IT 310: Database Technology
Fall 2023
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IT310 Database Technology

Final Project Report

MedSyncPro

Business Profile

Our business is a medical practice named MedSyncPro. There are five different stakeholders or end users needed to run this practice which are doctors, nurses, receptionists, pharmacists, and patients. Medical doctors are responsible for patient care, and nurses are responsible for patient care support and administering treatments. Receptionists handle appointments, patient information, and billing. Pharmacists manage medication and prescriptions. Last but not least, patients are the user of the service and our source of data.

The following is a description of how the system functions. The patient record management, stores and updates patient information, medical history, and treatment plans. The appointment scheduling manages doctor's schedules and patient appointments. Billing and invoicing, generating and managing patient invoices and bill payments. The medication inventory control, tracks and offers medical supplies and medications. The medical record access control ensures that only authorized staff can access patient data. Reporting and analytics generate reports for business analysis and compliance.
As for our inspiration, we got this idea from a hackathon web app project completed by one of the team members, which was a web app for medical practitioners to see patient data in a visual format as the system matches the doctor's note with existing database data.

Entity Relationship Design

Assumptions

We have 6 entities and 8 relationships. The entities we chose are patient, doctor, appointment, patient record, medication, and billing. Each entity table has a unique and not null primary key. Appointment, patient record, medication, and billing are related through the integration of the two foreign keys, DoctorID and PatientID. Following is the description of the 8 relationships.

1. Appointment
    - Patient-Appointment Relationship: One-to-Many (PatientID in Patient linked to PatientID in Appointment). A patient can have one or many appointments but an appointment can have one and only one patient.

   - Doctor-Appointment Relationship: One-to-Many (DoctorID in Doctor linked to DoctorID in Appointment). A doctor can have one or multiple appointments but there can be one and only one doctor in an appointment.
2. Patient Record
   - Doctor-PatientRecord Relationship: One-to-Many (DoctorID in Doctor linked to DoctorID in Patient_Record). A doctor can be in one or multiple patient records but a patient record can have one and only one doctor at a time.
   - Patient-Patient_Record Relationship: One-to-Many(PatientID in Patient linked to PatientID in Patient_Record). A patient can have one or multiple records but a patient record can have one and only one patient.
3. Billing
   - Patient-Billing Relationship: One-to-Many (PatientID in Patient linked to PatientID in Billing). A patient may have no or many billing but a billing can have one and only one patient at a time.
   - Doctor-Billing Relationship: Many-to-Many (DoctorID in Doctor is linked to Doctor ID in Billing). A doctor can have no or multiple billing but a billing must have one or multiple doctors.
4. Medication
   - Patient-Medication Relationship: Many-to-Many (PatientID in Patient is linked to Patient ID in Medication). A patient may have no or multiple medications but a medication may be prescribed to no or multiple patients.
   - Doctor-Medication Relationship: Many-to-Many (DoctorID in Doctor is linked to DoctorID in Medication). A doctor may prescribe no or multiple medications but and a medication may be prescribed by no or multiple doctors.

