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# PART A – RELATIONAL DATABASE

## Chapter 1 - Requirement Analysis

### 1.1 Functional requirements

The actions that the database system is capable of doing is known as Functional requirement. At the end of this project the target is to make the ability of the database to follow the given tasks. This allocates performances and other limiting requirements to all functional levels.

1. Data retrieval
2. Possibility to modify the content of the database
3. Able to fill in possible data gaps/ missing data
4. Ability to modify previously entered data in the database
5. Ability to add comments on data, when the data is missing or questionable.
6. Ability to supply data with improved performance

This schema was created in order to represent a database of a medical center or medicine related institute. In this medicine schema suitable entities are chosen in order to represent the schema. Doctors, Patients, Drugs, Hospitals, Pharmacies are the areas that are covered by this schema. The data spread between those areas can be retrieved by using this database. Also, above functional requirements are satisfied by this created schema.

### 1.2 Data requirements

Entity: Doctor – Attributes

- Doctor's name (Should not be null)
- Specialty (Should not be null)
- MBBS register number (Should not be null)
- Address
- Working Places (Should not be null)

Entity: Patient – Attributes

- Patient's name
- Address
- Date of Birth
- Age
- Sex (Should not be null)
- Patient ID (Should not be null)
- Residence
- Chronic diseases
- Doctors MBBS no

#### Entity: Drug Manufacturer – Attributes

- Name (Should not be null)
- Registered number (Should not be null)
- Address (Should not be null)
- Number of factories owned

#### Entity: Employee – Attributes

- Name (Should not be null)
- Employee ID (Should not be null)
- Pharmacy ID (Should not be null)
- Job position (Should not be null)
- Supervisor ID

#### Entity: Pharmacy – Attributes

- Pharmacy ID (Should not be null)
- Pharmacy name (Should not be null)
- Address (Should not be null)
- Contact no (Should not be null)
- Owner's/Owners' name (Should not be null)

#### Entity: Drug – Attributes

- Trade name (Should not be null)
- Common name
- Tablet price in LKR (Should not be null)
- Manufacturer Registered number (Should not be null)
- Prescribed Doctor MBBS number

Whether, an attribute can be null or not is decided by the nature of the schema. Data that are not null is mentioned in above list.

Brief analysis of some important relationships of this schema was done before creating ER diagram. They are,

- Doctors work in one or more work place and hospital name only attribute relevant to hospitals (No key attribute). Hence hospitals are taken as weak entity.
- Pharmacy can have multiple owner and one can own many pharmacies. Hence only owner name is obtained (No key attribute) pharmacy owners are taken as weak entity.
- In this medical institute a doctor can inspect any number of patients and data of patients that visit particular is stored in this database.
- Doctors prescribe different trade types of same medicines usually that is shown by the prescribe relationship in ER diagram.

## Chapter 2 - Conceptual Design

The Entity - Relationship (ER) diagram of the medicine schema is drawn using an appropriate tool according to the given instructions.

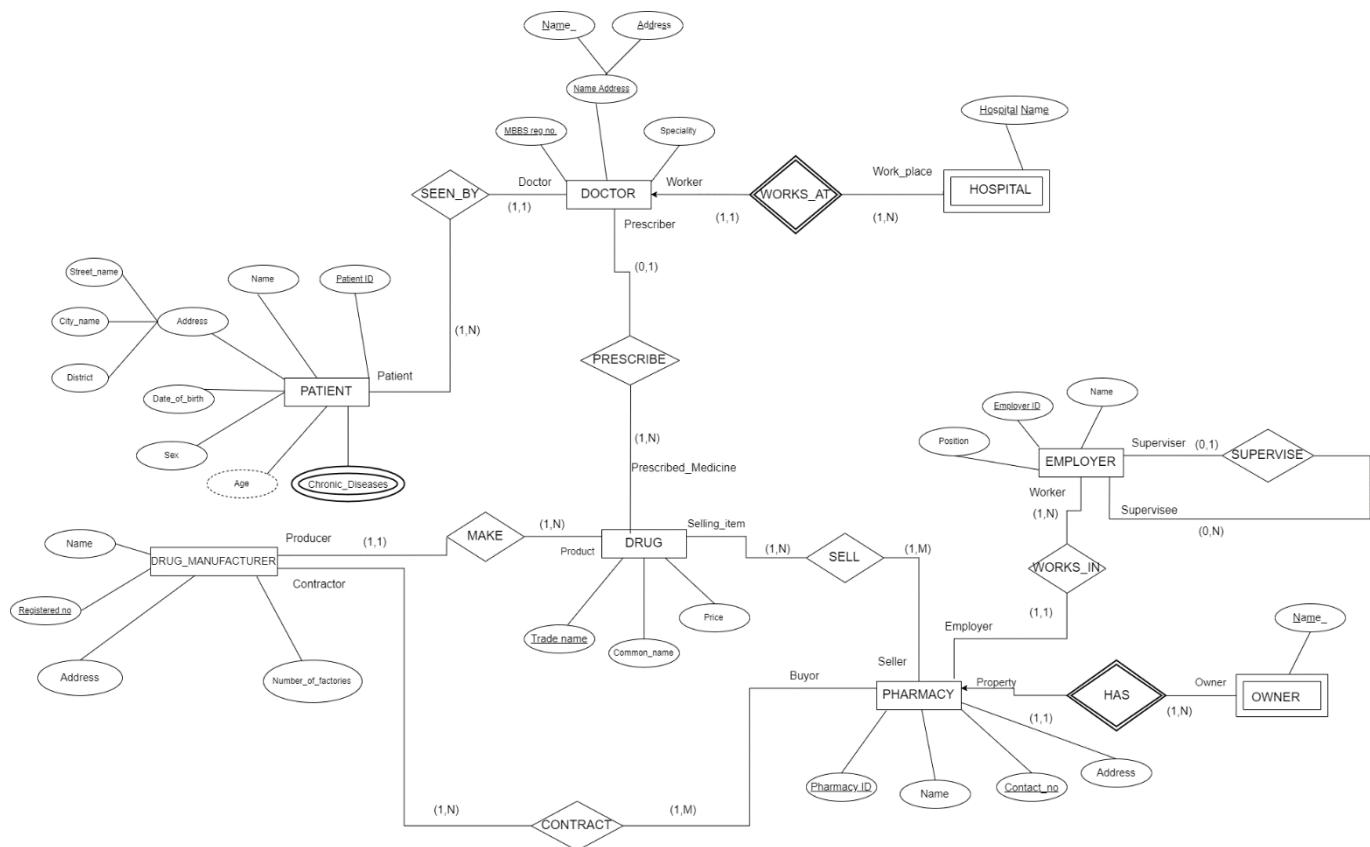


Figure 1 : Entity - relationship diagram of the medicine schema

# Chapter 3 - Logical Design

## 3.1 First Normal Form

ER diagram is mapped to the relational model in first normal by creating a separate table for “chronic diseases” which is a multivalued attribute. Also, primary keys are highlighted because in 1NF it should be identified out of multiple candidate keys. All Other important keys, functional dependencies and referential integrities are represented by usual notation.

There are two extra junction tables created because of the many to many relationships that occur between Drugs → Pharmacies and Drug manufacturers → Pharmacies.

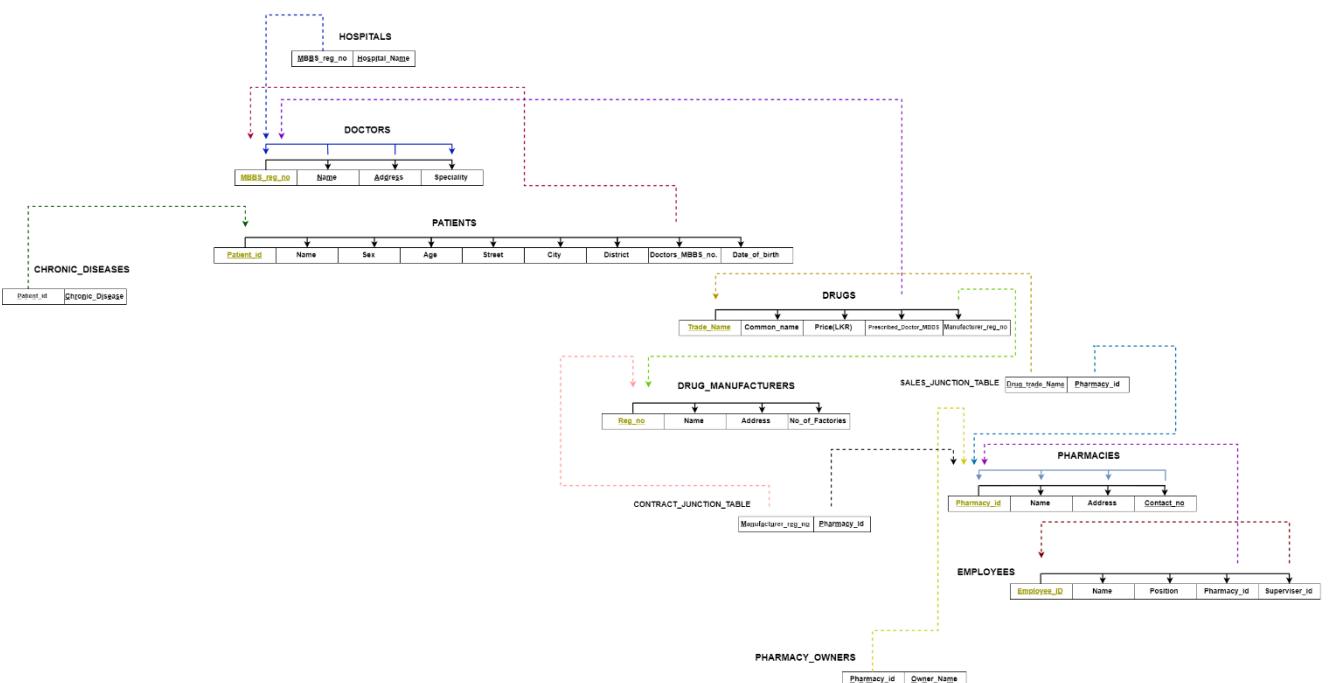


Figure 2 : The conceptual data model to representational data model mapping(1NF)

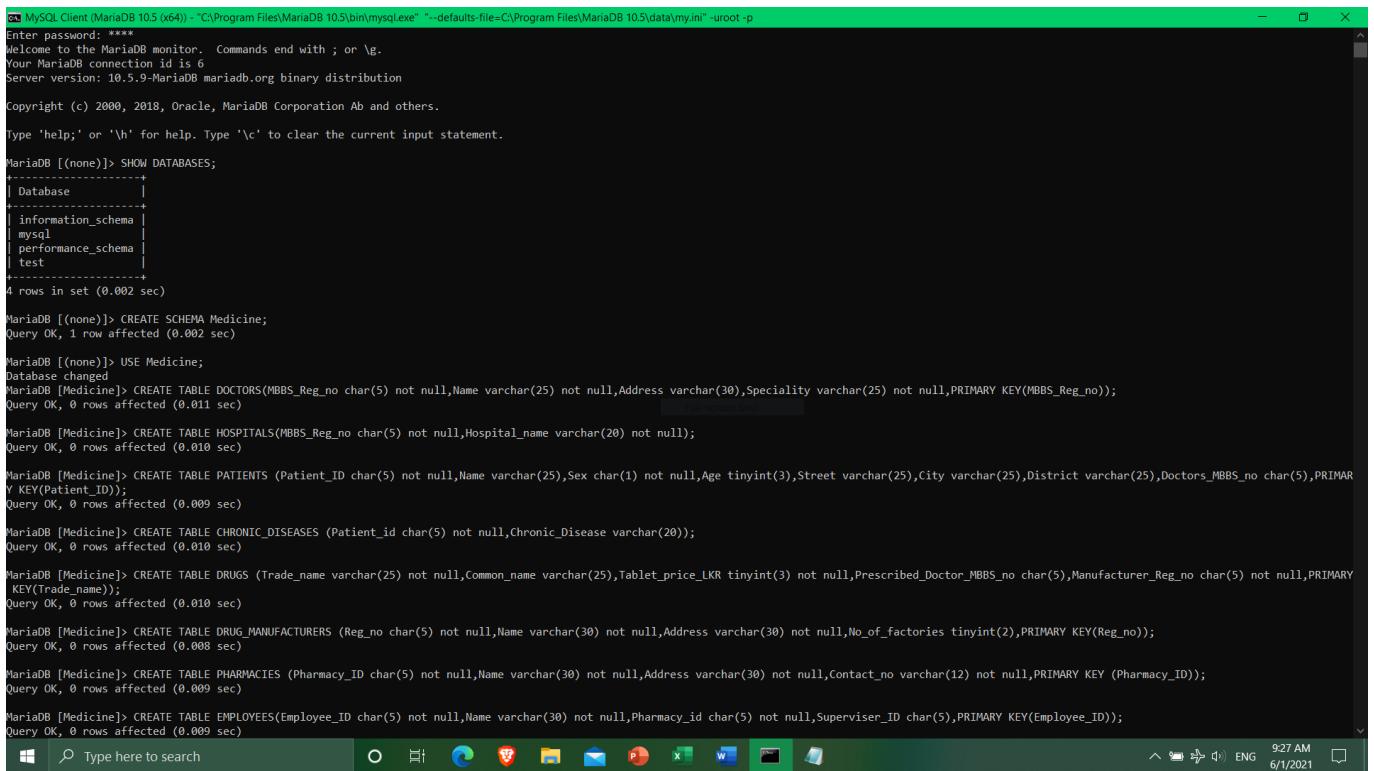
## 3.2 Second Normal Form

According to figure 2 there are no partial functional dependencies in the conceptual data model to representational data model mapping(1NF). Hence every non-prime attribute is fully functionally dependent on any prime attribute. Because of above mentioned reason the relational model in figure 2 is already in 2NF.

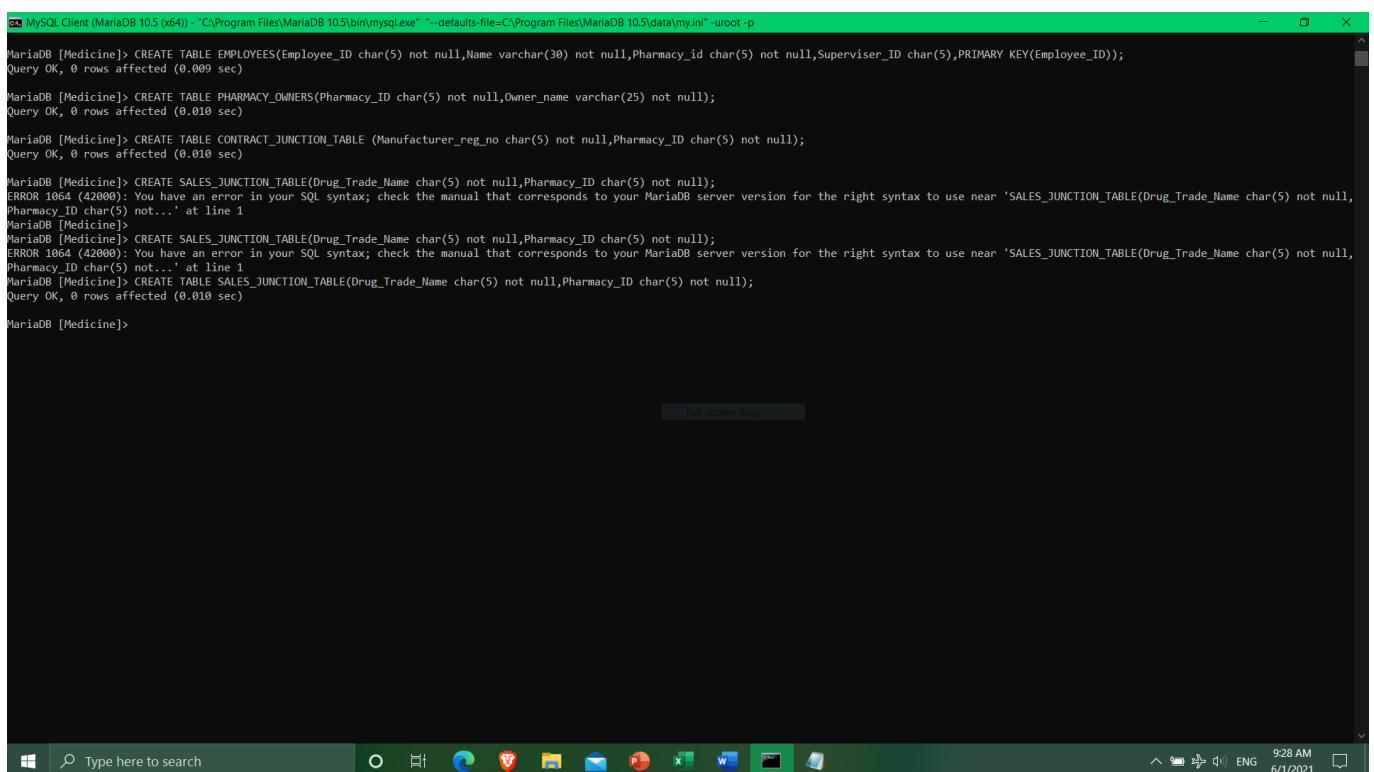
# Chapter 4 – Implementation

2NF of the representational data model is implemented using Maria DB MySQL client. Screenshots of schema creation, table definitions, insert, update and other important operations is included in this chapter.

