741 Birch St, City, State, 67890	05-JUL-80	7
8	666666666	Christopher	Taylor	6666666666	M	369 Oak St, City, State, 54321	15-SEP-91	9
9	777777777	Jessica	Lee	7777777777	F	963 Elm St, City, State, 87654	25-JUN-87	10
10	888888888	Jennifer	Anderson	4587963217	F	852 Walnut St, City, State, 12345	18-FEB-98	8

```
select * from Prescription;
```

Script Output | Query Result

SQL | All Rows Fetched: 10 in 0.003 seconds

	PRESCRIPTION_ID	SSN	DOCTOR_ID	PRESCRIBED_DATE
1	1	123456789	10001	01-MAY-24
2	2	987654321	10002	02-MAY-24
3	3	555555555	10003	03-MAY-24
4	4	111111111	10004	04-MAY-24
5	5	222222222	10005	05-MAY-24
6	6	333333333	10006	06-MAY-24
7	7	444444444	10007	07-MAY-24
8	8	555555555	10008	08-MAY-24
9	9	666666666	10009	09-MAY-24
10	10	777777777	10010	10-MAY-24

```
select * from Orders;
```

Script Output | Query Result

SQL | All Rows Fetched: 10 in 0.002 seconds

	ORDER_ID	PRESCRIPTION_ID	EMPLOYEEID	ORDER_DATE
1	10001	1	1	01-MAY-24
2	10002	2	2	02-MAY-24
3	10003	3	3	03-MAY-24
4	10004	4	4	04-MAY-24
5	10005	5	5	05-MAY-24
6	10006	6	6	06-MAY-24
7	10007	7	7	07-MAY-24
8	10008	8	8	08-MAY-24
9	10009	9	9	09-MAY-24
10	10010	10	10	10-MAY-24

```
select * from Ordered_Drugs;
```

Script Output | Query Result

SQL | All Rows Fetched: 10 in 0.003 seconds

	ORDER_ID	DRUG_NAME		BATCH_NUMBER	ORDERED_QUANTITY	PRICE
1	10001	Paracetamol	...	1001	50	10
2	10002	Amoxicillin	...	1002	30	15
3	10003	Lisinopril	...	1003	20	20
4	10004	Atorvastatin	...	1004	40	25
5	10005	Omeprazole	...	1005	25	18
6	10006	Aspirin	...	1006	60	12
7	10007	Metformin	...	1007	35	16
8	10008	Simvastatin	...	1008	45	22
9	10009	Losartan	...	1009	55	30
10	10010	Warfarin	...	1010	15	28

```
select * from Insurance;
```

Script Output | Query Result

SQL | All Rows Fetched: 10 in 0.004 seconds

	INSURANCE_ID	COMPANY_NAME		START_DATE	END_DATE	CO_INSURANCE
1	1	Insurance Company 1	...	01-JAN-23	01-JAN-24	20
2	2	Insurance Company 2	...	15-JUN-22	15-JUN-23	15
3	3	Insurance Company 3	...	10-MAR-23	10-MAR-24	25
4	4	Insurance Company 4	...	01-SEP-22	01-SEP-23	18
5	5	Insurance Company 5	...	20-JUL-22	20-JUL-23	22
6	6	Insurance Company 6	...	01-DEC-22	01-DEC-23	17
7	7	Insurance Company 7	...	15-MAY-23	15-MAY-24	21
8	8	Insurance Company 8	...	30-NOV-22	30-NOV-23	19
9	9	Insurance Company 9	...	28-FEB-23	28-FEB-24	23
10	10	Insurance Company 10	...	15-OCT-22	15-OCT-23	16

```
select * from Employee;
```

Script Output × Query Result ×

SQL | All Rows Fetched: 10 in 0.003 seconds

	ID	SSN	LICENSE	FIRST_NAME	LAST_NAME	START_DATE	END_DATE	ROLE	SALARY	PHONE_NUMBER	DATE_OF_BIRTH
1	1	1234567890	9876543210	John	Doe	01-JAN-24	(null)	Manager	5000	1234567890	01-JAN-90
2	2	2345678901	(null)	Jane	Smith	15-MAY-23	(null)	Assistant	3500	2345678901	15-MAY-95
3	3	3456789012	8765432109	Michael	Johnson	30-SEP-23	(null)	Technician	4000	3456789012	30-SEP-95
4	4	4567890123	(null)	Emily	Brown	20-JUL-23	(null)	Analyst	3800	4567890123	20-JUL-88
5	5	5678901234	7654321098	David	Martinez	10-MAR-22	(null)	Consultant	4200	5678901234	10-MAR-92
6	6	6789012345	(null)	Jessica	Lee	05-DEC-21	(null)	Assistant	3500	6789012345	05-DEC-83
7	7	7890123456	6543210987	Daniel	Garcia	28-FEB-20	(null)	Cashier	4500	7890123456	28-FEB-90
8	8	8901234567	(null)	Sarah	Wilson	12-NOV-20	(null)	Technician	3700	8901234567	12-NOV-94
9	9	9012345678	5432109876	Michelle	Lopez	25-APR-19	(null)	Analyst	4000	9012345678	25-APR-80
10	10	1234432112	(null)	Christophe...	Taylor	18-AUG-18	(null)	Cashier	5000	1234432112	18-AUG-98

```
select * from Medicine;
```