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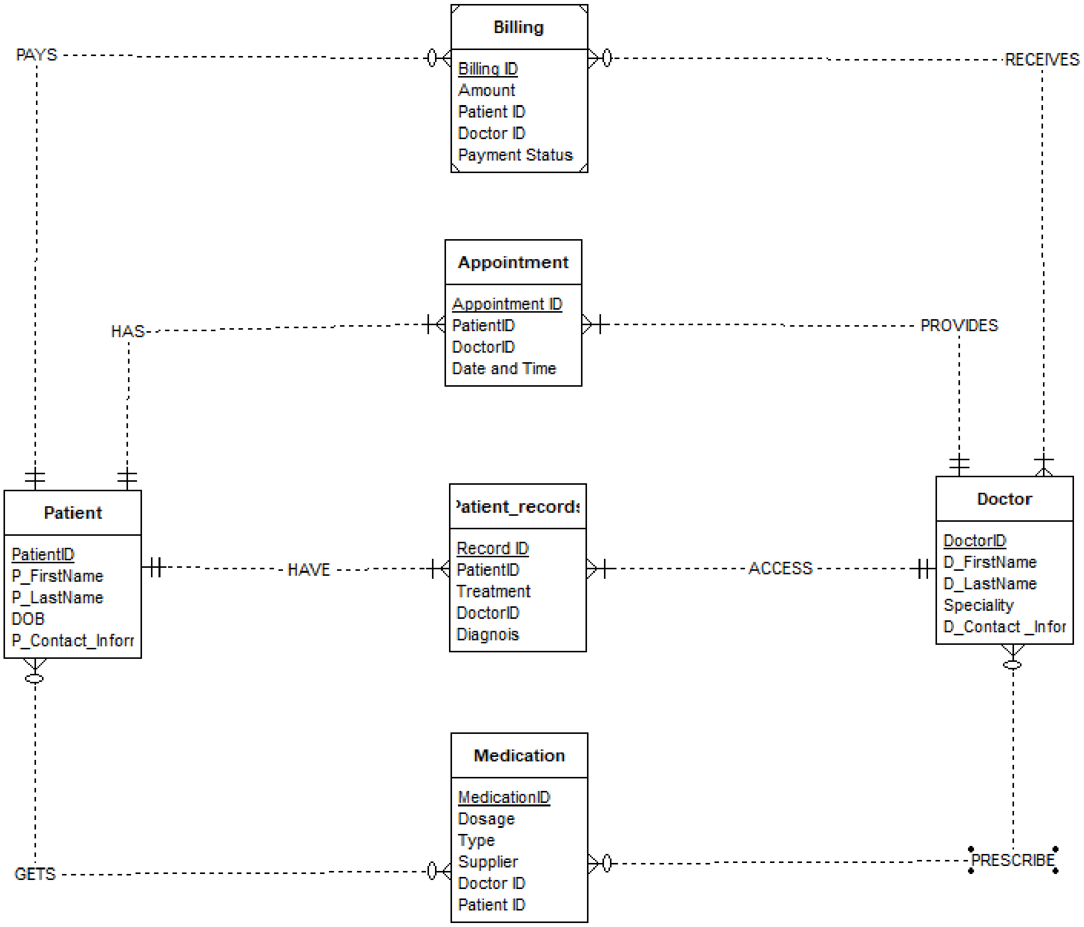


Relation Schema

When evaluating the data demonstrated through the E-R Diagram, it can be seen that the system has six entities. Therefore, the relation schema displays six tables. These tables are represented by the titles of Patient, Appointment, Patient_Record, Medication, Billing, and Doctor.

The Patient relation represents individuals with personal details. Patient has five attributes, PatientID, P_FirstName, P_LastName, DOB, P_ContactInformation. PatientID has been underlined in the schema, signifying its representation as the primary key for the Patient table.

The Appointment relation records scheduled appointments with links to patients and doctors. Appointment holds four attributes within the table, AppointmentID, PatientID, DoctorID, and DateandTime. The primary key is marked as AppointmentID; both PatientID and DoctorID are italicized in the schema showing that they are foreign keys that find themselves relating back to the Patient and Doctor tables.

The Patient_Record relation captures patient health data and is linked to patients and doctors. Patient_Record carries five attributes within the table with RecordID being the primary key. The other attributes consist of PatientID, DoctorID, Treatment, and Diagnosis. PatientID is italicized and recognized as a foreign key relating to the Patient table. DoctorID is italicized and recognized as a foreign key holding a relation to the Doctor table.

The Medication relation manages information on available medications. Medication encompasses six attributes consisting of MedicationID, PatientID, DoctorID, Dosage, Type, and Supplier. MedicationID is underlined and identified as the primary key. PatientID is italicized in the schema, as it is a foreign key in relation to the Patient table. DoctorID is also italicized due to its recognition as a foreign key relating to the Doctor table.

The Billing relation manages billing information connected to the patients. Billing consists of five attributes under the names of BillingID, PatientID, DoctorID, Amount, and Payment Status. BillingID is the primary key for this table therefore, it is underlined. Both PatientID and DoctorID are foreign keys relating to their alike tables; this is represented by their italicization.

The Doctor relation stores information about medical staff, including specialties. Doctor contains five attributes; DoctorID, D_FirstName, D_LastName, Specialty, and D_ContactInformation are their titles. DoctorID is underlined, labeling it as the primary key.