## 4.1 Schema creation with table creation



MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p  
Enter password: \*\*\*\*  
Welcome to the MariaDB monitor. Commands end with ; or \g.  
Your MariaDB connection id is 6  
Server version: 10.5.9-MariaDB mariadb.org binary distribution  
Copyright (c) 2000, 2018, Oracle, MariaDB Corporation Ab and others.  
Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.  
MariaDB [(none)]> SHOW DATABASES;  
+-----+  
| Database |  
+-----+  
| information\_schema |  
| mysql |  
| performance\_schema |  
| test |  
+-----+  
4 rows in set (0.002 sec)  
MariaDB [(none)]> CREATE SCHEMA Medicine;  
Query OK, 1 row affected (0.002 sec)  
MariaDB [(none)]> USE Medicine;  
Database changed  
MariaDB [Medicine]> CREATE TABLE DOCTORS(MBBS\_Reg\_no char(5) not null,Name varchar(25) not null,Address varchar(30),Speciality varchar(25) not null,PRIMARY KEY(MBBS\_Reg\_no));  
Query OK, 0 rows affected (0.011 sec)  
MariaDB [Medicine]> CREATE TABLE HOSPITALS(MBBS\_Reg\_no char(5) not null,Hospital\_name varchar(20) not null);  
Query OK, 0 rows affected (0.010 sec)  
MariaDB [Medicine]> CREATE TABLE PATIENTS (Patient\_ID char(5) not null,Name varchar(25),Sex char(1) not null,Age tinyint(3),Street varchar(25),City varchar(25),District varchar(25),Doctors\_MBBS\_no char(5),PRIMARY KEY(Patient\_ID));  
Query OK, 0 rows affected (0.009 sec)  
MariaDB [Medicine]> CREATE TABLE CHRONIC\_DISEASES (Patient\_id char(5) not null,Chronic\_Disease varchar(20));  
Query OK, 0 rows affected (0.010 sec)  
MariaDB [Medicine]> CREATE TABLE DRUGS (Trade\_name varchar(25) not null,Common\_name varchar(25),Tablet\_price\_LKR tinyint(3) not null,Prescribed\_Doctor\_MBBS\_no char(5),Manufacturer\_Reg\_no char(5) not null,PRIMARY KEY(Trade\_name));  
Query OK, 0 rows affected (0.010 sec)  
MariaDB [Medicine]> CREATE TABLE DRUG\_MANUFACTURERS (Reg\_no char(5) not null,Name varchar(30) not null,Address varchar(30) not null,No\_of\_factories tinyint(2),PRIMARY KEY(Reg\_no));  
Query OK, 0 rows affected (0.008 sec)  
MariaDB [Medicine]> CREATE TABLE PHARMACIES (Pharmacy\_ID char(5) not null,Name varchar(30) not null,Address varchar(30) not null,Contact\_no varchar(12) not null,PRIMARY KEY (Pharmacy\_ID));  
Query OK, 0 rows affected (0.009 sec)  
MariaDB [Medicine]> CREATE TABLE EMPLOYEES(Employee\_ID char(5) not null,Name varchar(30) not null,Pharmacy\_id char(5) not null,Supervisor\_ID char(5),PRIMARY KEY(Employee\_ID));  
Query OK, 0 rows affected (0.009 sec)



MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p  
MariaDB [Medicine]> CREATE TABLE EMPLOYEES(Employee\_ID char(5) not null,Name varchar(30) not null,Pharmacy\_id char(5) not null,Supervisor\_ID char(5),PRIMARY KEY(Employee\_ID));  
Query OK, 0 rows affected (0.009 sec)  
MariaDB [Medicine]> CREATE TABLE PHARMACY OWNERS(Pharmacy\_ID char(5) not null,Owner\_name varchar(25) not null);  
Query OK, 0 rows affected (0.010 sec)  
MariaDB [Medicine]> CREATE TABLE CONTRACT JUNCTION\_TABLE (Manufacturer\_reg\_no char(5) not null,Pharmacy\_ID char(5) not null);  
Query OK, 0 rows affected (0.010 sec)  
MariaDB [Medicine]> CREATE SALES JUNCTION\_TABLE(Drug\_Trade\_Name char(5) not null,Pharmacy\_ID char(5) not null);  
ERROR 1064 (42000): You have an error in your SQL syntax; check the manual that corresponds to your MariaDB server version for the right syntax to use near 'SALES JUNCTION\_TABLE(Drug\_Trade\_Name char(5) not null, Pharmacy\_ID char(5) not null...' at line 1  
MariaDB [Medicine]> CREATE SALES JUNCTION\_TABLE(Drug\_Trade\_Name char(5) not null,Pharmacy\_ID char(5) not null);  
ERROR 1064 (42000): You have an error in your SQL syntax; check the manual that corresponds to your MariaDB server version for the right syntax to use near 'SALES JUNCTION\_TABLE(Drug\_Trade\_Name char(5) not null, Pharmacy\_ID char(5) not null...' at line 1  
MariaDB [Medicine]> CREATE TABLE SALES JUNCTION\_TABLE(Drug\_Trade\_Name char(5) not null,Pharmacy\_ID char(5) not null);  
Query OK, 0 rows affected (0.010 sec)  
MariaDB [Medicine]>

## 4.2 Creating foreign key constraints

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p

MariaDB [Medicine]> SHOW TABLES;
+-----+
| Tables_in_medicine |
+-----+
| chronic_diseases |
| contract_junction_table |
| doctors |
| drug_manufacturers |
| drugs |
| employees |
| hospitals |
| patients |
| pharmacies |
| pharmacy_owners |
| sales_junction_table |
+-----+
11 rows in set (0.002 sec)

MariaDB [Medicine]> ALTER TABLE HOSPITALS add constraint fk1 foreign key(MBBS_Reg_no) references Doctors(MBBS_Reg_no) on delete cascade on update cascade;
Query OK, 0 rows affected (0.282 sec)
Records: 0 Duplicates: 0 Warnings: 0

MariaDB [Medicine]> ALTER TABLE PATIENTS add constraint fk2 foreign key(Doctors_MBBS_no) references Doctors(MBBS_Reg_no) on delete cascade on update cascade;
Query OK, 0 rows affected (0.269 sec)
Records: 0 Duplicates: 0 Warnings: 0

MariaDB [Medicine]> ALTER TABLE CHRONIC_DISEASES add constraint fk3 foreign key(Patient_ID) references PATIENTS(Patient_ID) on delete cascade on update cascade;
Query OK, 0 rows affected (0.257 sec)
Records: 0 Duplicates: 0 Warnings: 0

MariaDB [Medicine]> ALTER TABLE DRUGS add constraint fk4 foreign key(Prescribed_Doctor_MBBS) references Doctors(MBBS_Reg_no) on delete cascade on update cascade;
ERROR 1072 (42000): Key column 'Prescribed_Doctor_MBBS' doesn't exist in table
MariaDB [Medicine]> ALTER TABLE DRUGS add constraint fk4 foreign key(Prescribed_Doctor_MBBS_no) references Doctors(MBBS_Reg_no) on delete cascade on update cascade;
Query OK, 0 rows affected (0.258 sec)
Records: 0 Duplicates: 0 Warnings: 0

MariaDB [Medicine]> ALTER TABLE SALES_JUNCTION_TABLE add constraint fk5 foreign key(Drug_Trade_Name) references DRUGS(Trade_name) on delete cascade on update cascade;
Query OK, 0 rows affected (0.267 sec)
Records: 0 Duplicates: 0 Warnings: 0

MariaDB [Medicine]> ALTER TABLE SALES_JUNCTION_TABLE add constraint fk6 foreign key(Pharmacy_ID) references PHARMACIES(Pharmacy_ID) on delete cascade on update cascade;
Query OK, 0 rows affected (0.270 sec)
Records: 0 Duplicates: 0 Warnings: 0

MariaDB [Medicine]> ALTER TABLE CONTRACT_JUNCTION_TABLE add constraint fk7 foreign key((Manufacturer_Reg_no) references DRUG_MANUFACTURERS(Reg_no) on delete cascade on update cascade;
ERROR 1064 (42000): You have an error in your SQL syntax; check the manual that corresponds to your MariaDB server version for the right syntax to use near '(Manufacturer_Reg_no) references DRUG_MANUFACTURERS(R
eg_no) on delete cascad...' at line 1
MariaDB [Medicine]> ALTER TABLE CONTRACT_JUNCTION_TABLE add constraint fk7 foreign key(Manufacturer_Reg_no) references DRUG_MANUFACTURERS(Reg_no) on delete cascade on update cascade;
Query OK, 0 rows affected (0.299 sec)

Windows Taskbar: Type here to search, Start button, File Explorer, Edge, File History, Mail, Photos, OneDrive, Excel, Word, Powerpoint, File, Task View, 10:13 AM, ENG, 6/1/2021
```

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p

eg_no) on delete cascad...' at line 1
MariaDB [Medicine]> ALTER TABLE CONTRACT_JUNCTION_TABLE add constraint fk7 foreign key(Manufacturer_Reg_no) references DRUG_MANUFACTURERS(Reg_no) on delete cascade on update cascade;
Query OK, 0 rows affected (0.299 sec)
Records: 0 Duplicates: 0 Warnings: 0

MariaDB [Medicine]> ALTER TABLE CONTRACT_JUNCTION_TABLE add constraint fk8 foreign key(Pharmacy_ID) references PHARMACIES(Pharmacy_ID) on delete cascade on update cascade;
Query OK, 0 rows affected (0.268 sec)
Records: 0 Duplicates: 0 Warnings: 0

MariaDB [Medicine]> ALTER TABLE DRUGS add constraint fk9 foreign key(Manufacturer_Reg_no) references DRUG_MANUFACTURERS(Reg_no) on delete cascade on update cascade;
Query OK, 0 rows affected (0.270 sec)
Records: 0 Duplicates: 0 Warnings: 0

MariaDB [Medicine]> ALTER TABLE EMPLOYEES add constraint fk8 foreign key(Pharmacy_ID) references PHARMACIES(Pharmacy_ID) on delete cascade on update cascade;
ERROR 1005 (HY000): Can't create table `medicine`.`employees` (errno: 121 "Duplicate key on write or update")
MariaDB [Medicine]> ALTER TABLE EMPLOYEES add constraint fk10 foreign key(Pharmacy_ID) references PHARMACIES(Pharmacy_ID) on delete cascade on update cascade;
Query OK, 0 rows affected (0.198 sec)
Records: 0 Duplicates: 0 Warnings: 0

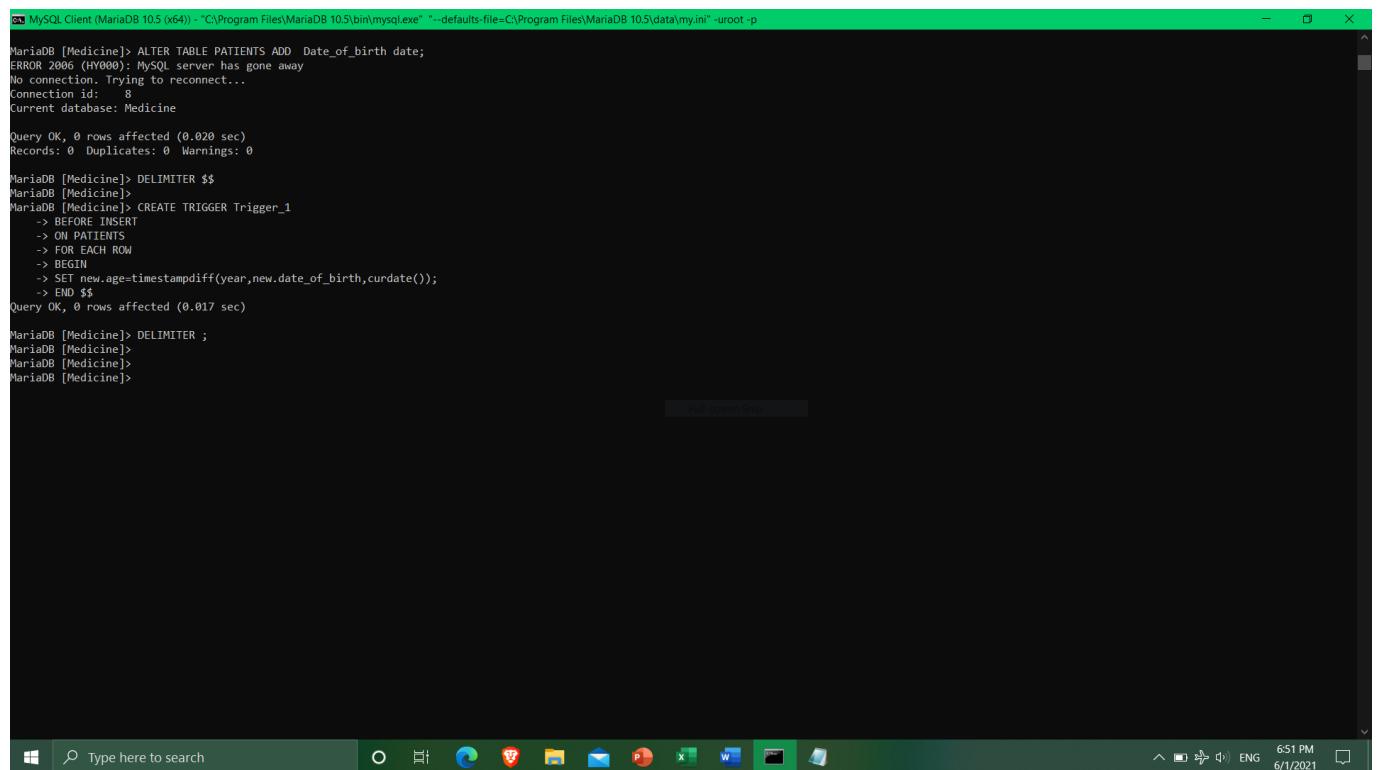
MariaDB [Medicine]> ALTER TABLE PHARMACY OWNERS add constraint fk11 foreign key(Pharmacy_ID) references PHARMACIES(Pharmacy_ID) on delete cascade on update cascade;
Query OK, 0 rows affected (0.267 sec)
Records: 0 Duplicates: 0 Warnings: 0

MariaDB [Medicine]> ALTER TABLE EMPLOYEES add constraint fk12 foreign key(Supervisor_ID) references EMPLOYEES(Employee_ID) on delete cascade on update cascade;
Query OK, 0 rows affected (0.271 sec)
Records: 0 Duplicates: 0 Warnings: 0

MariaDB [Medicine]>
```

## 4.3 Creating a trigger for the derived attribute “Age” in Patients table

In order to make “Age” a derived attribute “Date\_of\_birth” attribute is added to the patients table. Age is derived in years from the date of birth of each patient. The screenshot of adding the relevant trigger is shown below.



The screenshot shows a MySQL Client window running on a Windows operating system. The command line interface displays the following SQL commands:

```
MariaDB [Medicine]> ALTER TABLE PATIENTS ADD Date_of_birth date;
ERROR 2006 (HY000): MySQL server has gone away
No connection. Trying to reconnect...
Connection id: 8
Current database: Medicine

Query OK, 0 rows affected (0.020 sec)
Records: 0  Duplicates: 0  Warnings: 0

MariaDB [Medicine]> DELIMITER $$

MariaDB [Medicine]> CREATE TRIGGER Trigger_1
    --> BEFORE INSERT
    --> ON PATIENTS
    --> FOR EACH ROW
    --> BEGIN
    --> SET new.age=timestampdiff(year,new.date_of_birth,curdate());
    --> END $$

Query OK, 0 rows affected (0.017 sec)

MariaDB [Medicine]> DELIMITER ;
MariaDB [Medicine]>
MariaDB [Medicine]>
MariaDB [Medicine]>
```

The taskbar at the bottom of the screen shows various application icons, including File Explorer, Task View, Edge browser, File History, Mail, Photos, OneDrive, Excel, Word, and Powerpoint. The system tray indicates the date and time as 6/1/2021 6:51 PM, and shows battery status and network connectivity.