Script Output × Query Result ×

SQL | All Rows Fetched: 10 in 0.003 seconds

	DRUG_NAME	BATCH_NUMBER	MEDICINETYPE	MANUFACTURER	STOCK_QUANTITY	EXPIRY_DATE	PRICE
1	Paracetamol ...	1001	Over the counter ...	ABC Pharmaceuticals ...	500	31-DEC-25	10
2	Amoxicillin ...	1002	Prescription only ...	XYZ Pharma ...	300	31-OCT-25	15
3	Lisinopril ...	1003	Prescription only ...	PQR Pharmaceuticals ...	200	30-SEP-25	20
4	Atorvastatin ...	1004	Prescription only ...	LMN Pharma ...	400	30-NOV-25	25
5	Omeprazole ...	1005	Prescription only ...	RST Pharmaceuticals ...	250	31-AUG-25	18
6	Aspirin ...	1006	Over the counter ...	DEF Pharma ...	600	31-JUL-25	12
7	Metformin ...	1007	Prescription only ...	GHI Pharmaceuticals ...	350	30-JUN-25	16
8	Simvastatin ...	1008	Prescription only ...	JKL Pharma ...	450	31-MAY-25	22
9	Losartan ...	1009	Prescription only ...	MNO Pharmaceuticals ...	550	30-APR-25	30
10	Warfarin ...	1010	Restricted ...	STU Pharma ...	150	31-MAR-25	28

```
select * from Bill;
```

Script Output × Query Result ×

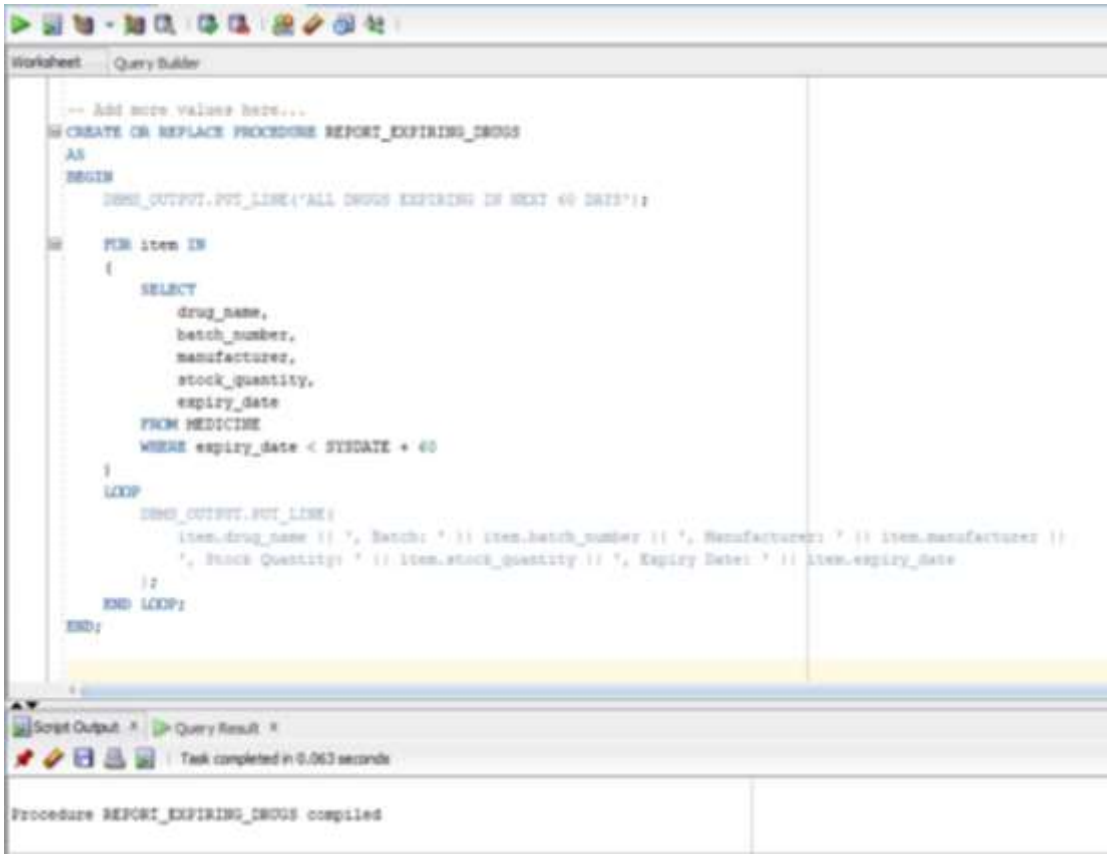
SQL | All Rows Fetched: 10 in 0.003 seconds