All relationships between foreign keys are shown in the relation schema diagram, represented through blue arrows.

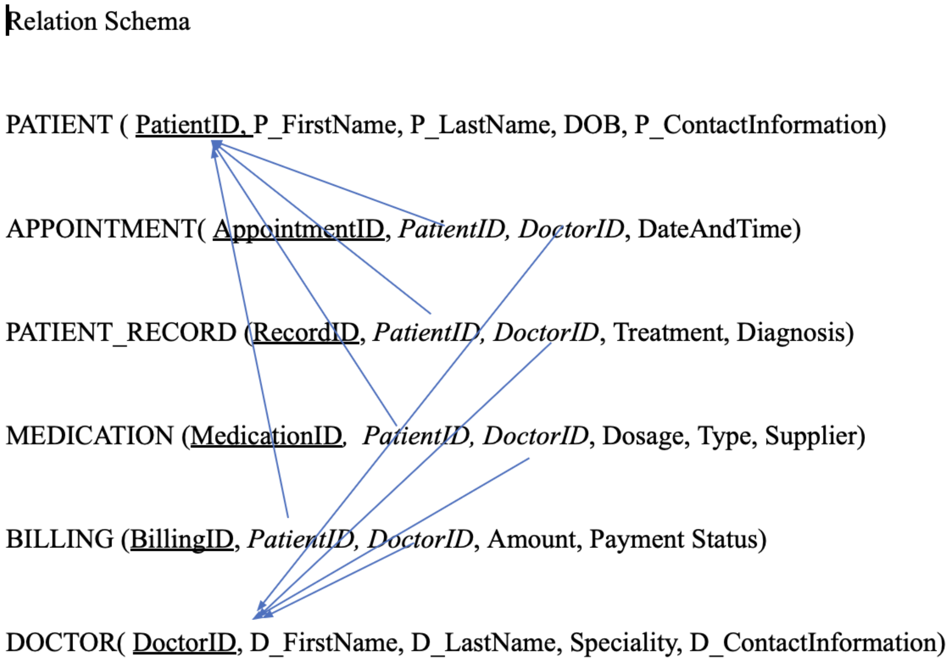
Determine your tables from the E-R Diagram. If needed (e.g., for m:n relationship), you may need to add new tables. Each table must be well-formed (in 3NF) and the relation schema must have the following elements:

i) The rationales to add new tables if necessary

ii) Mark the primary key for each table

iii) Mark the foreign key(s) for each table

iv) Mark all the relationships between the tables (arrows should point from foreign keys to their corresponding primary keys)



Relation Schema

PATIENT (PatientID, P_FirstName, P_LastName, DOB, P_ContactInformation)

APPOINTMENT(AppointmentID, *PatientID, DoctorID*, DateAndTime)

PATIENT_RECORD (RecordID, *PatientID, DoctorID*, Treatment, Diagnosis)

MEDICATION (MedicationID, *PatientID, DoctorID*, Dosage, Type, Supplier)

BILLING (BillingID, *PatientID, DoctorID*, Amount, Payment Status)

DOCTOR(DoctorID, D_FirstName, D_LastName, Speciality, D_ContactInformation)