## 4.4 Table definitions

- Doctors table

```
MySQL Client (MariaDB 10.5 (x64) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p
MariaDB [Medicine]> SHOW CREATE TABLE DOCTORS;
+-----+-----+
| Table | Create Table |
+-----+-----+
| DOCTORS | CREATE TABLE `doctors` (
`MBBS_Reg_no` char(5) NOT NULL,
`Name` varchar(25) NOT NULL,
`Address` varchar(30) DEFAULT NULL,
`Speciality` varchar(25) NOT NULL,
PRIMARY KEY (`MBBS_Reg_no`)
) ENGINE=InnoDB DEFAULT CHARSET=latin1 |
+-----+-----+
1 row in set (0.001 sec)

MariaDB [Medicine]>
```

- Hospitals table

```
MySQL Client (MariaDB 10.5 (x64) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p
MariaDB [Medicine]> SHOW CREATE TABLE HOSPITALS;
+-----+-----+
| Table | Create Table |
+-----+-----+
| HOSPITALS | CREATE TABLE `hospitals` (
`MBBS_Reg_no` char(5) NOT NULL,
`Hospital_name` varchar(20) NOT NULL,
KEY `fk1` (`MBBS_Reg_no`),
KEY `Hospital_id` (`Hospital_name`),
CONSTRAINT `fk1` FOREIGN KEY (`MBBS_Reg_no`) REFERENCES `doctors` (`MBBS_Reg_no`) ON DELETE CASCADE ON UPDATE CASCADE
) ENGINE=InnoDB DEFAULT CHARSET=latin1 |
+-----+-----+
1 row in set (0.001 sec)

MariaDB [Medicine]>
```

- Patients table

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p

MariaDB [Medicine]> SHOW CREATE TABLE PATIENTS;
+-----+-----+
| Table | Create Table |
+-----+-----+
| PATIENTS | CREATE TABLE `patients` (
  `Patient_ID` char(5) NOT NULL,
  `Name` varchar(25) DEFAULT NULL,
  `Sex` char(1) NOT NULL,
  `Age` tinyint(3) DEFAULT NULL,
  `Street` varchar(25) DEFAULT NULL,
  `City` varchar(25) DEFAULT NULL,
  `District` varchar(25) DEFAULT NULL,
  `Doctors_MBBS_no` char(5) DEFAULT NULL,
  `Date_of_birth` date DEFAULT NULL,
  PRIMARY KEY (`Patient_ID`),
  KEY `fk2` (`Doctors_MBBS_no`),
  CONSTRAINT `fk2` FOREIGN KEY (`Doctors_MBBS_no`) REFERENCES `doctors` (`MBBS_Reg_no`) ON DELETE CASCADE ON UPDATE CASCADE
) ENGINE=InnoDB DEFAULT CHARSET=latin1 |

1 row in set (0.001 sec)

MariaDB [Medicine]>
```

- Drugs table

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p

MariaDB [Medicine]> SHOW CREATE TABLE DRUGS;
+-----+-----+
| Table | Create Table |
+-----+-----+
| DRUGS | CREATE TABLE `drugs` (
  `Trade_name` varchar(25) NOT NULL,
  `Common_name` varchar(25) DEFAULT NULL,
  `Tablet_price_LKR` tinyint(3) NOT NULL,
  `Prescribed_Doctor_MBBS_no` char(5) DEFAULT NULL,
  `Manufacturer_Reg_no` char(5) NOT NULL,
  PRIMARY KEY (`Trade_name`),
  KEY `fk4` (`Prescribed_Doctor_MBBS_no`),
  KEY `fk9` (`Manufacturer_Reg_no`),
  KEY `Tablet_price_Ind` (`Tablet_price_LKR`),
  KEY `Common_drug_name_Ind` (`Common_name`),
  CONSTRAINT `fk4` FOREIGN KEY (`Prescribed_Doctor_MBBS_no`) REFERENCES `doctors` (`MBBS_Reg_no`) ON DELETE CASCADE ON UPDATE CASCADE,
  CONSTRAINT `fk9` FOREIGN KEY (`Manufacturer_Reg_no`) REFERENCES `drug_manufacturers` (`Reg_no`) ON DELETE CASCADE ON UPDATE CASCADE
) ENGINE=InnoDB DEFAULT CHARSET=latin1 |

1 row in set (0.001 sec)

MariaDB [Medicine]>
```

- Drug manufacturers table

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p

MariaDB [Medicine]> SHOW CREATE TABLE DRUG_MANUFACTURERS;
+-----+-----+
| Table | Create Table |
+-----+-----+
| DRUG_MANUFACTURERS | CREATE TABLE `drug_manufacturers` (
  `Reg_no` char(5) NOT NULL,
  `Name` varchar(30) NOT NULL,
  `Address` varchar(30) NOT NULL,
  `No_of_factories` tinyint(2) DEFAULT NULL,
  PRIMARY KEY (`Reg_no`),
  KEY `Factory_m_idx` (`No_of_factories`)
) ENGINE=InnoDB DEFAULT CHARSET=latin1 |
+-----+-----+
1 row in set (0.001 sec)

MariaDB [Medicine]>
```

- Chronic diseases table

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p

MariaDB [Medicine]> SHOW CREATE TABLE CHRONIC_DISEASES;
+-----+-----+
| Table | Create Table |
+-----+-----+
| CHRONIC_DISEASES | CREATE TABLE `chronic_diseases` (
  `Patient_id` char(5) NOT NULL,
  `Chronic_Disease` varchar(20) DEFAULT NULL,
  KEY `fk3` (`Patient_id`),
  KEY `Chronic_disease_idx` (`Chronic_Disease`),
  CONSTRAINT `fk3` FOREIGN KEY (`Patient_id`) REFERENCES `patients` (`Patient_ID`) ON DELETE CASCADE ON UPDATE CASCADE
) ENGINE=InnoDB DEFAULT CHARSET=latin1 |
+-----+-----+
1 row in set (0.001 sec)

MariaDB [Medicine]>
```

- Contract junction table

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p
MariaDB [Medicine]> SHOW CREATE TABLE CONTRACT_JUNCTION_TABLE;;
+-----+-----+
| Table          | Create Table           |
+-----+-----+
| CONTRACT_JUNCTION_TABLE | CREATE TABLE `contract_junction_table` (
`Manufacturer_reg_no` char(5) NOT NULL,
`Pharmacy_ID` char(5) NOT NULL,
KEY `fk7` (`Manufacturer_reg_no`),
KEY `fk8` (`Pharmacy_ID`),
CONSTRAINT `fk7` FOREIGN KEY (`Manufacturer_reg_no`) REFERENCES `drug_manufacturers` (`Reg_no`) ON DELETE CASCADE ON UPDATE CASCADE,
CONSTRAINT `fk8` FOREIGN KEY (`Pharmacy_ID`) REFERENCES `pharmacies` (`Pharmacy_ID`) ON DELETE CASCADE ON UPDATE CASCADE
) ENGINE=InnoDB DEFAULT CHARSET=latin1 |

1 row in set (0.001 sec)

ERROR: No query specified
MariaDB [Medicine]>
```

- Sales junction table

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p
MariaDB [Medicine]> SHOW CREATE TABLE SALES_JUNCTION_TABLE;;
+-----+-----+
| Table          | Create Table           |
+-----+-----+
| SALES_JUNCTION_TABLE | CREATE TABLE `sales_junction_table` (
`Drug_Trade_Name` varchar(15) NOT NULL,
`Pharmacy_ID` char(5) NOT NULL,
KEY `fk6` (`Pharmacy_ID`),
KEY `fk5` (`Drug_Trade_Name`),
CONSTRAINT `fk5` FOREIGN KEY (`Drug_Trade_Name`) REFERENCES `drugs` (`Trade_name`) ON DELETE CASCADE ON UPDATE CASCADE,
CONSTRAINT `fk6` FOREIGN KEY (`Pharmacy_ID`) REFERENCES `pharmacies` (`Pharmacy_ID`) ON DELETE CASCADE ON UPDATE CASCADE
) ENGINE=InnoDB DEFAULT CHARSET=latin1 |

1 row in set (0.001 sec)

ERROR: No query specified
MariaDB [Medicine]>
```

- Pharmacies table

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini"--uroot -p
MariaDB [Medicine]> SHOW CREATE TABLE PHARMACIES;
+-----+-----+
| Table | Create Table |
+-----+-----+
| PHARMACIES | CREATE TABLE `pharmacies` (
`Pharmacy_ID` char(5) NOT NULL,
`Name` varchar(30) NOT NULL,
`Address` varchar(30) NOT NULL,
`Contact_no` varchar(12) NOT NULL,
PRIMARY KEY (`Pharmacy_ID`)
) ENGINE=InnoDB DEFAULT CHARSET=latin1 |
+-----+-----+
1 row in set (0.000 sec)

MariaDB [Medicine]>
```

- Pharmacy owners table

```
Select MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini"--uroot -p
MariaDB [Medicine]> SHOW CREATE TABLE PHARMACY OWNERS;
+-----+-----+
| Table | Create Table |
+-----+-----+
| PHARMACY OWNERS | CREATE TABLE `pharmacy_owners` (
`Pharmacy_ID` char(5) NOT NULL,
`Owner_name` varchar(25) NOT NULL,
KEY `fk11` (`Pharmacy_ID`),
KEY `Owner_name_idx` (`Owner_name`),
CONSTRAINT `fk11` FOREIGN KEY (`Pharmacy_ID`) REFERENCES `pharmacies` (`Pharmacy_ID`) ON DELETE CASCADE ON UPDATE CASCADE
) ENGINE=InnoDB DEFAULT CHARSET=latin1 |
+-----+-----+
1 row in set (0.000 sec)

MariaDB [Medicine]>
```

- Employees table

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p
MariaDB [Medicine]> SHOW CREATE TABLE EMPLOYEES;
+-----+-----+
| Table | Create Table |
+-----+-----+
| EMPLOYEES | CREATE TABLE `employees` (
  `Employee_ID` char(5) NOT NULL,
  `Name` varchar(30) NOT NULL,
  `Position` varchar(15) NOT NULL,
  `Pharmacy_id` char(5) NOT NULL,
  `Supervisor_ID` char(5) DEFAULT NULL,
  PRIMARY KEY (`Employee_ID`),
  KEY `fk10` (`Pharmacy_id`),
  KEY `fk12` (`Supervisor_ID`),
  CONSTRAINT `fk10` FOREIGN KEY (`Pharmacy_id`) REFERENCES `pharmacies` (`Pharmacy_ID`) ON DELETE CASCADE ON UPDATE CASCADE,
  CONSTRAINT `fk12` FOREIGN KEY (`Supervisor_ID`) REFERENCES `employees` (`Employee_ID`) ON DELETE CASCADE ON UPDATE CASCADE
) ENGINE=InnoDB DEFAULT CHARSET=latin1 |
+-----+-----+
1 row in set (0.000 sec)

MariaDB [Medicine]>
```

## 4.4 Inserting data for tables

- Doctors table

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p
MariaDB [Medicine]> INSERT INTO DOCTORS values('24825','Lakshman Silva','No.4,Highlevel rd,Nugegoda','Neurologist');
Query OK, 1 row affected (0.022 sec)

MariaDB [Medicine]> INSERT INTO DOCTORS values('24952','Sanduni Wickramanayake','No.65,Air force rd,Rathmalana','Cardiologist');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO DOCTORS values('25022','Mohammad Mazar','Kandy rd,Gampaha','Psychiatric');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO DOCTORS values('25095','Udaya Wijekoon','Temple rd,Kelaniya','Pediatrician');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO DOCTORS values('25511','Asela Wickramanayake','No.65,Air force rd,Rathmalana','Cardiologist');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO DOCTORS values('25721','Lakshman Silva','Galle rd,Panadura','Dentist');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> SELECT * FROM DOCTORS;
+-----+-----+-----+-----+
| MBBS_Reg_no | Name          | Address        | Speciality   |
+-----+-----+-----+-----+
| 24825       | Lakshman Silva | No.4,Highlevel rd,Nugegoda | Neurologist |
| 24952       | Sanduni Wickramanayake | No.65,Air force rd,Rathmalana | Cardiologist |
| 25022       | Mohammad Mazar | Kandy rd,Gampaha | Psychiatric |
| 25095       | Udaya Wijekoon | Temple rd,Kelaniya | Pediatrician |
| 25511       | Asela Wickramanayake | No.65,Air force rd,Rathmalana | Cardiologist |
| 25721       | Lakshman Silva | Galle rd,Panadura | Dentist      |
+-----+-----+-----+-----+
6 rows in set (0.001 sec)

MariaDB [Medicine]>
```

- Hospitals table

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p
6 rows in set (0.001 sec)

MariaDB [Medicine]> INSERT INTO HOSPITALS values('25511','Colombo Gen Hospital');
Query OK, 1 row affected (0.021 sec)

MariaDB [Medicine]> INSERT INTO HOSPITALS values('25511','Lanka pvt Hospital');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO HOSPITALS values('25022','Colombo Gen Hospital');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO HOSPITALS values('24952','Ragama Gen Hospital');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO HOSPITALS values('24952','Asiri pvt Hospital');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO HOSPITALS values('25721','Colombo Gen Hospital');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO HOSPITALS values('24825','Colombo Gen Hospital');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO HOSPITALS values('25095','Ragama Gen Hospital');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> SELECT * FROM HOSPITALS;
+-----+-----+
| MBBS_Reg_no | Hospital_name |
+-----+-----+
| 25511      | Colombo Gen Hospital |
| 25511      | Lanka pvt Hospital |
| 25022      | Colombo Gen Hospital |
| 24952      | Ragama Gen Hospital |
| 24952      | Asiri pvt Hospital |
| 25721      | Colombo Gen Hospital |
| 24825      | Colombo Gen Hospital |
| 25095      | Ragama Gen Hospital |
+-----+-----+
8 rows in set (0.001 sec)

MariaDB [Medicine]>
```

- Patients table

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p
MariaDB [Medicine]> INSERT INTO PATIENTS values('P0001','Ruwan Sanjaya','M','00','Hill street','Nagoda','Kalutara','24825','2010-01-31');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO PATIENTS values('P0011','Iresha Bandara','F','00','Galle rd','Moratuwa','Colombo','25095','2007-06-25');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO PATIENTS values('P0020','Ashoka Silva','F','00','Temple rd','Nugegoda','Colombo','25721','1978-09-25');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO PATIENTS values('P0020','Ashoka Silva','F','00','Temple rd','Nugegoda','Colombo','25721','1978-09-25');
ERROR 1062 (23000): Duplicate entry 'P0020' for key 'PRIMARY'
MariaDB [Medicine]> INSERT INTO PATIENTS values('P0152','Nimal Perera','M','00','Beach rd','Mount-Lavinia','Colombo','24952','1968-11-13');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO PATIENTS values('P0525','Nimal Silva','M','00','Church rd','Ja-Ela','Gampaha','24952','1958-04-04');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO PATIENTS values('P0154','Ranjith Fernando','M','00','Church rd','Ja-Ela','Gampaha','25511','1982-02-28');
Query OK, 1 row affected (0.001 sec)

MariaDB [Medicine]> SELECT * FROM PATIENTS;
+-----+-----+-----+-----+-----+-----+-----+-----+
| Patient_ID | Name          | Sex | Age | Street       | City        | District | Doctors_MBBS_no | Date_of_birth |
+-----+-----+-----+-----+-----+-----+-----+-----+
| P0001      | Ruwan Sanjaya | M   | 11  | Hill street  | Nagoda     | Kalutara | 24825    | 2010-01-31  |
| P0011      | Iresha Bandara | F   | 13  | Galle rd    | Moratuwa  | Colombo  | 25095    | 2007-06-25  |
| P0152      | Nimal Perera   | M   | 52  | Beach rd   | Mount-Lavinia | Colombo | 24952    | 1968-11-13  |
| P0154      | Ranjith Fernando | M   | 39  | Church rd  | Ja-Ela     | Gampaha  | 25511    | 1982-02-28  |
| P0525      | Nimal Silva    | M   | 63  | Church rd  | Ja-Ela     | Gampaha  | 24952    | 1958-04-04  |
| P0020      | Ashoka Silva   | F   | 42  | Temple rd  | Nugegoda   | Colombo  | 25721    | 1978-09-25  |
+-----+-----+-----+-----+-----+-----+-----+-----+
6 rows in set (0.001 sec)

MariaDB [Medicine]>
```

- Chronic diseases table

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p

MariaDB [Medicine]> INSERT INTO CHRONIC_DISEASES values ('P0001',NULL);
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO CHRONIC_DISEASES values ('P0011',NULL);
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO CHRONIC_DISEASES values ('P0154',NULL);
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO CHRONIC_DISEASES values ('P0152','Diabetes');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO CHRONIC_DISEASES values ('P0152','Blood Pressure');
Query OK, 1 row affected (0.001 sec)

MariaDB [Medicine]> INSERT INTO CHRONIC_DISEASES values ('P0525','Arthritis');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO CHRONIC_DISEASES values ('P0920','Blood Pressure');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO CHRONIC_DISEASES values ('P0920','Diabetes');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO CHRONIC_DISEASES values ('P0920','Lung Cancer');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> SELECT * FROM CHRONIC_DISEASES;
+-----+-----+
| Patient_id | Chronic_Disease |
+-----+-----+
| P0001       | NULL           |
| P0011       | NULL           |
| P0154       | NULL           |
| P0152       | Diabetes        |
| P0152       | Blood Pressure |
| P0525       | Arthritis       |
| P0920       | Blood Pressure |
| P0920       | Diabetes        |
| P0920       | Lung Cancer     |
+-----+-----+
9 rows in set (0.001 sec)

MariaDB [Medicine]>
```

- Drug manufacturers table

```
Select MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p

MariaDB [Medicine]> INSERT INTO DRUG_MANUFACTURERS values ('D0001','GSK products','No.15,Main rd,Colombo 01','3');
Query OK, 1 row affected (0.001 sec)

MariaDB [Medicine]> INSERT INTO DRUG_MANUFACTURERS values ('D0002','Sun pharmaceuticals','Nugegoda,Colombo','1');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO DRUG_MANUFACTURERS values ('D0003','Astron pharmaceuticals','No.96,Kandy rd,Kelaniya','1');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO DRUG_MANUFACTURERS values ('D0004','CIC pvt ltd','Colombo rd,Welisara','2');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO DRUG_MANUFACTURERS values ('D0005','Morisons products','Main rd,Homagama','4');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO DRUG_MANUFACTURERS values ('D0006','SPMC products','Kandawala estate,Rathmalana','3');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> SELECT * FROM DRUG_MANUFACTURERS;
+-----+-----+-----+
| Reg_no | Name          | Address          | No_of_factories |
+-----+-----+-----+
| D0001 | GSK products  | No.15,Main rd,Colombo 01 | 3               |
| D0002 | Sun pharmaceuticals | Nugegoda,Colombo | 1               |
| D0003 | Astron pharmaceuticals | No.96,Kandy rd,Kelaniya | 1               |
| D0004 | CIC pvt ltd  | Colombo rd,Welisara | 2               |
| D0005 | Morisons products | Main rd,Homagama | 4               |
| D0006 | SPMC products  | Kandawala estate,Rathmalana | 3               |
+-----+-----+-----+
6 rows in set (0.001 sec)

MariaDB [Medicine]>
```

- Drugs table

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p
+-----+-----+-----+
6 rows in set (0.001 sec)

MariaDB [Medicine]> INSERT INTO DRUGS values ('Panadol','Paracetamol','2','25095','D0001');
Query OK, 1 row affected (0.023 sec)

MariaDB [Medicine]> INSERT INTO DRUGS values ('Pacadol','Paracetamol','1','24825','D0002');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO DRUGS values ('Amoxil','Amoxiline','8','25095','D0003');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO DRUGS values ('Gluctrol','Glipzide','10','24952','D0006');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO DRUGS values ('Codopyron','Asprin','5','24952','D0001');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO DRUGS values ('Anacin','Asprin','7','25511','D0004');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> SELECT * FROM DRUGS;
+-----+-----+-----+-----+-----+
| Trade_name | Common_name | Tablet_price_LKR | Prescribed_Doctor_MBBS_no | Manufacturer_Reg_no |
+-----+-----+-----+-----+
| Amoxil    | Amoxiline   |     8 | 25095      | D0003          |
| Anacin    | Asprin      |     7 | 25511      | D0004          |
| Codopyron | Asprin      |     5 | 24952      | D0001          |
| Gluctrol  | Glipzide    |    10 | 24952      | D0006          |
| Pacadol   | Paracetamol |     1 | 24825      | D0002          |
| Panadol   | Paracetamol |     2 | 25095      | D0001          |
+-----+-----+-----+-----+
6 rows in set (0.001 sec)