	ORDER_ID	CUSTOMERSSN	TOTAL_AMOUNT	CUSTOMER_PAYMENT	INSURANCE_PAYMENT
1	10001	123456789	100	90	10
2	10002	987654321	150	100	50
3	10003	555555555	200	150	50
4	10004	111111111	120	120	0
5	10005	222222222	180	100	80
6	10006	333333333	220	200	20
7	10007	444444444	250	200	50
8	10008	555555555	300	300	0
9	10009	666666666	180	180	0
10	10010	777777777	200	150	50

Procedures and cursors:

Report Expiring Drugs

Any drugs that are going to expire within 60 days are displayed on screen along with their quantity and batch number.

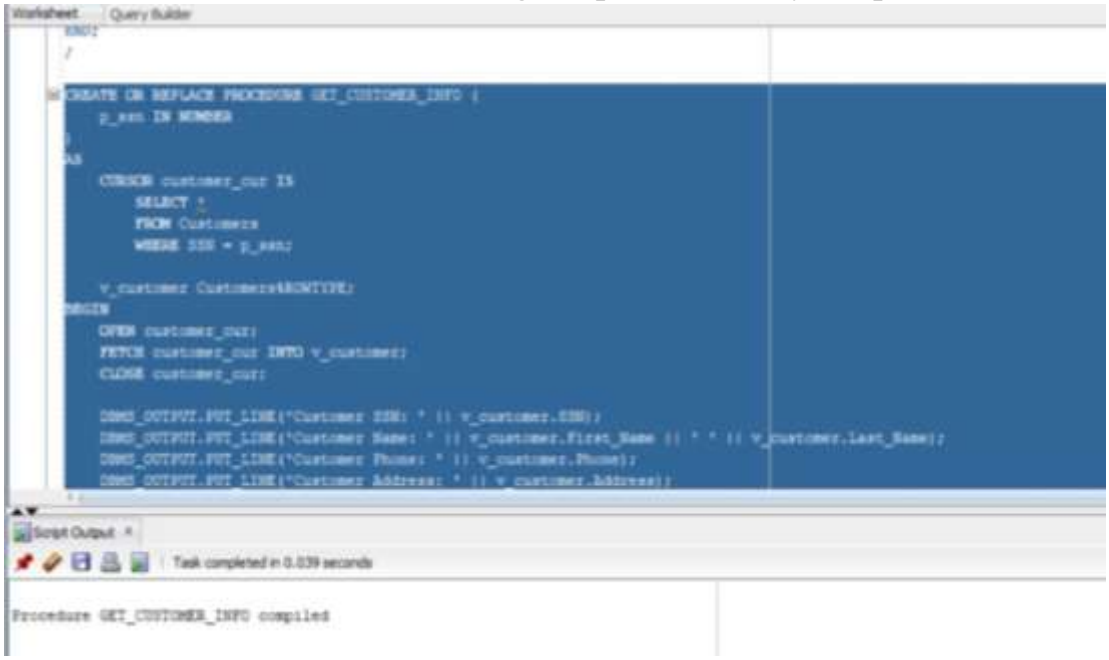


Retrieving customer's insurance details

Since a percentage of the bills are paid by the customer's insurance company, hence it is important to retrieve their insurance details.

Getting customer info

Customer info is to be stored in logs as per the law by the pharmacist.



Conclusion

The pharmacy project was a good learning experience for implementing a real world DBMS and helped us understand the nuances of a full implementation. The most interesting part was the experience of starting from real world and then translating the concepts into the terms of a DBMS. The final implementation is robust and can handle various edge cases and scenarios. Paired with a capable application front end, it can handle day to day operations for a pharmacy.

Citations and References

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