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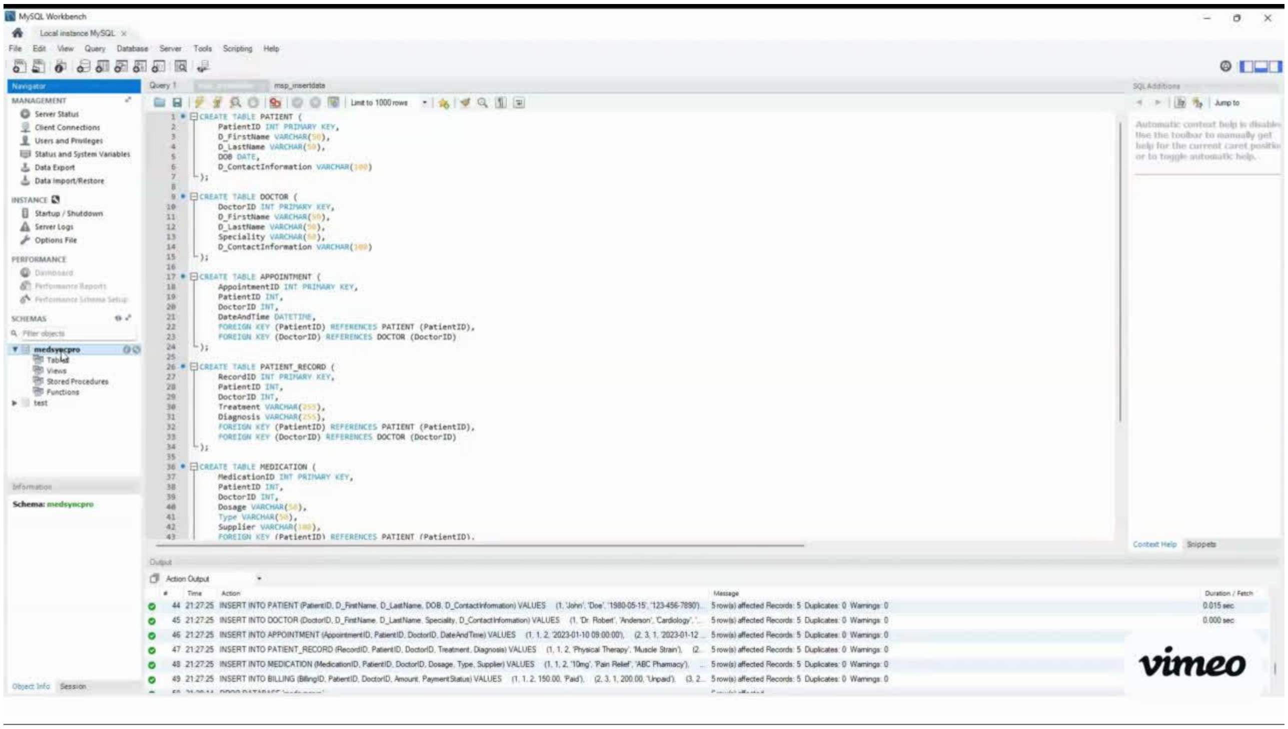
4. Actual Implementation: For further clarification, we have attached the files in our submission. But here is a screenshot of our database.



```sql
CREATE TABLE PATIENT (
    PatientID INT PRIMARY KEY,
    D_FirstName VARCHAR(50),
    D_LastName VARCHAR(50),
    DOB DATE,
    D_ContactInformation VARCHAR(100)
);

CREATE TABLE DOCTOR (
    DoctorID INT PRIMARY KEY,
    D_FirstName VARCHAR(50),
    D_LastName VARCHAR(50),
    Speciality VARCHAR(50),
    D_ContactInformation VARCHAR(100)
);

CREATE TABLE APPOINTMENT (
    AppointmentID INT PRIMARY KEY,
    PatientID INT,
    DoctorID INT,
    DateAndTime DATETIME,
    FOREIGN KEY (PatientID) REFERENCES PATIENT (PatientID),
    FOREIGN KEY (DoctorID) REFERENCES DOCTOR (DoctorID)
);

CREATE TABLE PATIENT_RECORD (
    RecordID INT PRIMARY KEY,
    PatientID INT,
    DoctorID INT,
    Treatment VARCHAR(255),
    Diagnosis VARCHAR(255),
    FOREIGN KEY (PatientID) REFERENCES PATIENT (PatientID),
    FOREIGN KEY (DoctorID) REFERENCES DOCTOR (DoctorID)
);

CREATE TABLE MEDICATION (
    MedicationID INT PRIMARY KEY,
    PatientID INT,
    DoctorID INT,
    Dosage VARCHAR(50),
    Type VARCHAR(50),
    Supplier VARCHAR(100),
    FOREIGN KEY (PatientID) REFERENCES PATIENT (PatientID),
```

```
#   Time      Action                                                                                                                                                    Message                                                          Duration / Fetch
44  21:27:25  INSERT INTO PATIENT (PatientID, D_FirstName, D_LastName, DOB, D_ContactInformation) VALUES   (1, 'John', 'Doe', '1980-05-15', '123-456-7890')...       5 row(s) affected Records: 5  Duplicates: 0  Warnings: 0   0.015 sec
45  21:27:25  INSERT INTO DOCTOR (DoctorID, D_FirstName, D_LastName, Speciality, D_ContactInformation) VALUES   (1, 'Dr. Robert', 'Anderson', 'Cardiology', '...  5 row(s) affected Records: 5  Duplicates: 0  Warnings: 0   0.000 sec
46  21:27:25  INSERT INTO APPOINTMENT (AppointmentID, PatientID, DoctorID, DateAndTime) VALUES   (1, 1, 2, '2023-01-10 09:00:00'),   (2, 3, 1, '2023-01-12 ...      5 row(s) affected Records: 5  Duplicates: 0  Warnings: 0
47  21:27:25  INSERT INTO PATIENT_RECORD (RecordID, PatientID, DoctorID, Treatment, Diagnosis) VALUES   (1, 1, 2, 'Physical Therapy', 'Muscle Strain'),   (2...     5 row(s) affected Records: 5  Duplicates: 0  Warnings: 0
48  21:27:25  INSERT INTO MEDICATION (MedicationID, PatientID, DoctorID, Dosage, Type, Supplier) VALUES   (1, 1, 2, '10mg', 'Pain Relief', 'ABC Pharmacy'),   ...   5 row(s) affected Records: 5  Duplicates: 0  Warnings: 0
49  21:27:25  INSERT INTO BILLING (BillingID, PatientID, DoctorID, Amount, PaymentStatus) VALUES   (1, 1, 2, 150.00, 'Paid'),   (2, 3, 1, 200.00, 'Unpaid'),   (3, 2...  5 row(s) affected Records: 5  Duplicates: 0  Warnings: 0
```