MariaDB [Medicine]>
```

- Pharmacies table

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p
+-----+-----+
6 rows in set (0.001 sec)

MariaDB [Medicine]>
MariaDB [Medicine]>
MariaDB [Medicine]>
MariaDB [Medicine]> INSERT INTO PHARMACIES values ('PH001','SPC','Olcott rd,Colombo','011-2955219');
Query OK, 1 row affected (0.023 sec)

MariaDB [Medicine]> INSERT INTO PHARMACIES values ('PH002','Union chemists','Colombo 10','011-2692532');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO PHARMACIES values ('PH003','Lanka','Colombo 01','011-2254789');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO PHARMACIES values ('PH004','Health Guard','Main rd,Dehiwala','011-4577782');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO PHARMACIES values ('PH005','Unique','Galle rd,Moratuwa','011-6879548');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO PHARMACIES values ('PH006','Nawaloka','Colombo 07','011-6871258');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> SELECT * FROM PHARMACIES;
+-----+-----+-----+-----+
| Pharmacy_ID | Name       | Address        | Contact_no   |
+-----+-----+-----+-----+
| PH001       | SPC        | Olcott rd,Colombo | 011-2955219 |
| PH002       | Union chemists | Colombo 10 | 011-2692532 |
| PH003       | Lanka       | Colombo 01 | 011-2254789 |
| PH004       | Health Guard | Main rd,Dehiwala | 011-4577782 |
| PH005       | Unique      | Galle rd,Moratuwa | 011-6879548 |
| PH006       | Nawaloka    | Colombo 07 | 011-6871258 |
+-----+-----+-----+-----+
6 rows in set (0.001 sec)

MariaDB [Medicine]>
```

- Employees table

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p
MariaDB [Medicine]> ALTER TABLE EMPLOYEES ADD Position varchar(15) not null AFTER Name ;
Query OK, 0 rows affected (0.015 sec)
Records: 0 Duplicates: 0 Warnings: 0

MariaDB [Medicine]> INSERT INTO EMPLOYEES values ('EM001','Shashika Perera','Superviser','PH001',NULL);
Query OK, 1 row affected (0.019 sec)

MariaDB [Medicine]> INSERT INTO EMPLOYEES values ('EM002','Pasan Narangoda','Supervisee','PH001','EM001');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO EMPLOYEES values ('EM003','Sandun Vishwanath','Superviser','PH002',NULL);
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO EMPLOYEES values ('EM004','Heshan Kumaradasa','Superviser','PH003',NULL);
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO EMPLOYEES values ('EM005','Dhanuka Kumara','Supervisee','PH003','EM004');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO EMPLOYEES values ('EM006','Anjana Gamage','Supervisee','PH002','EM003');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> SELECT * FROM EMPLOYEES;
+-----+-----+-----+-----+
| Employee_ID | Name      | Position | Pharmacy_id | Supervisor_ID |
+-----+-----+-----+-----+
| EM001       | Shashika Perera | Superviser | PH001     | NULL          |
| EM002       | Pasan Narangoda | Supervisee | PH001     | EM001         |
| EM003       | Sandun Vishwanath | Superviser | PH002     | NULL          |
| EM004       | Heshan Kumaradasa | Superviser | PH003     | NULL          |
| EM005       | Dhanuka Kumara | Supervisee | PH003     | EM004         |
| EM006       | Anjana Gamage | Supervisee | PH002     | EM003         |
+-----+-----+-----+-----+
6 rows in set (0.000 sec)

MariaDB [Medicine]>
```

- Pharmacy owners table

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p
MariaDB [Medicine]> INSERT INTO PHARMACY OWNERS values ('PH001','Dhammika Perera');
Query OK, 1 row affected (0.019 sec)

MariaDB [Medicine]> INSERT INTO PHARMACY OWNERS values ('PH001','Jagath Vithana');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO PHARMACY OWNERS values ('PH002','Rohana Silva');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO PHARMACY OWNERS values ('PH003','Dhammika Perera');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO PHARMACY OWNERS values ('PH004','Dhammika Perera');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO PHARMACY OWNERS values ('PH005','Ashen Silva');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO PHARMACY OWNERS values ('PH006','Kumara Fernando');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> SELECT * FROM PHARMACY OWNERS;
+-----+-----+
| Pharmacy_ID | Owner_name   |
+-----+-----+
| PH001       | Dhammika Perera |
| PH001       | Jagath Vithana  |
| PH002       | Rohana Silva   |
| PH003       | Dhammika Perera |
| PH004       | Dhammika Perera |
| PH005       | Ashen Silva    |
| PH006       | Kumara Fernando|
+-----+-----+
7 rows in set (0.001 sec)

MariaDB [Medicine]>
```

- Contract junction table

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" --uroot -p
7 rows in set (0.001 sec)

MariaDB [Medicine]> INSERT INTO CONTRACT_JUNCTION_TABLE values ('D0001','PH001');
Query OK, 1 row affected (0.016 sec)

MariaDB [Medicine]> INSERT INTO CONTRACT_JUNCTION_TABLE values ('D0001','PH002');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO CONTRACT_JUNCTION_TABLE values ('D0002','PH005');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO CONTRACT_JUNCTION_TABLE values ('D0002','PH003');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO CONTRACT_JUNCTION_TABLE values ('D0003','PH004');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO CONTRACT_JUNCTION_TABLE values ('D0006','PH001');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> SELECT * FROM CONTRACT_JUNCTION_TABLE;
+-----+-----+
| Manufacturer_reg_no | Pharmacy_ID |
+-----+-----+
| D0001                | PH001      |
| D0001                | PH002      |
| D0002                | PH005      |
| D0002                | PH003      |
| D0003                | PH004      |
| D0006                | PH001      |
+-----+-----+
6 rows in set (0.001 sec)

MariaDB [Medicine]>
```

- Sales junction tables

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" --uroot -p
MariaDB [Medicine]> INSERT INTO SALES_JUNCTION_TABLE values ('Panadol','PH001');
ERROR 1406 (22001): Data too long for column 'Drug_Trade_Name' at row 1
MariaDB [Medicine]>
MariaDB [Medicine]> ALTER TABLE SALES_JUNCTION_TABLE MODIFY Drug_Trade_Name varchar(15) not null;
ERROR 1832 (HY000): Cannot change column 'Drug_Trade_Name': used in a foreign key constraint 'fk5'
MariaDB [Medicine]> ALTER TABLE SALES_JUNCTION_TABLE DROP CONSTRAINT fk5;
Query OK, 0 rows affected (0.006 sec)
Records: 0  Duplicates: 0  Warnings: 0

MariaDB [Medicine]> ALTER TABLE SALES_JUNCTION_TABLE MODIFY Drug_Trade_Name varchar(15) not null;
Query OK, 0 rows affected (0.158 sec)
Records: 0  Duplicates: 0  Warnings: 0

MariaDB [Medicine]> ALTER TABLE SALES_JUNCTION_TABLE add constraint fk5 foreign key(Drug_Trade_Name) references DRUGS(Trade_name) on delete cascade on update cascade;
Query OK, 0 rows affected (0.266 sec)
Records: 0  Duplicates: 0  Warnings: 0

MariaDB [Medicine]> INSERT INTO SALES_JUNCTION_TABLE values ('Panadol','PH001');
Query OK, 1 row affected (0.009 sec)

MariaDB [Medicine]> INSERT INTO SALES_JUNCTION_TABLE values ('Panadol','PH002');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO SALES_JUNCTION_TABLE values ('Pacidol','PH003');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO SALES_JUNCTION_TABLE values ('Amoxil','PH004');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO SALES_JUNCTION_TABLE values ('Codopyron','PH001');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> INSERT INTO SALES_JUNCTION_TABLE values ('Gluctrol','PH001');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> SELECT * FROM SALES_JUNCTION_TABLE;
+-----+-----+
| Drug_Trade_Name | Pharmacy_ID |
+-----+-----+
| Panadol        | PH001      |
| Panadol        | PH002      |
| Pacidol         | PH003      |
| Amoxil          | PH004      |
| Codopyron       | PH001      |
| Gluctrol         | PH001      |
+-----+-----+
6 rows in set (0.000 sec)

MariaDB [Medicine]>
```

## 4.5 Updating and deleting from tables

- Doctors table

The screenshot shows a MySQL Client window with the following commands and output:

```
MariaDB [Medicine]> UPDATE DOCTORS set Speciality='Family Surgeon' where MBBS_REG_NO='25095';
Query OK, 1 row affected (0.003 sec)
Rows matched: 1 Changed: 1 Warnings: 0

MariaDB [Medicine]> UPDATE DOCTORS set Address='Galle rd,Dehiwala' where MBBS_REG_NO='24825';
Query OK, 1 row affected (0.002 sec)
Rows matched: 1 Changed: 1 Warnings: 0

MariaDB [Medicine]> DELETE FROM DOCTORS where MBBS_REG_NO='25022';
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> SELECT * FROM DOCTORS;
+-----+-----+-----+-----+
| MBBS_Reg_no | Name | Address | Speciality |
+-----+-----+-----+-----+
| 24825 | Lakshman Silva | Galle rd,Dehiwala | Neurologist |
| 24952 | Sanduni Wickramanayake | No.65,Air force rd,Rathmalana | Cardiologist |
| 25095 | Udaya Wijekoon | Temple rd,Kelaniya | Family Surgeon |
| 25511 | Asela Wickramanayake | No.65,Air force rd,Rathmalana | Cardiologist |
| 25721 | Lakshman Silva | Galle rd,Panadura | Dentist |
+-----+-----+-----+-----+
5 rows in set (0.001 sec)

MariaDB [Medicine]>
```

The taskbar at the bottom shows various open applications including File Explorer, Edge, and Office.

- Hospitals table

The screenshot shows a MySQL Client window with the following commands and output:

```
MariaDB [Medicine]> UPDATE HOSPITALS set Hospital_name='Nawaloka hospital' where (MBBS_reg_no='24952')AND( Hospital_name='Asiri pvt Hospital');
Query OK, 1 row affected (0.004 sec)
Rows matched: 1 Changed: 1 Warnings: 0

MariaDB [Medicine]> UPDATE HOSPITALS set Hospital_name='Gampaha Gen hospital' where (MBBS_reg_no='25721');
Query OK, 1 row affected (0.002 sec)
Rows matched: 1 Changed: 1 Warnings: 0

MariaDB [Medicine]> DELETE FROM HOSPITALS where (MBBS_REG_NO='25511')AND( Hospital_name='Lanka pvt hospital');
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> SELECT * FROM HOSPITALS;
+-----+-----+
| MBBS_Reg_no | Hospital_name |
+-----+-----+
| 25511 | Colombo Gen Hospital |
| 24952 | Ragama Gen Hospital |
| 24952 | Nawaloka hospital |
| 25721 | Gampaha Gen hospital |
| 24925 | Colombo Gen Hospital |
| 25095 | Ragama Gen Hospital |
+-----+-----+
5 rows in set (0.000 sec)

MariaDB [Medicine]>
```

The taskbar at the bottom shows various open applications including File Explorer, Edge, and Office.

- Patients table

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p
6 rows in set (0.000 sec)

MariaDB [Medicine]> UPDATE PATIENTS set Name = 'Ashoka Perera' where Patient_id='P0920';
Query OK, 1 row affected (0.003 sec)
Rows matched: 1 Changed: 1 Warnings: 0

MariaDB [Medicine]> UPDATE PATIENTS set Street = 'Pushparama rd',City = 'Gampaha',District = 'Gampaha' where Patient_id='P0525';
Query OK, 1 row affected (0.002 sec)
Rows matched: 1 Changed: 1 Warnings: 0

MariaDB [Medicine]> DELETE FROM PATIENTS where Patient_id = 'P0011';
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> SELECT * FROM PATIENTS;
+-----+-----+-----+-----+-----+-----+-----+
| Patient_ID | Name | Sex | Age | Street | City | District |
+-----+-----+-----+-----+-----+-----+-----+
| P0001 | Ruwan Sanjaya | M | 11 | Hill street | Nagoda | Kalutara |
| P0152 | Nimal Perera | M | 52 | Beach rd | Mount-Lavinia | Colombo |
| P0154 | Ranjith Fernando | M | 39 | Church rd | Ja-Ela | Gampaha |
| P0525 | Nimal Silva | M | 63 | Pushparama rd | Gampaha | Gampaha |
| P0920 | Ashoka Perera | F | 42 | Temple rd | Nugegoda | Colombo |
+-----+-----+-----+-----+-----+-----+-----+
5 rows in set (0.001 sec)

MariaDB [Medicine]>
```

- Chronic diseases table

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p
MariaDB [Medicine]>
MariaDB [Medicine]>
MariaDB [Medicine]>
MariaDB [Medicine]> UPDATE CHRONIC_DISEASES set Chronic_disease = 'Diabetes' where (Patient_id = 'P0525');
Query OK, 1 row affected (0.002 sec)
Rows matched: 1 Changed: 1 Warnings: 0

MariaDB [Medicine]> UPDATE CHRONIC_DISEASES set Chronic_disease = 'Heart Disease' where (Patient_id = 'P0154');
Query OK, 1 row affected (0.002 sec)
Rows matched: 1 Changed: 1 Warnings: 0

MariaDB [Medicine]> DELETE FROM CHRONIC_DISEASES where (Patient_id = 'P0920')AND( Chronic_disease = 'Lung Cancer');
Query OK, 1 row affected (0.003 sec)

MariaDB [Medicine]> SELECT * FROM CHRONIC_DISEASES;
+-----+-----+
| Patient_id | Chronic_Disease |
+-----+-----+
| P0001 | NULL |
| P0154 | Heart Disease |
| P0152 | Diabetes |
| P0152 | Blood Pressure |
| P0525 | Diabetes |
| P0920 | Blood Pressure |
| P0920 | Diabetes |
+-----+-----+
7 rows in set (0.001 sec)

MariaDB [Medicine]>
```

- Drugs table

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" --defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini -uroot -p
MariaDB [Medicine]> UPDATE DRUGS set Tablet_price_LKR = '3' where Trade_name = 'Panadol';
Query OK, 1 row affected (0.002 sec)
Rows matched: 1 Changed: 1 Warnings: 0

MariaDB [Medicine]> UPDATE DRUGS set Tablet_price_LKR = '9' where Trade_name = 'Amoxil';
Query OK, 1 row affected (0.002 sec)
Rows matched: 1 Changed: 1 Warnings: 0

MariaDB [Medicine]> DELETE FROM DRUGS where Trade_name = 'Anacin';
Query OK, 1 row affected (0.003 sec)

MariaDB [Medicine]> SELECT * FROM DRUGS;
+-----+-----+-----+-----+
| Trade_name | Common_name | Tablet_price_LKR | Prescribed_Doctor_MBBS_no | Manufacturer_Reg_no |
+-----+-----+-----+-----+
| Amoxil    | Amoxiline   | 9              | 25095                  | D0003                |
| Codopyron | Asprin      | 5              | 24952                  | D0001                |
| Gluctrol   | Glipzide     | 10             | 24952                  | D0006                |
| Pacidol   | Paracetamol  | 1              | 24825                  | D0002                |
| Panadol   | Paracetamol  | 3              | 25095                  | D0001                |
+-----+-----+-----+-----+
5 rows in set (0.001 sec)

MariaDB [Medicine]>
```

- Drug manufacturers table

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" --defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini -uroot -p
5 rows in set (0.001 sec)

MariaDB [Medicine]> UPDATE DRUG_MANUFACTURERS set Name = 'GSK Pharmaceuticals' where Reg_no = 'D0001';
Query OK, 1 row affected (0.002 sec)
Rows matched: 1 Changed: 1 Warnings: 0

MariaDB [Medicine]> UPDATE DRUG_MANUFACTURERS set No_of_factories = '4' where Reg_no = 'D0006';
Query OK, 1 row affected (0.002 sec)
Rows matched: 1 Changed: 1 Warnings: 0

MariaDB [Medicine]> DELETE FROM DRUG_MANUFACTURERS where Reg_no = 'D0004';
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> SELECT * FROM DRUG_MANUFACTURERS;
+-----+-----+-----+
| Reg_no | Name          | Address           | No_of_factories |
+-----+-----+-----+
| D0001 | GSK Pharmaceuticals | No.15,Main rd,Colombo 01 | 3               |
| D0002 | Sun pharmaceuticals | Nugegoda,Colombo | 1               |
| D0003 | Astron pharmaceuticals | No.96,Kandy rd,Kelaniya | 1               |
| D0005 | Morisons products | Main rd,Homagama | 4               |
| D0006 | SPMC products | Kandawala estate,Rathmalana | 4               |
+-----+-----+-----+
5 rows in set (0.001 sec)

MariaDB [Medicine]>
```

- Pharmacies table

```
MySQL Client (MariaDB 10.5 (x64) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p
5 rows in set (0.001 sec)

MariaDB [Medicine]> UPDATE PHARMACIES set Contact_no = '011-6988083' where Name = 'SPC';
Query OK, 1 row affected (0.003 sec)
Rows matched: 1 Changed: 1 Warnings: 0

MariaDB [Medicine]> UPDATE PHARMACIES set Contact_no = '038-2233401',Address = 'Temple rd,Pandura' where Name = 'Unique';
Query OK, 1 row affected (0.002 sec)
Rows matched: 1 Changed: 1 Warnings: 0

MariaDB [Medicine]> DELETE FROM PHARMACIES where Pharmacy_id = 'PH006';
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> SELECT * FROM PHARMACIES;
+-----+-----+-----+
| Pharmacy_ID | Name | Address |
+-----+-----+-----+
| PH001 | SPC | Olcott rd,Colombo |
| PH002 | Union chemists | Colombo 10 |
| PH003 | Lanka | Colombo 01 |
| PH004 | Health Guard | Main rd,Dehiwala |
| PH005 | Unique | Temple rd,Pandura |
+-----+-----+-----+
5 rows in set (0.000 sec)

MariaDB [Medicine]>
```

- Pharmacy owners table

```
MySQL Client (MariaDB 10.5 (x64) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p
5 rows in set (0.000 sec)

MariaDB [Medicine]> UPDATE PHARMACY OWNERS set Owner_name = 'Ajith Bandara' where (Pharmacy_id = 'PH001')AND(Owner_name = 'Dhammika Perera');
Query OK, 1 row affected (0.002 sec)
Rows matched: 1 Changed: 1 Warnings: 0

MariaDB [Medicine]> UPDATE PHARMACY OWNERS set Owner_name = 'Dhammika Perera' where (Pharmacy_id = 'PH005');
Query OK, 1 row affected (0.002 sec)
Rows matched: 1 Changed: 1 Warnings: 0

MariaDB [Medicine]> DELETE FROM PHARMACY OWNERS where Pharmacy_id = 'PH002';
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> SELECT * FROM PHARMACY OWNERS;
+-----+-----+
| Pharmacy_ID | Owner_name |
+-----+-----+
| PH001 | Ajith Bandara |
| PH001 | Jagath Vithana |
| PH003 | Dhammika Perera |
| PH004 | Dhammika Perera |
| PH005 | Dhammika Perera |
+-----+-----+
5 rows in set (0.000 sec)

MariaDB [Medicine]>
```

- Contract junction table

```
c:\ MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p
MariaDB [Medicine]> UPDATE CONTRACT_JUNCTION_TABLE set Manufacturer_Reg_no = 'D0003' where Pharmacy_id = 'PH005';
Query OK, 1 row affected (0.002 sec)
Rows matched: 1 Changed: 1 Warnings: 0

MariaDB [Medicine]> UPDATE CONTRACT_JUNCTION_TABLE set Manufacturer_Reg_no = 'D0001' where Pharmacy_id = 'PH003';
Query OK, 1 row affected (0.002 sec)
Rows matched: 1 Changed: 1 Warnings: 0

MariaDB [Medicine]> DELETE FROM CONTRACT_JUNCTION_TABLE where Pharmacy_id = 'PH002';
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> SELECT * FROM CONTRACT_JUNCTION_TABLE;
+-----+-----+
| Manufacturer_Reg_no | Pharmacy_ID |
+-----+-----+
| D0001               | PH001      |
| D0003               | PH005      |
| D0001               | PH003      |
| D0003               | PH004      |
| D0006               | PH001      |
+-----+-----+
5 rows in set (0.000 sec)

MariaDB [Medicine]>
```

- Sales junction table

```
c:\ MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p
+-----+-----+
| Drug_Trade_Name | Pharmacy_ID |
+-----+-----+
5 rows in set (0.000 sec)

MariaDB [Medicine]> UPDATE SALES_JUNCTION_TABLE set Drug_trade_name = 'Panadol' where Pharmacy_id = 'PH003';
Query OK, 1 row affected (0.002 sec)
Rows matched: 1 Changed: 1 Warnings: 0

MariaDB [Medicine]> UPDATE SALES_JUNCTION_TABLE set Pharmacy_id = 'PH005' where Drug_trade_name = 'Amoxil' ;
Query OK, 1 row affected (0.002 sec)
Rows matched: 1 Changed: 1 Warnings: 0

MariaDB [Medicine]> DELETE FROM SALES_JUNCTION_TABLE where Pharmacy_id = 'PH002';
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> SELECT * FROM SALES_JUNCTION_TABLE;
+-----+-----+
| Drug_Trade_Name | Pharmacy_ID |
+-----+-----+
| Panadol          | PH001      |
| Panadol          | PH003      |
| Amoxil           | PH005      |
| Codopyron        | PH001      |
| Gluctrol          | PH001      |
+-----+-----+
5 rows in set (0.001 sec)

MariaDB [Medicine]>
```

- Employees table

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p

MariaDB [Medicine]>
MariaDB [Medicine]>
MariaDB [Medicine]> UPDATE EMPLOYEES set Supervisor_id = NULL,Position = 'Supervisor' where (Employee_id = 'EM002');
Query OK, 1 row affected (0.005 sec)
Rows matched: 1 Changed: 1 Warnings: 0

MariaDB [Medicine]> UPDATE EMPLOYEES set Supervisor_id = 'EM002',Position = 'Supervisee' where (Employee_id = 'EM001');
Query OK, 1 row affected (0.002 sec)
Rows matched: 1 Changed: 1 Warnings: 0

MariaDB [Medicine]> DELETE FROM EMPLOYEES where Employee_id = 'EM005';
Query OK, 1 row affected (0.002 sec)

MariaDB [Medicine]> SELECT * FROM EMPLOYEES;
+-----+-----+-----+-----+
| Employee_ID | Name      | Position   | Pharmacy_id | Supervisor_ID |
+-----+-----+-----+-----+
| EM001       | Shashika Perera | Supervisee | PH001      | EM002         |
| EM002       | Pasan Narangoda | Supervisor  | PH001      | NULL          |
| EM003       | Sandun Vishwanath | Supervisor  | PH002      | NULL          |
| EM004       | Heshan Kumaradasa | Supervisor  | PH003      | NULL          |
| EM006       | Anjana Gamage    | Supervisee | PH002      | EM003         |
+-----+-----+-----+-----+
5 rows in set (0.000 sec)

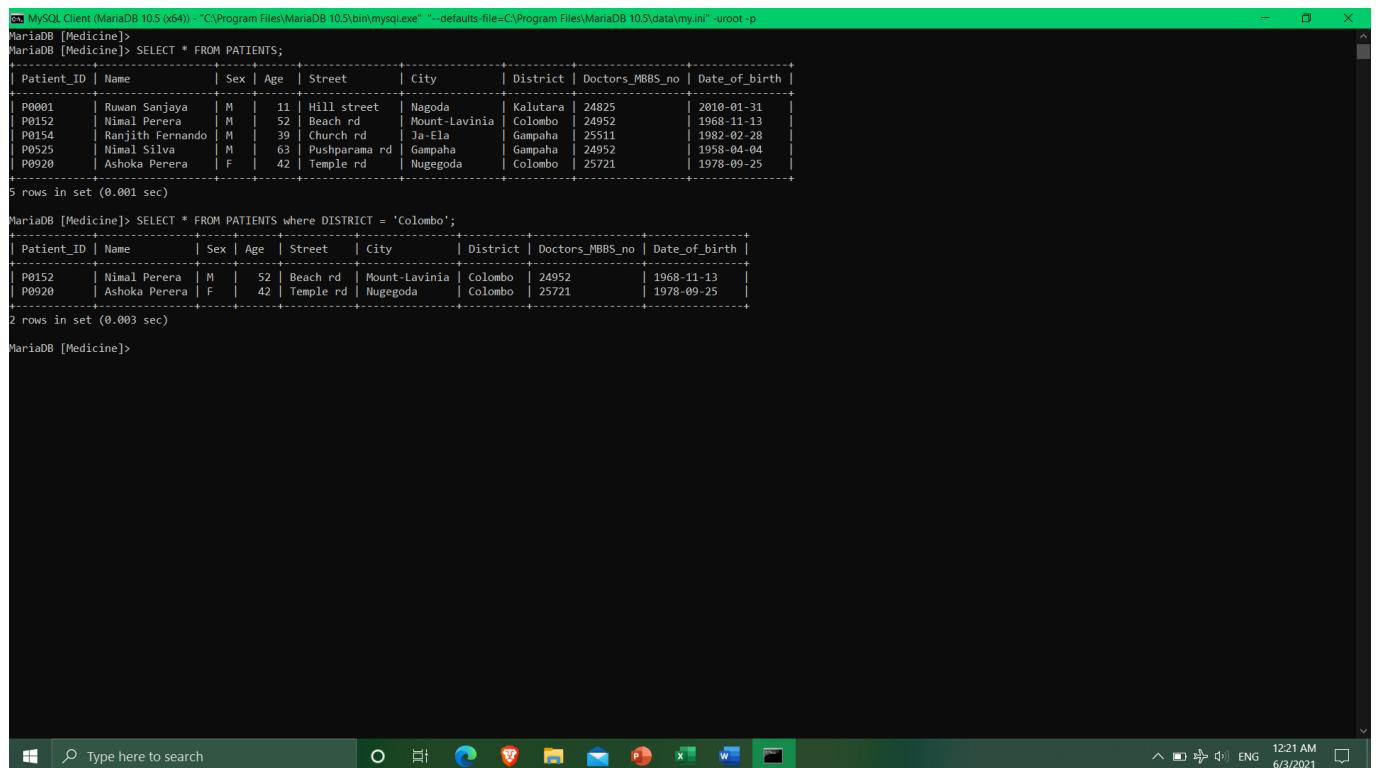
MariaDB [Medicine]>
```

# Chapter 5 – Transactions

Seven simple queries and thirteen complex queries is performed according to given instructions. Screenshots are shown below. Tables used for each transaction are retrieved first in order to give clear understanding about the transaction. After that query is performed.

## 5.1 Simple queries

- Select operation



The screenshot shows a MySQL Client window with two SQL queries run against a 'Medicine' database. The first query retrieves all rows from the 'PATIENTS' table:

```
MariaDB [Medicine]> SELECT * FROM PATIENTS;
```

Patient_ID	Name	Sex	Age	Street	City	District	Doctors_MBB5_no	Date_of_birth
P0001	Ruhan Sanjaya	M	11	Hill street	Nagoda	Kalutara	24825	2010-01-31
P0152	Nimal Perera	M	52	Beach rd	Mount-Lavinia	Colombo	24952	1968-11-13
P0154	Ranjith Fernando	M	39	Church rd	Ja-Ela	Gampaha	25511	1982-02-28
P0525	Nimal Silva	M	63	Pushparama rd	Gampaha	Gampaha	24952	1958-04-04
P0920	Ashoka Perera	F	42	Temple rd	Nugegoda	Colombo	25721	1978-09-25

5 rows in set (0.001 sec)

The second query retrieves rows from the 'PATIENTS' table where the 'District' is 'Colombo':

```
MariaDB [Medicine]> SELECT * FROM PATIENTS where DISTRICT = 'Colombo';
```

Patient_ID	Name	Sex	Age	Street	City	District	Doctors_MBB5_no	Date_of_birth
P0152	Nimal Perera	M	52	Beach rd	Mount-Lavinia	Colombo	24952	1968-11-13
P0920	Ashoka Perera	F	42	Temple rd	Nugegoda	Colombo	25721	1978-09-25

2 rows in set (0.003 sec)

```
MariaDB [Medicine]>
```

- Project operation

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p
MariaDB [Medicine]> SELECT * FROM DOCTORS;
+-----+-----+-----+
| MBBS_Reg_no | Name          | Address        | Speciality    |
+-----+-----+-----+
| 24825       | Lakshman Silva | Galle rd,Dehiwala | Neurologist   |
| 24952       | Sanduni Wickramanayake | No.65,Air force rd,Rathmalana | Cardiologist |
| 25095       | Udaya Wijekoon | Temple rd,Kelaniya | Family Surgeon |
| 25511       | Asela Wickramanayake | No.65,Air force rd,Rathmalana | Cardiologist |
| 25721       | Lakshman Silva | Galle rd,Panadura | Dentist       |
+-----+-----+-----+
5 rows in set (0.000 sec)

MariaDB [Medicine]> SELECT NAME,SPECIALITY FROM DOCTORS;
+-----+-----+
| NAME      | SPECIALITY |
+-----+-----+
| Lakshman Silva | Neurologist   |
| Sanduni Wickramanayake | Cardiologist |
| Udaya Wijekoon | Family Surgeon |
| Asela Wickramanayake | Cardiologist |
| Lakshman Silva | Dentist       |
+-----+-----+
5 rows in set (0.001 sec)

MariaDB [Medicine]>
```

- Cartesian product operation

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p
MariaDB [Medicine]> SELECT * FROM PHARMACIES;
+-----+-----+-----+-----+
| Pharmacy_ID | Name          | Address        | Contact_no   |
+-----+-----+-----+-----+
| PH001       | SPC           | Olcott rd,Colombo | 011-6980003 |
| PH002       | Union chemists | Colombo 10     | 011-2692532 |
| PH003       | Lanka          | Colombo 01     | 011-2254789 |
| PH004       | Health Guard   | Main rd,Dehiwala | 011-4577782 |
| PH005       | Unique          | Temple rd,Pandura | 038-2233401 |
+-----+-----+-----+-----+
5 rows in set (0.001 sec)

MariaDB [Medicine]> SELECT * FROM PHARMACY OWNERS;
+-----+-----+
| Pharmacy_ID | Owner_name    |
+-----+-----+
| PH001       | Ajith Bandara |
| PH001       | Jagath Vithana |
| PH003       | Dhammika Perera |
| PH004       | Dhammika Perera |
| PH005       | Dhammika Perera |
+-----+-----+
5 rows in set (0.000 sec)

MariaDB [Medicine]> SELECT * FROM PHARMACY OWNERS CROSS JOIN PHARMACIES;
+-----+-----+-----+-----+-----+
| Pharmacy_ID | Owner_name    | Pharmacy_ID | Name          | Address        | Contact_no   |
+-----+-----+-----+-----+-----+
| PH001       | Ajith Bandara | PH001       | SPC           | Olcott rd,Colombo | 011-6980003 |
| PH001       | Jagath Vithana | PH001       | SPC           | Olcott rd,Colombo | 011-6980003 |
| PH003       | Dhammika Perera | PH001       | SPC           | Olcott rd,Colombo | 011-6980003 |
| PH004       | Dhammika Perera | PH001       | SPC           | Olcott rd,Colombo | 011-6980003 |
| PH005       | Dhammika Perera | PH001       | SPC           | Olcott rd,Colombo | 011-6980003 |
| PH001       | Ajith Bandara | PH002       | Union chemists | Colombo 10     | 011-2692532 |
| PH001       | Jagath Vithana | PH002       | Union chemists | Colombo 10     | 011-2692532 |
| PH003       | Dhammika Perera | PH002       | Union chemists | Colombo 10     | 011-2692532 |
| PH004       | Dhammika Perera | PH002       | Union chemists | Colombo 10     | 011-2692532 |
| PH005       | Dhammika Perera | PH002       | Union chemists | Colombo 10     | 011-2692532 |
| PH001       | Ajith Bandara | PH003       | Lanka          | Colombo 01     | 011-2254789 |
| PH001       | Jagath Vithana | PH003       | Lanka          | Colombo 01     | 011-2254789 |
| PH003       | Dhammika Perera | PH003       | Lanka          | Colombo 01     | 011-2254789 |
| PH004       | Dhammika Perera | PH003       | Lanka          | Colombo 01     | 011-2254789 |
| PH005       | Dhammika Perera | PH003       | Lanka          | Colombo 01     | 011-2254789 |
| PH001       | Ajith Bandara | PH004       | Health Guard   | Main rd,Dehiwala | 011-4577782 |
| PH001       | Jagath Vithana | PH004       | Health Guard   | Main rd,Dehiwala | 011-4577782 |
| PH003       | Dhammika Perera | PH004       | Health Guard   | Main rd,Dehiwala | 011-4577782 |
| PH004       | Dhammika Perera | PH004       | Health Guard   | Main rd,Dehiwala | 011-4577782 |
| PH005       | Dhammika Perera | PH004       | Health Guard   | Main rd,Dehiwala | 011-4577782 |
| PH001       | Ajith Bandara | PH005       | Unique          | Temple rd,Pandura | 038-2233401 |
| PH001       | Jagath Vithana | PH005       | Unique          | Temple rd,Pandura | 038-2233401 |
+-----+-----+-----+-----+-----+
5 rows in set (0.000 sec)
```

```

MySQL Client (MariaDB 10.5 (x64) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p)
5 rows in set (0.000 sec)

MariaDB [Medicine]> SELECT * FROM PHARMACY OWNERS CROSS JOIN PHARMACIES;
+-----+-----+-----+-----+-----+
| Pharmacy_ID | Owner_name | Pharmacy_ID | Name | Address | Contact_no |
+-----+-----+-----+-----+-----+
| PH001 | Ajith Bandara | PH001 | SPC | Olcott rd,Colombo | 011-69888893 |
| PH001 | Jagath Vithana | PH001 | SPC | Olcott rd,Colombo | 011-69888893 |
| PH003 | Dhammika Perera | PH001 | SPC | Olcott rd,Colombo | 011-69888893 |
| PH004 | Dhammika Perera | PH001 | SPC | Olcott rd,Colombo | 011-69888893 |
| PH005 | Dhammika Perera | PH001 | SPC | Olcott rd,Colombo | 011-69888893 |
| PH001 | Ajith Bandara | PH002 | Union chemists | Colombo 10 | 011-2692532 |
| PH001 | Jagath Vithana | PH002 | Union chemists | Colombo 10 | 011-2692532 |
| PH003 | Dhammika Perera | PH002 | Union chemists | Colombo 10 | 011-2692532 |
| PH004 | Dhammika Perera | PH002 | Union chemists | Colombo 10 | 011-2692532 |
| PH005 | Dhammika Perera | PH002 | Union chemists | Colombo 10 | 011-2692532 |
| PH001 | Ajith Bandara | PH003 | Lanka | Colombo 01 | 011-2254789 |
| PH001 | Jagath Vithana | PH003 | Lanka | Colombo 01 | 011-2254789 |
| PH003 | Dhammika Perera | PH003 | Lanka | Colombo 01 | 011-2254789 |
| PH004 | Dhammika Perera | PH003 | Lanka | Colombo 01 | 011-2254789 |
| PH005 | Dhammika Perera | PH003 | Lanka | Colombo 01 | 011-2254789 |
| PH001 | Ajith Bandara | PH004 | Health Guard | Main rd,Dehiwala | 011-4577782 |
| PH001 | Jagath Vithana | PH004 | Health Guard | Main rd,Dehiwala | 011-4577782 |
| PH003 | Dhammika Perera | PH004 | Health Guard | Main rd,Dehiwala | 011-4577782 |
| PH004 | Dhammika Perera | PH004 | Health Guard | Main rd,Dehiwala | 011-4577782 |
| PH005 | Dhammika Perera | PH004 | Health Guard | Main rd,Dehiwala | 011-4577782 |
| PH001 | Ajith Bandara | PH005 | Unique | Temple rd,Pandura | 038-2233401 |
| PH001 | Jagath Vithana | PH005 | Unique | Temple rd,Pandura | 038-2233401 |
| PH003 | Dhammika Perera | PH005 | Unique | Temple rd,Pandura | 038-2233401 |
| PH004 | Dhammika Perera | PH005 | Unique | Temple rd,Pandura | 038-2233401 |
| PH005 | Dhammika Perera | PH005 | Unique | Temple rd,Pandura | 038-2233401 |
+-----+-----+-----+-----+-----+
25 rows in set (0.002 sec)