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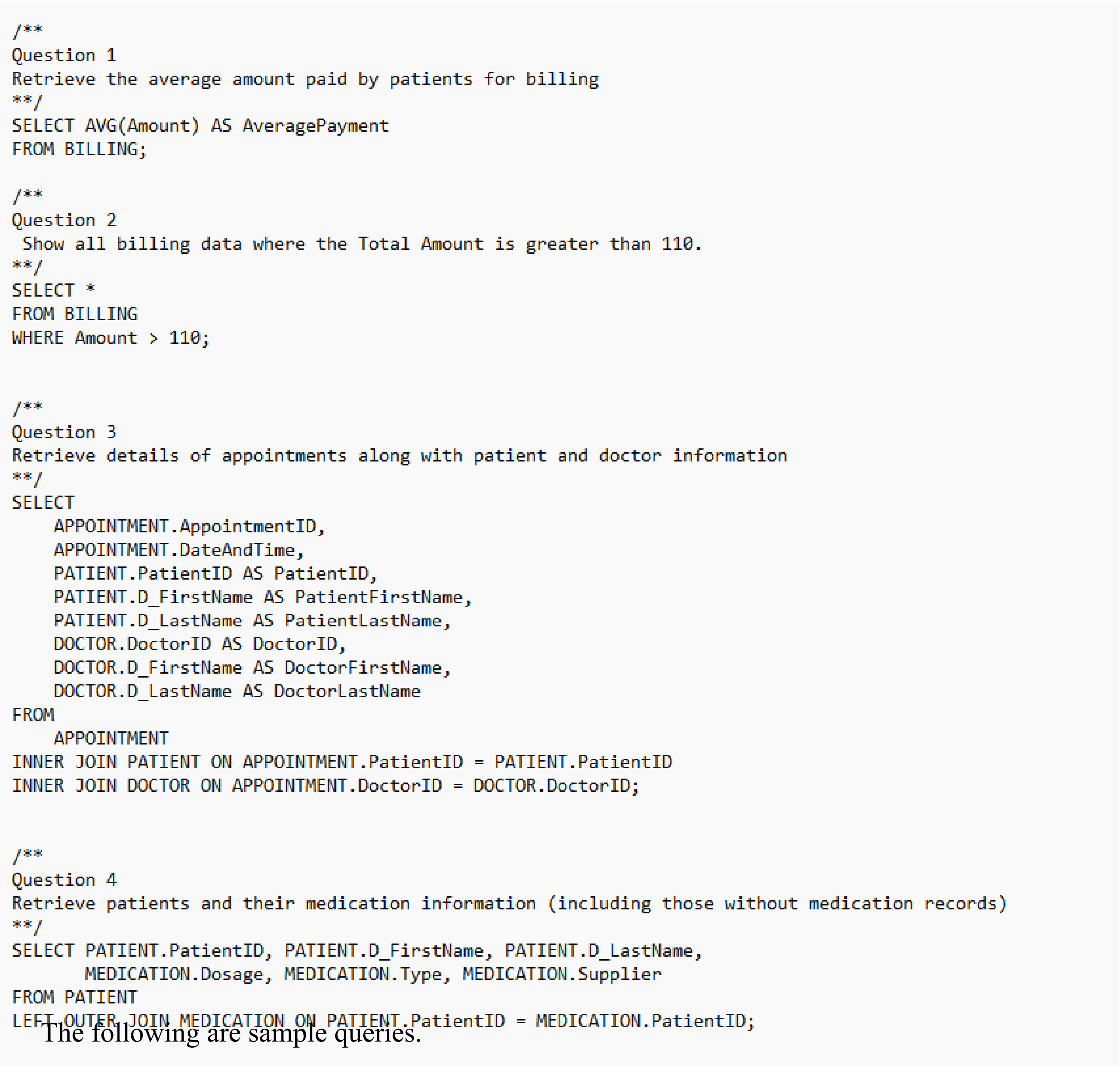
5. Sample SQL Queries:



```
/**
Question 1
Retrieve the average amount paid by patients for billing
**/
SELECT AVG(Amount) AS AveragePayment
FROM BILLING;

/**
Question 2
 Show all billing data where the Total Amount is greater than 110.
**/
SELECT *
FROM BILLING
WHERE Amount > 110;


/**
Question 3
Retrieve details of appointments along with patient and doctor information
**/
SELECT
    APPOINTMENT.AppointmentID,
    APPOINTMENT.DateAndTime,
    PATIENT.PatientID AS PatientID,
    PATIENT.D_FirstName AS PatientFirstName,
    PATIENT.D_LastName AS PatientLastName,
    DOCTOR.DoctorID AS DoctorID,
    DOCTOR.D_FirstName AS DoctorFirstName,
    DOCTOR.D_LastName AS DoctorLastName
FROM
    APPOINTMENT
INNER JOIN PATIENT ON APPOINTMENT.PatientID = PATIENT.PatientID
INNER JOIN DOCTOR ON APPOINTMENT.DoctorID = DOCTOR.DoctorID;


/**
Question 4
Retrieve patients and their medication information (including those without medication records)
**/
SELECT PATIENT.PatientID, PATIENT.D_FirstName, PATIENT.D_LastName,
       MEDICATION.Dosage, MEDICATION.Type, MEDICATION.Supplier
FROM PATIENT
LEFT OUTER JOIN MEDICATION ON PATIENT.PatientID = MEDICATION.PatientID;
```