MariaDB [Medicine]>

```

- Creating a user view

```

MySQL Client (MariaDB 10.5 (x64) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p)
2 rows in set (0.002 sec)

MariaDB [Medicine]> CREATE VIEW UV0 AS SELECT MBBS_Reg_no,Name FROM DOCTORS;
Query OK, 0 rows affected (0.007 sec)

MariaDB [Medicine]> SELECT * FROM UV0;
+-----+-----+
| MBBS_Reg_no | Name |
+-----+-----+
| 24825 | Lakshman Silva |
| 24952 | Sanduni Wickramanayake |
| 25095 | Udaya Wijekoon |
| 25511 | Asela Wickramanayake |
| 25721 | Lakshman Silva |
+-----+-----+
5 rows in set (0.014 sec)

MariaDB [Medicine]>

```

- Rename operation

```
MySQL Client (MariaDB 10.5 (x64) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p
MariaDB [Medicine]>
MariaDB [Medicine]> MariaDB [Medicine]> RENAME TABLE HOSPITALS TO WORKING_HOSPITALS;
Query OK, 0 rows affected (0.011 sec)

MariaDB [Medicine]> SHOW TABLES;
+-----+
| Tables_in_medicine |
+-----+
| chronic_diseases |
| contract_junction_table |
| doctors |
| drug_manufacturers |
| drugs |
| employees |
| patients |
| pharmacies |
| pharmacy_owners |
| sales_junction_table |
| uv@ |
| working_hospitals |
+-----+
12 rows in set (0.001 sec)

MariaDB [Medicine]>
```

- Demonstrating the use of an aggregation function (MAX function)

```
MySQL Client (MariaDB 10.5 (x64) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p
MariaDB [Medicine]>
MariaDB [Medicine]> SELECT * FROM PATIENTS;
+-----+-----+-----+-----+-----+-----+-----+-----+
| Patient_ID | Name | Sex | Age | Street | City | District | Doctors_MBBs_no | Date_of_birth |
+-----+-----+-----+-----+-----+-----+-----+-----+
| P0001 | Ruwan Sanjaya | M | 11 | Hill street | Nagoda | Kalutara | 24825 | 2010-01-31 |
| P0152 | Nimal Perera | M | 52 | Beach rd | Mount-Lavinia | Colombo | 24952 | 1968-11-13 |
| P0154 | Ranjith Fernando | M | 39 | Church rd | Ja-Ela | Gampaha | 25511 | 1982-02-28 |
| P0525 | Nimal Silva | M | 63 | Pushparama rd | Gampaha | Gampaha | 24952 | 1958-04-04 |
| P0920 | Ashoka Perera | F | 42 | Temple rd | Nugegoda | Colombo | 25721 | 1978-09-25 |
+-----+-----+-----+-----+-----+-----+-----+-----+
5 rows in set (0.001 sec)

MariaDB [Medicine]> SELECT * FROM PATIENTS where Age = (SELECT MAX(Age) FROM PATIENTS);
+-----+-----+-----+-----+-----+-----+-----+
| Patient_ID | Name | Sex | Age | Street | City | District | Doctors_MBBs_no | Date_of_birth |
+-----+-----+-----+-----+-----+-----+-----+
| P0525 | Nimal Silva | M | 63 | Pushparama rd | Gampaha | Gampaha | 24952 | 1958-04-04 |
+-----+-----+-----+-----+-----+-----+-----+
1 row in set (0.015 sec)

MariaDB [Medicine]>
```

- Demonstrating the use of LIKE keyword

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p
Empty set (0.002 sec)

MariaDB [Medicine]> SELECT * FROM DRUG_MANUFACTURERS;
+-----+-----+-----+
| Reg_no | Name | Address | No_of_factories |
+-----+-----+-----+
| D0001 | GSK Pharmaceuticals | No.15,Main rd,Colombo 01 | 3 |
| D0002 | Sun pharmaceuticals | Nugegoda,Colombo | 1 |
| D0003 | Astron pharmaceuticals | No.96,Kandy rd,Kelaniya | 1 |
| D0005 | Morisons products | Main rd,Homagama | 4 |
| D0006 | SPMC products | Kandawala estate,Rathmalana | 4 |
+-----+-----+-----+
5 rows in set (0.000 sec)

MariaDB [Medicine]> SELECT * FROM DRUG_MANUFACTURERS where (Name LIKE "%pharmaceuticals");
+-----+-----+-----+
| Reg_no | Name | Address | No_of_factories |
+-----+-----+-----+
| D0001 | GSK Pharmaceuticals | No.15,Main rd,Colombo 01 | 3 |
| D0002 | Sun pharmaceuticals | Nugegoda,Colombo | 1 |
| D0003 | Astron pharmaceuticals | No.96,Kandy rd,Kelaniya | 1 |
+-----+-----+-----+
3 rows in set (0.001 sec)

MariaDB [Medicine]>
```

Windows Taskbar:

- Type here to search
- Start button
- File Explorer
- Edge browser
- File Manager
- Mail
- Powerpoint
- Excel
- Word
- Snipping Tool
- Calculator
- System

System tray:

- Network icon
- Battery icon
- Speaker icon
- ENG
- 1253 AM
- 6/3/2021

## 5.2 Complex queries

Demonstration of basic set operations (union, intersection, set difference, division) without user views are shown below with aliasing.

- Union operation

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p
MariaDB [Medicine]>
MariaDB [Medicine]>
MariaDB [Medicine]> SELECT * FROM PATIENTS;
+-----+-----+-----+-----+-----+-----+-----+
| Patient_ID | Name | Sex | Age | Street | City | District |
+-----+-----+-----+-----+-----+-----+-----+
| P0001 | Ruwan Sanjaya | M | 11 | Hill street | Nagoda | Kalutara |
| P0152 | Nimal Perera | M | 52 | Beach rd | Mount-Lavinia | Colombo |
| P0154 | Ranjith Fernando | M | 39 | Church rd | Ja-Ela | Gampaha |
| P0525 | Nimal Silva | M | 63 | Pushparama rd | Gampaha | Gampaha |
| P0920 | Ashoka Perera | F | 42 | Temple rd | Nugegoda | Colombo |
+-----+-----+-----+-----+-----+-----+-----+
5 rows in set (0.001 sec)

MariaDB [Medicine]> (SELECT Name AS Patient_Name,City AS Living_city from PATIENTS where District = 'Colombo')
-> UNION
-> (SELECT Name AS Patient_Name,City AS Living_city from PATIENTS where District = 'Gampaha');
+-----+-----+
| Patient_Name | Living_city |
+-----+-----+
| Nimal Perera | Mount-Lavinia |
| Ashoka Perera | Nugegoda |
| Ranjith Fernando | Ja-Ela |
| Nimal Silva | Gampaha |
+-----+-----+
4 rows in set (0.002 sec)

MariaDB [Medicine]>
```

- Intersection operation

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p
2 rows in set (0.002 sec)

MariaDB [Medicine]> SELECT * FROM DRUGS;
+-----+-----+-----+-----+
| Trade_name | Common_name | Tablet_price_LKR | Prescribed_Doctor_MBBS_no | Manufacturer_Reg_no |
+-----+-----+-----+-----+
| Amoxil | Amoxiline | 9 | 25095 | D0003 |
| Codopyron | Asprin | 5 | 24952 | D0001 |
| Gluctrol | Glipzide | 10 | 24952 | D0006 |
| Pacidol | Paracetamol | 1 | 24825 | D0002 |
| Panadol | Paracetamol | 3 | 25095 | D0001 |
+-----+-----+-----+-----+
5 rows in set (0.001 sec)

MariaDB [Medicine]> (SELECT Trade_name AS Medicine_name,Tablet_price_LKR AS Price_of_a_tablet from DRUGS where (Tablet_price_LKR < 9))
-> INTERSECT
-> (SELECT Trade_name AS Medicine_name,Tablet_price_LKR AS Price_of_a_tablet from DRUGS where (Manufacturer_reg_no = 'D0001') OR (Manufacturer_reg_no = 'D0006'));
+-----+-----+
| Medicine_name | Price_of_a_tablet |
+-----+-----+
| Codopyron | 5 |
| Panadol | 3 |
+-----+-----+
2 rows in set (0.001 sec)

MariaDB [Medicine]>
```

- Set difference operation

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p

MariaDB [Medicine]> SELECT * FROM DRUG_MANUFACTURERS;
+-----+-----+-----+
| Reg_no | Name | Address | No_of_factories |
+-----+-----+-----+
| D0001 | GSK Pharmaceuticals | No.15,Main rd,Colombo 01 | 3 |
| D0002 | Sun pharmaceuticals | Nugegoda,Colombo | 1 |
| D0003 | Astron pharmaceuticals | No.96,Kandy rd,Kelaniya | 1 |
| D0005 | Morisons products | Main rd,Homagama | 4 |
| D0006 | SPMC products | Kandawala estate,Rathmalana | 4 |
+-----+-----+-----+
5 rows in set (0.000 sec)

MariaDB [Medicine]> (SELECT Name AS "Manufacturer name",No_of_factories AS "Number of factories" from DRUG_MANUFACTURERS)
-> EXCEPT
-> (SELECT Name AS "Manufacturer name",No_of_factories AS "Number of factories" from DRUG_MANUFACTURERS where No_of_factories = 1);
+-----+-----+
| Manufacturer name | Number of factories |
+-----+-----+
| GSK Pharmaceuticals | 3 |
| Morisons products | 4 |
| SPMC products | 4 |
+-----+-----+
3 rows in set (0.001 sec)

MariaDB [Medicine]>
```

- Division operation

$$R = R1 / R2$$

R1(First table in the screenshot), R2 (Second table in the screenshot), R (Third table in the screenshot)

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p

MariaDB [Medicine]>
MariaDB [Medicine]> SELECT * FROM CHRONIC_DISEASES;
+-----+-----+
| Patient_id | Chronic_Disease |
+-----+-----+
| P0001 | NULL |
| P0154 | Heart Disease |
| P0152 | Diabetes |
| P0152 | Blood Pressure |
| P0525 | Diabetes |
| P0920 | Blood Pressure |
| P0920 | Diabetes |
+-----+-----+
7 rows in set (0.001 sec)

MariaDB [Medicine]> select DISTINCT PATIENT_ID FROM CHRONIC_DISEASES WHERE PATIENT_ID = 'P0920' OR PATIENT_ID = 'P0152';
+-----+
| PATIENT_ID |
+-----+
| P0152 |
| P0920 |
+-----+
2 rows in set (0.001 sec)

MariaDB [Medicine]> SELECT DISTINCT chronic_disease from CHRONIC_DISEASES as c1
->   where not exists (( SELECT DISTINCT patient_id FROM CHRONIC_DISEASES WHERE PATIENT_ID = 'P0920' OR PATIENT_ID = 'P0152')
->   EXCEPT
->   (SELECT c2.patient_id from CHRONIC_DISEASES as c2 where c1.chronic_disease=c2.chronic_disease));
+-----+
| chronic_disease |
+-----+
| Diabetes |
| Blood Pressure |
+-----+
2 rows in set (0.001 sec)

MariaDB [Medicine]>
```

Representation of inner join, natural join, left outer join, right outer join, full outer join, outer union relational algebraic operations by using user views are shown below with aliasing. First, user views that are needed to demonstrate relevant operation, is created and shown. After that the operation is performed.

- Inner join operation

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" --uroot -p

MariaDB [Medicine]> CREATE VIEW UV1 AS (SELECT Name,Sex,Age,District,Doctors_MBBS_no FROM PATIENTS);
Query OK, 0 rows affected (0.004 sec)

MariaDB [Medicine]> CREATE VIEW UV2 AS (SELECT * FROM WORKING_HOSPITALS);
Query OK, 0 rows affected (0.003 sec)

MariaDB [Medicine]> SELECT * UV1;
ERROR 1064 (42000): You have an error in your SQL syntax; check the manual that corresponds to your MariaDB server version for the right syntax to use near 'UV1' at line 1
MariaDB [Medicine]> SELECT * FROM UV1;
+-----+-----+-----+-----+-----+
| Name | Sex | Age | District | Doctors_MBBS_no |
+-----+-----+-----+-----+-----+
| Ruwan Sanjaya | M | 11 | Kalutara | 24825 |
| Nimal Perera | M | 52 | Colombo | 24952 |
| Ranjith Fernando | M | 39 | Gampaha | 25511 |
| Nimal Silva | M | 63 | Gampaha | 24952 |
| Ashoka Perera | F | 42 | Colombo | 25721 |
+-----+-----+-----+-----+-----+
5 rows in set (0.009 sec)

MariaDB [Medicine]> SELECT * FROM UV2;
+-----+-----+
| MBBS_Reg_no | Hospital_name |
+-----+-----+
| 25511 | Colombo Gen Hospital |
| 24952 | Ragama Gen Hospital |
| 24952 | Nawaloka hospital |
| 25721 | Gampaha Gen hospital |
| 24825 | Colombo Gen Hospital |
| 25095 | Ragama Gen Hospital |
+-----+-----+
6 rows in set (0.013 sec)

MariaDB [Medicine]> SELECT * FROM UV1 AS View1 INNER JOIN UV2 AS View2 on View1.Doctors_MBBS_no = View2.MBBS_Reg_no where (View2.HOSPITAL_NAME LIKE "%Gen%");

+-----+-----+-----+-----+-----+-----+
| Name | Sex | Age | District | Doctors_MBBS_no | MBBS_Reg_no | Hospital_name |
+-----+-----+-----+-----+-----+-----+
| Ranjith Fernando | M | 39 | Gampaha | 25511 | 25511 | Colombo Gen Hospital |
| Nimal Perera | M | 52 | Colombo | 24952 | 24952 | Ragama Gen Hospital |
| Nimal Silva | M | 63 | Gampaha | 24952 | 24952 | Ragama Gen Hospital |
| Ashoka Perera | F | 42 | Colombo | 25721 | 25721 | Gampaha Gen hospital |
| Ruwan Sanjaya | M | 11 | Kalutara | 24825 | 24825 | Colombo Gen Hospital |
+-----+-----+-----+-----+-----+-----+
5 rows in set (0.001 sec)

MariaDB [Medicine]>
MariaDB [Medicine]>
```

- Natural join operation

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" --uroot -p

5 rows in set (0.001 sec)

MariaDB [Medicine]>
MariaDB [Medicine]>
MariaDB [Medicine]>
MariaDB [Medicine]>
MariaDB [Medicine]>
MariaDB [Medicine]> CREATE VIEW UV3 AS (SELECT Patient_id,Name,Sex,Age FROM PATIENTS);
Query OK, 0 rows affected (0.005 sec)

MariaDB [Medicine]> CREATE VIEW UV4 AS (SELECT * FROM CHRONIC_DISEASES);
Query OK, 0 rows affected (0.004 sec)

MariaDB [Medicine]> SELECT * FROM UV3;
+-----+-----+-----+-----+
| Patient_id | Name | Sex | Age |
+-----+-----+-----+-----+
| P0001 | Ruwan Sanjaya | M | 11 |
| P0152 | Nimal Perera | M | 52 |
| P0154 | Ranjith Fernando | M | 39 |
| P0525 | Nimal Silva | M | 63 |
| P0920 | Ashoka Perera | F | 42 |
+-----+-----+-----+-----+
5 rows in set (0.007 sec)

MariaDB [Medicine]> SELECT * FROM UV4;
+-----+-----+
| Patient_id | Chronic_Disease |
+-----+-----+
| P0001 | NULL |
| P0154 | Heart Disease |
| P0152 | Diabetes |
| P0152 | Blood Pressure |
| P0525 | Diabetes |
| P0920 | Blood Pressure |
| P0920 | Diabetes |
+-----+-----+
7 rows in set (0.007 sec)

MariaDB [Medicine]> SELECT * FROM UV3 AS view3 NATURAL JOIN UV4 AS view4 where (view4.Chronic_disease = 'Diabetes');
+-----+-----+-----+-----+
| Patient_id | Name | Sex | Age | Chronic_Disease |
+-----+-----+-----+-----+
| P0152 | Nimal Perera | M | 52 | Diabetes |
| P0525 | Nimal Silva | M | 63 | Diabetes |
| P0920 | Ashoka Perera | F | 42 | Diabetes |
+-----+-----+-----+-----+
3 rows in set (0.001 sec)
```

- Right outer join operation

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p

MariaDB [Medicine]> CREATE VIEW UV5 AS (SELECT * FROM PATIENTS);
Query OK, 0 rows affected (0.004 sec)

MariaDB [Medicine]> SELECT * FROM UV5;
+-----+-----+-----+-----+-----+-----+-----+
| Patient_ID | Name | Sex | Age | Street | City | District |
+-----+-----+-----+-----+-----+-----+-----+
| P0001 | Ruwan Sanjaya | M | 11 | Hill street | Nagoda | Kalutara |
| P0152 | Nimal Perera | M | 52 | Beach rd | Mount-Lavinia | Colombo |
| P0154 | Ranjith Fernando | M | 39 | Church rd | Ja-Ela | Gampaha |
| P0525 | Nimal Silva | M | 63 | Pushparama rd | Gampaha | Gampaha |
| P0920 | Ashoka Perera | F | 42 | Temple rd | Nugegoda | Colombo |
+-----+-----+-----+-----+-----+-----+-----+
5 rows in set (0.008 sec)

MariaDB [Medicine]> SELECT * FROM UV2;
+-----+-----+
| MBBS_Reg_no | Hospital_name |
+-----+-----+
| 25511 | Colombo Gen Hospital |
| 24952 | Ragama Gen Hospital |
| 24952 | Nawaloka hospital |
| 25721 | Gampaha Gen hospital |
| 24825 | Colombo Gen Hospital |
| 25095 | Ragama Gen Hospital |
+-----+-----+
6 rows in set (0.001 sec)

MariaDB [Medicine]> SELECT * FROM UV5 RIGHT OUTER JOIN UV2 AS view2 on view5.Doctors_MBBS_no = view2.MBBS_Reg_no where (view2.Hospital_name = 'Ragama Gen Hospital')OR(view2.Hospital_name='Gampaha Gen Hospital');
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Patient_ID | Name | Sex | Age | Street | City | District | Doctors_MBBS_no | MBBS_Reg_no | Hospital_name |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| P0152 | Nimal Perera | M | 52 | Beach rd | Mount-Lavinia | Colombo | 24952 | 1968-11-13 | Ragama Gen Hospital |
| P0525 | Nimal Silva | M | 63 | Pushparama rd | Gampaha | Gampaha | 24952 | 1958-04-04 | Ragama Gen Hospital |
| P0920 | Ashoka Perera | F | 42 | Temple rd | Nugegoda | Colombo | 25721 | 1978-09-25 | Gampaha Gen hospital |
| NULL | 25095 | Ragama Gen Hospital |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
4 rows in set (0.001 sec)

MariaDB [Medicine]>
```

- Left outer join operation

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p

MariaDB [Medicine]>
MariaDB [Medicine]> SELECT * FROM UV5;
+-----+-----+-----+-----+-----+-----+-----+
| Patient_ID | Name | Sex | Age | Street | City | District |
+-----+-----+-----+-----+-----+-----+-----+
| P0001 | Ruwan Sanjaya | M | 11 | Hill street | Nagoda | Kalutara |
| P0152 | Nimal Perera | M | 52 | Beach rd | Mount-Lavinia | Colombo |
| P0154 | Ranjith Fernando | M | 39 | Church rd | Ja-Ela | Gampaha |
| P0525 | Nimal Silva | M | 63 | Pushparama rd | Gampaha | Gampaha |
| P0920 | Ashoka Perera | F | 42 | Temple rd | Nugegoda | Colombo |
+-----+-----+-----+-----+-----+-----+-----+
5 rows in set (0.001 sec)

MariaDB [Medicine]> SELECT * FROM UV2;
+-----+-----+
| MBBS_Reg_no | Hospital_name |
+-----+-----+
| 25511 | Colombo Gen Hospital |
| 24952 | Ragama Gen Hospital |
| 24952 | Nawaloka hospital |
| 25721 | Gampaha Gen hospital |
| 24825 | Colombo Gen Hospital |
| 25095 | Ragama Gen Hospital |
+-----+-----+
6 rows in set (0.001 sec)

MariaDB [Medicine]> SELECT * FROM UV5 LEFT OUTER JOIN UV2 AS view2 on view5.Doctors_MBBS_no = view2.MBBS_Reg_no where (view2.Hospital_name = 'Ragama Gen Hospital')OR(view2.Hospital_name='Gampaha Gen Hospital');
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Patient_ID | Name | Sex | Age | Street | City | District | Doctors_MBBS_no | MBBS_Reg_no | Hospital_name |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| P0152 | Nimal Perera | M | 52 | Beach rd | Mount-Lavinia | Colombo | 24952 | 1968-11-13 | Ragama Gen Hospital |
| P0525 | Nimal Silva | M | 63 | Pushparama rd | Gampaha | Gampaha | 24952 | 1958-04-04 | Ragama Gen Hospital |
| P0920 | Ashoka Perera | F | 42 | Temple rd | Nugegoda | Colombo | 25721 | 1978-09-25 | Gampaha Gen hospital |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
3 rows in set (0.001 sec)

MariaDB [Medicine]>
```

- Full outer join operation

Union of the previously created right outer and left outer joins are used to demonstrate full outer join in the below screenshot.

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" --defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini -uroot -p
MariaDB [Medicine]>
MariaDB [Medicine]>
MariaDB [Medicine]> CREATE VIEW Right_outer_join_uv AS (SELECT * FROM UV5 RIGHT OUTER JOIN UV2 AS view2 on view5.Doctors_MBBS_no = view2.MBBS_Reg_no where (view2.Hospital_name = 'Ragama Gen Hospital')OR (view2.Hospital_name='Gampaha Gen Hospital'));
Query OK, 0 rows affected (0.004 sec)

MariaDB [Medicine]> CREATE VIEW Left_outer_join_uv AS (SELECT * FROM UV5 LEFT OUTER JOIN UV2 AS view2 on view5.Doctors_MBBS_no = view2.MBBS_Reg_no where (view2.Hospital_name = 'Ragama Gen Hospital')OR (view2.Hospital_name='Gampaha Gen Hospital'));
Query OK, 0 rows affected (0.004 sec)

MariaDB [Medicine]> SELECT * FROM Right_outer_join_uv;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Patient_ID | Name | Sex | Age | Street | city | District | Doctors_MBBS_no | MBBS_Reg_no | Hospital_name |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| P0152 | Nimal Perera | M | 52 | Beach rd | Mount-Lavinia | Colombo | 24952 | 1968-11-13 | 24952 | Ragama Gen Hospital |
| P0525 | Nimal Silva | M | 63 | Pushparama rd | Gampaha | Gampaha | 24952 | 1958-04-04 | 24952 | Ragama Gen Hospital |
| P0920 | Ashoka Perera | F | 42 | Temple rd | Nugegoda | Colombo | 25721 | 1978-09-25 | 25721 | Gampaha Gen hospital |
| NULL | Ragama Gen Hospital |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
4 rows in set (0.019 sec)

MariaDB [Medicine]> SELECT * FROM Left_outer_join_uv;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Patient_ID | Name | Sex | Age | Street | City | District | Doctors_MBBS_no | Date_of_birth | MBBS_Reg_no | Hospital_name |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| P0152 | Nimal Perera | M | 52 | Beach rd | Mount-Lavinia | Colombo | 24952 | 1968-11-13 | 24952 | Ragama Gen Hospital |
| P0525 | Nimal Silva | M | 63 | Pushparama rd | Gampaha | Gampaha | 24952 | 1958-04-04 | 24952 | Ragama Gen Hospital |
| P0920 | Ashoka Perera | F | 42 | Temple rd | Nugegoda | Colombo | 25721 | 1978-09-25 | 25721 | Gampaha Gen hospital |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
3 rows in set (0.018 sec)

MariaDB [Medicine]> SELECT * FROM Right_outer_join_uv
-> UNION
-> SELECT * FROM Left_outer_join_uv
-> ;
+-----+-----+-----+-----+-----+-----+-----+-----+
| Patient_ID | Name | Sex | Age | Street | city | District | Doctors_MBBS_no | MBBS_Reg_no | Hospital_name |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| P0152 | Nimal Perera | M | 52 | Beach rd | Mount-Lavinia | Colombo | 24952 | 1968-11-13 | 24952 | Ragama Gen Hospital |
| P0525 | Nimal Silva | M | 63 | Pushparama rd | Gampaha | Gampaha | 24952 | 1958-04-04 | 24952 | Ragama Gen Hospital |
| P0920 | Ashoka Perera | F | 42 | Temple rd | Nugegoda | Colombo | 25721 | 1978-09-25 | 25721 | Gampaha Gen hospital |
| NULL | Ragama Gen Hospital |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
4 rows in set (0.002 sec)

MariaDB [Medicine]>
```

- Outer union operation

Outer union of the pharmacies and the pharmacy owners table are demonstrated below

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" --defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini -uroot -p
MariaDB [Medicine]> SELECT * FROM PHARMACIES;
+-----+-----+-----+
| Pharmacy_ID | Name | Address | Contact_no |
+-----+-----+-----+
| PH001 | SPC | Olcott rd,Colombo | 011-6980003 |
| PH002 | Union chemists | Colombo 10 | 011-2692532 |
| PH003 | Lanka | Colombo 01 | 011-2254789 |
| PH004 | Health Guard | Main rd,Dehiwala | 011-4577782 |
| PH005 | Unique | Temple rd,Pandura | 038-2233401 |
+-----+-----+-----+
5 rows in set (0.001 sec)

MariaDB [Medicine]> SELECT * FROM PHARMACY OWNERS;
+-----+-----+
| Pharmacy_ID | Owner_name |
+-----+-----+
| PH001 | Ajith Bandara |
| PH001 | Jagath Vithana |
| PH003 | Dhammika Perera |
| PH004 | Dhammika Perera |
| PH005 | Dhammika Perera |
+-----+-----+
5 rows in set (0.000 sec)

MariaDB [Medicine]> CREATE VIEW UV6 AS ((SELECT * FROM PHARMACIES AS P NATURAL JOIN PHARMACY OWNERS AS PO) UNION (SELECT P.Phasy_ID,P.Name,P.Address,P.Contact_no,NULL FROM PHARMACIES AS P));
Query OK, 0 rows affected (0.004 sec)

MariaDB [Medicine]> SELECT * FROM UV6;
+-----+-----+-----+-----+
| Pharmacy_ID | Name | Address | Contact_no | Owner_name |
+-----+-----+-----+-----+
| PH001 | SPC | Olcott rd,Colombo | 011-6980003 | Ajith Bandara |
| PH001 | SPC | Olcott rd,Colombo | 011-6980003 | Jagath Vithana |
| PH003 | Lanka | Colombo 01 | 011-2254789 | Dhammika Perera |
| PH004 | Health Guard | Main rd,Dehiwala | 011-4577782 | Dhammika Perera |
| PH005 | Unique | Temple rd,Pandura | 038-2233401 | Dhammika Perera |
| PH001 | SPC | Olcott rd,Colombo | 011-6980003 | NULL |
| PH002 | Union chemists | Colombo 10 | 011-2692532 | NULL |
| PH003 | Lanka | Colombo 01 | 011-2254789 | NULL |
| PH004 | Health Guard | Main rd,Dehiwala | 011-4577782 | NULL |
| PH005 | Unique | Temple rd,Pandura | 038-2233401 | NULL |
+-----+-----+-----+-----+
10 rows in set (0.019 sec)

MariaDB [Medicine]> (SELECT * FROM UV6)
-> EXCEPT
-> (SELECT * FROM UV6 WHERE ((Pharmacy_id IN (SELECT Pharmacy_id FROM PHARMACY OWNERS)) AND (Owner_name is NULL)));
+-----+-----+-----+-----+
| Pharmacy_ID | Name | Address | Contact_no | Owner_name |
+-----+-----+-----+-----+

```

```

MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini"--uroot -p
| PH005 | Unique | Temple rd,Pandura | 038-2233401 | NULL |
+-----+-----+-----+-----+-----+
10 rows in set (0.019 sec)

MariaDB [Medicine]> (SELECT * FROM UV6
-> EXCEPT
-> (SELECT * FROM UV6 WHERE ((Pharmacy_id IN (SELECT Pharmacy_id FROM PHARMACY OWNERS)) AND (Owner_name is NULL)));
+-----+-----+-----+-----+-----+
| Pharmacy_ID | Name | Address | Contact_no | Owner_name |
+-----+-----+-----+-----+-----+
| PH001 | SPC | Olcott rd,Colombo | 011-6980803 | Ajith Bandara |
| PH001 | SPC | Olcott rd,Colombo | 011-6980803 | Jagath Vithana |
| PH003 | Lanka | Colombo 01 | 011-2254789 | Dharmika Perera |
| PH004 | Health Guard | Main rd,Dehiwala | 011-4577782 | Dharmika Perera |
| PH005 | Unique | Temple rd,Pandura | 038-2233401 | Dharmika Perera |
| PH002 | Union chemists | Colombo 10 | 011-2692532 | NULL |
+-----+-----+-----+-----+-----+
6 rows in set (0.002 sec)

MariaDB [Medicine]>

```

Nested queries in combination with any other relational algebraic operation are demonstrated below with aliasing.

- Nested query 1

Using this query, names and specialties of doctors who prescribed Paracetamol are retrieved.

```

MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini"--uroot -p
MariaDB [Medicine]>
MariaDB [Medicine]> SELECT * FROM DOCTORS;
+-----+-----+-----+-----+
| MBBS_Reg_no | Name | Address | Speciality |
+-----+-----+-----+-----+
| 24825 | Lakshman Silva | Galle rd,Dehiwala | Neurologist |
| 24952 | Sanduni Wickramanayake | No.65,Air force rd,Rathmalana | Cardiologist |
| 25095 | Udaya Wijekoon | Temple rd,Kelaniya | Family Surgeon |
| 25511 | Asela Wickramanayake | No.65,Air force rd,Rathmalana | Cardiologist |
| 25721 | Lakshman Silva | Galle rd,Panadura | Dentist |
+-----+-----+-----+-----+
5 rows in set (0.001 sec)

MariaDB [Medicine]> SELECT * FROM DRUGS;
+-----+-----+-----+-----+
| Trade_name | Common_name | Tablet_price_LKR | Prescribed_Doctor_MBBS_no | Manufacturer_Reg_no |
+-----+-----+-----+-----+
| Amoxil | Amoxilne | 9 | 25095 | D0003 |
| Codopryron | Asprin | 5 | 24952 | D0001 |
| Gluctrol | Glipizide | 10 | 24952 | D0006 |
| Pacidol | Paracetamol | 1 | 24825 | D0002 |
| Panadol | Paracetamol | 3 | 25095 | D0001 |
+-----+-----+-----+-----+
5 rows in set (0.001 sec)

MariaDB [Medicine]> SELECT DR.Name,DR.Speciality FROM DOCTORS AS DR WHERE DR.MBBS_Reg_no IN(SELECT D.Prescribed_doctor_MBBS_no FROM DRUGS AS D WHERE D.common_name = 'Paracetamol');
+-----+-----+
| Name | Speciality |
+-----+-----+
| Lakshman Silva | Neurologist |
| Udaya Wijekoon | Family Surgeon |
+-----+-----+
2 rows in set (0.001 sec)

MariaDB [Medicine]>

```

- Nested query 2

Using this query names, addresses and specialties of doctors who are seen by diabetic patients are retrieved

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p
MariaDB [Medicine]> SELECT * FROM DOCTORS;
+-----+-----+-----+
| MBBS_Reg_no | Name          | Address           | Speciality |
+-----+-----+-----+
| 24825       | Lakshman Silva | Galle rd,Dehiwala | Neurologist  |
| 24952       | Sanduni Wickramanayake | No.65,Air force rd,Rathmalana | Cardiologist |
| 25095       | Udaya Wijekoon | Temple rd,Kelaniya | Family Surgeon |
| 25511       | Asela Wickramanayake | No.65,Air force rd,Rathmalana | Cardiologist |
| 25721       | Lakshman Silva | Galle rd,Panadura | Dentist      |
+-----+-----+-----+
5 rows in set (0.000 sec)

MariaDB [Medicine]> SELECT * FROM PATIENTS;
+-----+-----+-----+-----+-----+-----+-----+
| Patient_ID | Name          | Sex   | Age   | Street        | City      | District | Doctors_MBBS_no | Date_of_birth |
+-----+-----+-----+-----+-----+-----+-----+
| P0001       | Ruwan Sanjaya | M    | 11    | Hill street   | Nagoda   | Kalutara | 24825      | 2010-01-31   |
| P0152       | Nimal Perera  | M    | 52    | Beach rd     | Mount-Lavinia | Colombo | 24952      | 1968-11-13   |
| P0154       | Ranjith Fernando | M    | 39    | Church rd   | Ja-Ela    | Gampaha | 25511      | 1982-02-28   |
| P0525       | Nimal Silva   | M    | 63    | Pushparama rd | Gampaha | Gampaha | 24952      | 1958-04-04   |
| P0920       | Ashoka Perera | F    | 42    | Temple rd    | Nugegoda | Colombo | 25721      | 1978-09-25   |
+-----+-----+-----+-----+-----+-----+-----+
5 rows in set (0.000 sec)

MariaDB [Medicine]> SELECT * FROM CHRONIC_DISEASES;
+-----+-----+
| Patient_id | Chronic_Disease |
+-----+-----+
| P0001       | NULL            |
| P0154       | Heart Disease   |
| P0152       | Diabetes         |
| P0152       | Blood Pressure   |
| P0525       | Diabetes         |
| P0920       | Blood Pressure   |
| P0920       | Diabetes         |
+-----+-----+
7 rows in set (0.000 sec)

MariaDB [Medicine]> SELECT DR.Name,DR.Address,DR.Speciality FROM DOCTORS AS DR WHERE DR.MBBS_Reg_no IN
-> (SELECT P.Doctors_MBBS_no FROM PATIENTS AS P WHERE P.Patient_id IN
-> (SELECT C.Patient_id FROM CHRONIC_DISEASES AS C WHERE C.CHRONIC_DISEASE = 'Diabetes'));
+-----+-----+-----+
| Name          | Address           | Speciality |
+-----+-----+-----+
| Sanduni Wickramanayake | No.65,Air Force rd,Rathmalana | Cardiologist |
| Lakshman Silva | Galle rd,Panadura | Dentist      |
+-----+-----+
2 rows in set (0.001 sec)

MariaDB [Medicine]>
```

- Nested query 3

Using this query, Names, addresses and contact numbers of pharmacies that are owned by Dhammika Perera are retrieved.

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p
MariaDB [Medicine]> SELECT * FROM PHARMACIES;
+-----+-----+-----+
| Pharmacy_ID | Name          | Address           | Contact_no |
+-----+-----+-----+
| PH001       | SPC           | Olcott rd,Colombo | 011-6980803 |
| PH002       | Union chemists | Colombo 10        | 011-2602532 |
| PH003       | Lanka          | Colombo 01        | 011-2254789 |
| PH004       | Health Guard   | Main rd,Dehiwala | 011-4577782 |
| PH005       | Unique          | Temple rd,Pandura | 038-2233401 |
+-----+-----+-----+
5 rows in set (0.001 sec)

MariaDB [Medicine]> SELECT * FROM PHARMACY OWNERS;
+-----+-----+
| Pharmacy_ID | Owner_name   |
+-----+-----+
| PH001       | Ajith Bandara |
| PH001       | Jagath Vithana |
| PH003       | Dhammika Perera |
| PH004       | Dhammika Perera |
| PH005       | Dhammika Perera |
+-----+-----+
5 rows in set (0.000 sec)

MariaDB [Medicine]> SELECT P.Name,P.Address,P.Contact_no FROM PHARMACIES AS P Where Pharmacy_id IN (SELECT PO.Pharmacy_id FROM PHARMACY OWNERS AS PO WHERE Owner_name = 'Dhammika Perera');
+-----+-----+-----+
| Name          | Address           | Contact_no |
+-----+-----+-----+
| Lanka          | Colombo 01        | 011-2254789 |
| Health Guard   | Main rd,Dehiwala | 011-4577782 |
| Unique          | Temple rd,Pandura | 038-2233401 |
+-----+-----+
3 rows in set (0.001 sec)

MariaDB [Medicine]>
```

# Chapter 6 - Database Tuning

Tuning of 10 selected complex queries that have written in chapter 5 is tuned using indexing technique. Following steps are taken in query tuning for each complex query in order to provide a clear understanding.