The following are sample queries.

Following the implementation of the data and running the queries we came up with the following answers for each sample question.

Answer 1. The average amount paid by patients for billing is $115

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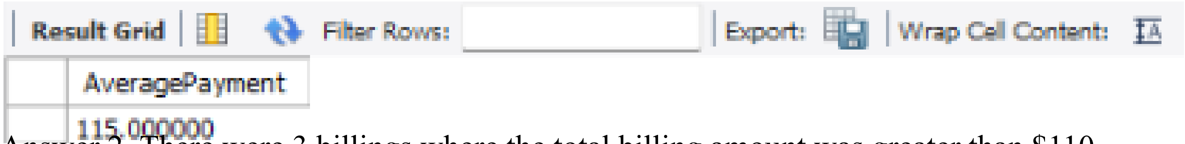
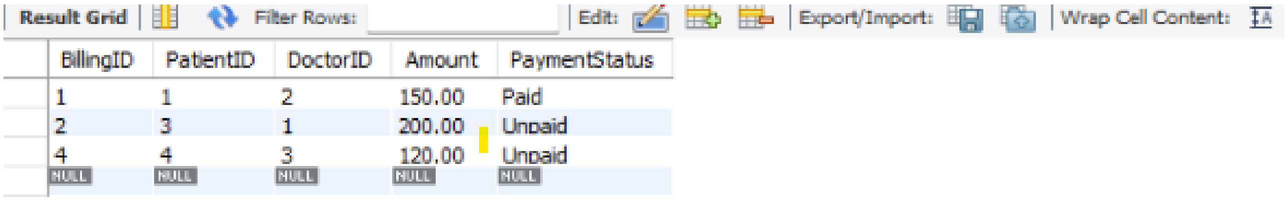


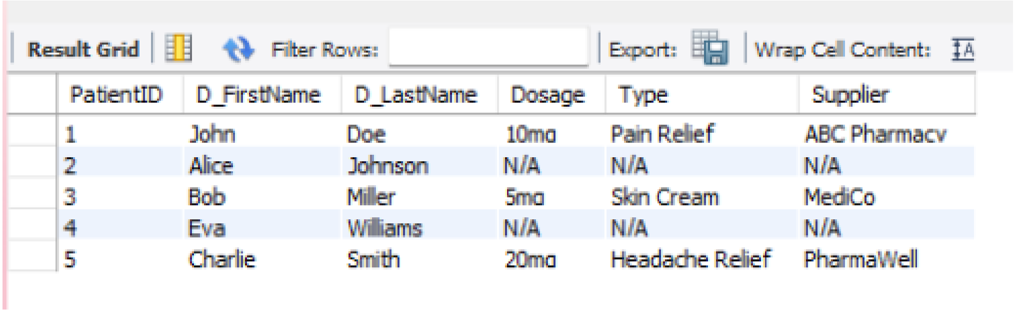
AveragePayment
115.000000

Answer 2. There were 3 billings where the total billing amount was greater than $110 which were Billing IDs 1 ($150), 2($200), and 4 ($120).



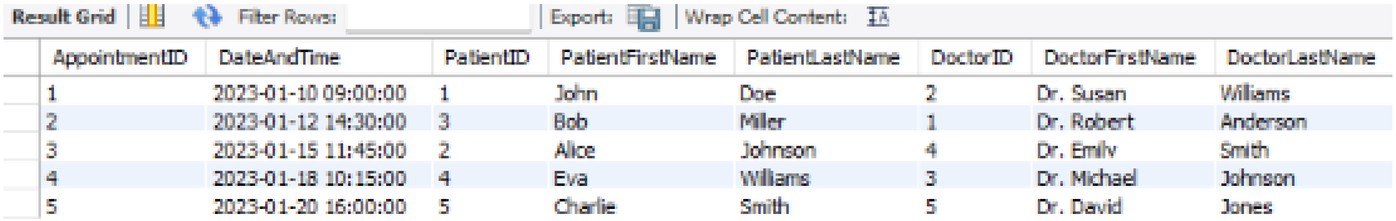
BillingID	PatientID	DoctorID	Amount	PaymentStatus
1	1	2	150.00	Paid
2	3	1	200.00	Unpaid
4	4	3	120.00	Unpaid
NULL	NULL	NULL	NULL	NULL

Answer 3. All appointment details including doctor information are the following



PatientID	D_FirstName	D_LastName	Dosage	Type	Supplier
1	John	Doe	10mg	Pain Relief	ABC Pharmacy
2	Alice	Johnson	N/A	N/A	N/A
3	Bob	Miller	5mg	Skin Cream	MediCo
4	Eva	Williams	N/A	N/A	N/A
5	Charlie	Smith	20mg	Headache Relief	PharmaWell

Answer 4: These are all patient medication records including those that do not have any medication records.



AppointmentID	DateAndTime	PatientID	PatientFirstName	PatientLastName	DoctorID	DoctorFirstName	DoctorLastName
1	2023-01-10 09:00:00	1	John	Doe	2	Dr. Susan	Williams
2	2023-01-12 14:30:00	3	Bob	Miller	1	Dr. Robert	Anderson
3	2023-01-15 11:45:00	2	Alice	Johnson	4	Dr. Emily	Smith
4	2023-01-18 10:15:00	4	Eva	Williams	3	Dr. Michael	Johnson
5	2023-01-20 16:00:00	5	Charlie	Smith	5	Dr. David	Jones