- Drop existing indexes that are externally created in used tables
- Show indexes of table before creating suitable index (using SHOW INDEX command)
- Show number of accessed rows before creating suitable index (using EXPLAIN command)
- Create suitable index in order to tune the query
- Show indexes of table after creating suitable index (using SHOW INDEX command)
- Show number of accessed rows after creating suitable index (using EXPLAIN command)

Tuning of a query is shown by comparing number of accessed rows in explain table, before creating suitable index and after creating that index. If there is a decrement of accessed rows after creating index, we can say that the query is tuned properly. In all screenshots that are included below satisfy that requirement.

- Tunning of Union operation

The screenshot shows a MySQL Client window with the following session history:

```
MariaDB [Medicine]> SHOW INDEX FROM PATIENTS;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| patients | 0 | PRIMARY | 1 | Patient_ID | A | 5 | NULL | BTREE |
| patients | 1 | fk2 | 1 | Doctors_MBBS_no | A | 5 | NULL | BTREE |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
2 rows in set (0.002 sec)

MariaDB [Medicine]> EXPLAIN((SELECT Name AS Patient_Name,City AS Living_city from PATIENTS where District = 'Colombo')
-> UNION
-> (SELECT Name AS Patient_Name,City AS Living_city from PATIENTS where District = 'Gampaha'));
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | type | possible_keys | key | key_len | ref | rows |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | PRIMARY | PATIENTS | ALL | NULL | NULL | NULL | NULL | 5 |
| 2 | UNION | PATIENTS | ALL | NULL | NULL | NULL | NULL | 5 |
| NULL | UNION RESULT | union1,2> | ALL | NULL | NULL | NULL | NULL | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
3 rows in set (0.001 sec)

MariaDB [Medicine]> CREATE INDEX District_ind on PATIENTS(District);
Query OK, 0 rows affected (0.017 sec)
Records: 0 Duplicates: 0 Warnings: 0

MariaDB [Medicine]> SHOW INDEX FROM PATIENTS;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| patients | 0 | PRIMARY | 1 | Patient_ID | A | 5 | NULL | BTREE |
| patients | 1 | fk2 | 1 | Doctors_MBBS_no | A | 5 | NULL | BTREE |
| patients | 1 | District_ind | 1 | District | A | 5 | NULL | BTREE |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
3 rows in set (0.017 sec)

MariaDB [Medicine]> EXPLAIN((SELECT Name AS Patient_Name,City AS Living_city from PATIENTS where District = 'Colombo')
-> UNION
-> (SELECT Name AS Patient_Name,City AS Living_city from PATIENTS where District = 'Gampaha'));
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | type | possible_keys | key | key_len | ref | rows |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | PRIMARY | PATIENTS | ref | District_ind | District_ind | 28 | const | 2 |
| 2 | UNION | PATIENTS | ref | District_ind | District_ind | 28 | const | 2 |
| NULL | UNION RESULT | union1,2> | ALL | NULL | NULL | NULL | NULL | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
3 rows in set (0.003 sec)

MariaDB [Medicine]>
```

The screenshot shows the Windows taskbar at the bottom with various application icons.

- Tuning of Intersect operation

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" --defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini -uroot -p
MariaDB [Medicine]> SHOW INDEX FROM DRUGS;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| drugs | 0 | PRIMARY | 1 | Trade_name | A | 5 | NULL | NULL | BTREE |  | |
| drugs | 1 | fk4 | 1 | Prescribed_Doctor_MBBS_no | A | 5 | NULL | NULL | YES | BTREE |  |
| drugs | 1 | fk9 | 1 | Manufacturer_Reg_no | A | 5 | NULL | NULL | BTREE |  |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
3 rows in set (0.002 sec)

MariaDB [Medicine]> EXPLAIN ((SELECT Trade_name AS Medicine_name,Tablet_price_LKR AS Price_of_a_tablet from DRUGS where (Tablet_price_LKR < 9))
-> INTERSECT
-> (SELECT Trade_name AS Medicine_name,Tablet_price_LKR AS Price_of_a_tablet from DRUGS where (Manufacturer_reg_no = 'D0001') OR (Manufacturer_reg_no = 'D0006')));
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | type | possible_keys | key | key_len | ref | rows | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | PRIMARY | DRUGS | ALL | NULL | NULL | 5 | NULL | 5 | Using where |
| 2 | INTERSECT | DRUGS | range | fk9 | fk9 | 5 | NULL | 3 | Using index condition |
| NULL | INTERSECT RESULT | <intersect1,2> | ALL | NULL | NULL | NULL | NULL | NULL |  |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
3 rows in set (0.001 sec)

MariaDB [Medicine]> CREATE INDEX Tablet_price_ind on DRUGS(Tablet_price_LKR);
Query OK, 0 rows affected (0.014 sec)
Records: 0 Duplicates: 0 Warnings: 0

MariaDB [Medicine]> SHOW INDEX FROM DRUGS;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| drugs | 0 | PRIMARY | 1 | Trade_name | A | 5 | NULL | NULL | BTREE |  | |
| drugs | 1 | fk4 | 1 | Prescribed_Doctor_MBBS_no | A | 5 | NULL | NULL | YES | BTREE |  |
| drugs | 1 | fk9 | 1 | Manufacturer_Reg_no | A | 5 | NULL | NULL | BTREE |  |
| drugs | 1 | Tablet_price_ind | 1 | Tablet_price_LKR | A | 5 | NULL | NULL | BTREE |  |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
4 rows in set (0.011 sec)

MariaDB [Medicine]> EXPLAIN ((SELECT Trade_name AS Medicine_name,Tablet_price_LKR AS Price_of_a_tablet from DRUGS where (Tablet_price_LKR < 9))
-> INTERSECT
-> (SELECT Trade_name AS Medicine_name,Tablet_price_LKR AS Price_of_a_tablet from DRUGS where (Manufacturer_reg_no = 'D0001') OR (Manufacturer_reg_no = 'D0006')));
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | type | possible_keys | key | key_len | ref | rows | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | PRIMARY | DRUGS | range | Tablet_price_ind | Tablet_price_ind | 1 | NULL | 3 | Using where; Using index |
| 2 | INTERSECT | DRUGS | range | fk9 | fk9 | 5 | NULL | 3 | Using index condition |
| NULL | INTERSECT RESULT | <intersect1,2> | ALL | NULL | NULL | NULL | NULL | NULL |  |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
3 rows in set (0.002 sec)

MariaDB [Medicine]>
```

- Tuning of Set difference operation

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" --defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini -uroot -p
MariaDB [Medicine]> SHOW INDEX FROM DRUG_MANUFACTURERS;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| drug_manufacturers | 0 | PRIMARY | 1 | Reg_no | A | 5 | NULL | NULL | BTREE |  |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
1 row in set (0.001 sec)

MariaDB [Medicine]> EXPLAIN( (SELECT Name AS "Manufacturer name",No_of_factories AS "Number of factories" from DRUG_MANUFACTURERS)
-> EXCEPT
-> (SELECT Name AS "Manufacturer name",No_of_factories AS "Number of factories" from DRUG_MANUFACTURERS where No_of_factories = 1));
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | type | possible_keys | key | key_len | ref | rows | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | PRIMARY | DRUG_MANUFACTURERS | ALL | NULL | NULL | NULL | 5 | 1 | Using where |
| 2 | EXCEPT | DRUG_MANUFACTURERS | ALL | NULL | NULL | NULL | 5 | 1 | Using where |
| NULL | EXCEPT RESULT | <except1,2> | ALL | NULL | NULL | NULL | NULL | NULL |  |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
3 rows in set (0.001 sec)

MariaDB [Medicine]> CREATE INDEX Factory_no_ind on DRUG_MANUFACTURERS(No_of_factories);
Query OK, 0 rows affected (0.010 sec)
Records: 0 Duplicates: 0 Warnings: 0

MariaDB [Medicine]> SHOW INDEX FROM DRUG_MANUFACTURERS;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| drug_manufacturers | 0 | PRIMARY | 1 | Reg_no | A | 5 | NULL | NULL | BTREE |  |
| drug_manufacturers | 1 | Factory_no_ind | 1 | No_of_factories | A | 5 | NULL | NULL | YES | BTREE |  |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
2 rows in set (0.015 sec)

MariaDB [Medicine]> EXPLAIN( (SELECT Name AS "Manufacturer name",No_of_factories AS "Number of factories" from DRUG_MANUFACTURERS)
-> EXCEPT
-> (SELECT Name AS "Manufacturer name",No_of_factories AS "Number of factories" from DRUG_MANUFACTURERS where No_of_factories = 1));
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | type | possible_keys | key | key_len | ref | rows | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | PRIMARY | DRUG_MANUFACTURERS | ALL | NULL | NULL | NULL | 5 | 1 |  |
| 2 | EXCEPT | DRUG_MANUFACTURERS | ref | Factory_no_ind | Factory_no_ind | 2 | const | 2 |  |
| NULL | EXCEPT RESULT | <except1,2> | ALL | NULL | NULL | NULL | NULL | NULL |  |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
3 rows in set (0.002 sec)

MariaDB [Medicine]>
```

- Tuning of Natural join operation

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" --defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini -uroot -p

MariaDB [Medicine]> SHOW INDEX FROM PATIENTS;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| patients | 0 | PRIMARY | 1 | Patient_ID | A | 5 | NULL | NULL | YES | BTREE |  |
| patients | 1 | fk2 | 1 | Doctors_MBBS_no | A | 5 | NULL | NULL | YES | BTREE |  |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
2 rows in set (0.002 sec)

MariaDB [Medicine]> SHOW INDEX FROM CHRONIC_DISEASES;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| chronic_diseases | 1 | fk3 | 1 | Patient_id | A | 7 | NULL | NULL | YES | BTREE |  |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
1 row in set (0.023 sec)

MariaDB [Medicine]> EXPLAIN (SELECT * FROM UV3 NATURAL JOIN UV4 AS view4 WHERE (view4.chronic_disease = 'Diabetes'));
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | type | possible_keys | key | key_len | ref | rows | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | SIMPLE | patients | ALL | PRIMARY | NULL | NULL | NULL | 5 |  | Using where; Using join buffer (flat, BNL join) |
| 1 | SIMPLE | chronic_diseases | ALL | fk3 | NULL | NULL | NULL | 7 |  | Using where; Using join buffer (flat, BNL join) |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
2 rows in set (0.001 sec)

MariaDB [Medicine]> CREATE INDEX Chronic_disease_ind ON CHRONIC_DISEASES(chronic_disease);
Query OK, 0 rows affected (0.011 sec)
Records: 0 Duplicates: 0 Warnings: 0

MariaDB [Medicine]> SHOW INDEX FROM CHRONIC_DISEASES;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| chronic_diseases | 1 | fk3 | 1 | Patient_id | A | 7 | NULL | NULL | YES | BTREE |  |
| chronic_diseases | 1 | Chronic_disease_ind | 1 | Chronic_Disease | A | 7 | NULL | NULL | YES | BTREE |  |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
2 rows in set (0.010 sec)

MariaDB [Medicine]> EXPLAIN (SELECT * FROM UV3 NATURAL JOIN UV4 AS view4 WHERE (view4.chronic_disease = 'Diabetes'));
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | type | possible_keys | key | key_len | ref | rows | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | SIMPLE | chronic_diseases | ref | fk3,Chronic_disease_ind | Chronic_disease_ind | 23 | const | 3 | Using index condition |
| 1 | SIMPLE | patients | eq_ref | PRIMARY | PRIMARY | 5 | medicine.chronic_diseases.Patient_id | 1 |  |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
2 rows in set (0.001 sec)

MariaDB [Medicine]>
```

- Tuning of Right outer join operation

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" --defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini -uroot -p

MariaDB [Medicine]> SHOW INDEX FROM PATIENTS;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| patients | 0 | PRIMARY | 1 | Patient_ID | A | 5 | NULL | NULL | YES | BTREE |  |
| patients | 1 | fk2 | 1 | Doctors_MBBS_no | A | 5 | NULL | NULL | YES | BTREE |  |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
2 rows in set (0.002 sec)

MariaDB [Medicine]> SHOW INDEX FROM WORKING_HOSPITALS;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| working_hospitals | 1 | Fk1 | 1 | MBBS_Reg_no | A | 6 | NULL | NULL | YES | BTREE |  |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
1 row in set (0.020 sec)

MariaDB [Medicine]> EXPLAIN (SELECT * FROM UV5 AS view5 RIGHT OUTER JOIN UV2 AS view2 ON view5.Doctors_MBBS_no = view2.MBBS_Reg_no WHERE (view2.Hospital_name = 'Ragama Gen Hospital') OR (view2.Hospital_name = 'Gampaha Gen Hospital'));
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | type | possible_keys | key | key_len | ref | rows | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | SIMPLE | working_hospitals | ALL | NULL | NULL | NULL | NULL | 6 | Using where |
| 1 | SIMPLE | patients | ALL | fk2 | NULL | NULL | NULL | 5 | Using where; Using join buffer (flat, BNL join) |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
2 rows in set (0.001 sec)

MariaDB [Medicine]> CREATE INDEX Hospital_ind ON WORKING_HOSPITALS(Hospital_name);
Query OK, 0 rows affected (0.012 sec)
Records: 0 Duplicates: 0 Warnings: 0

MariaDB [Medicine]> SHOW INDEX FROM WORKING_HOSPITALS;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| working_hospitals | 1 | Fk1 | 1 | MBBS_Reg_no | A | 6 | NULL | NULL | YES | BTREE |  |
| working_hospitals | 1 | Hospital_ind | 1 | Hospital_name | A | 6 | NULL | NULL | YES | BTREE |  |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
2 rows in set (0.011 sec)

MariaDB [Medicine]> EXPLAIN (SELECT * FROM UV5 AS view5 RIGHT OUTER JOIN UV2 AS view2 ON view5.Doctors_MBBS_no = view2.MBBS_Reg_no WHERE (view2.Hospital_name = 'Ragama Gen Hospital') OR (view2.Hospital_name = 'Gampaha Gen Hospital'));
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | type | possible_keys | key | key_len | ref | rows | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | SIMPLE | working_hospitals | range | Hospital_ind | Hospital_ind | 22 | NULL | 3 | Using index condition |
| 1 | SIMPLE | patients | ALL | fk2 | NULL | NULL | NULL | 5 | Using where; Using join buffer (flat, BNL join) |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
2 rows in set (0.002 sec)
```

- Tuning of Left outer join operation

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p
MariaDB [Medicine]> DROP INDEX Hospital_Ind ON WORKING_HOSPITALS;
Query OK, 0 rows affected (0.008 sec)
Records: 0 Duplicates: 0 Warnings: 0

MariaDB [Medicine]> SHOW INDEX FROM PATIENTS;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed |
| patients | 0 | PRIMARY | 1 | Patient_ID | A | 5 | NULL | NULL |
| patients | 1 | fk2 | 1 | Doctors_MBBS_no | A | 5 | NULL | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+
2 rows in set (0.002 sec)

MariaDB [Medicine]> SHOW INDEX FROM WORKING_HOSPITALS;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed |
| working_hospitals | 1 | fk1 | 1 | MBBS_Reg_no | A | 6 | NULL | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+
1 row in set (0.018 sec)

MariaDB [Medicine]> EXPLAIN (SELECT * FROM UV5 as view5 LEFT OUTER JOIN UV2 AS view2 on view5.Doctors_MBBS_no = view2.MBBS_Reg_no where (view2.Hospital_name = 'Ragama Gen Hospital')OR(view2.Hospital_name = 'Gampa Gen Hospital'));
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | type | possible_keys | key | key_len | ref | rows | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | SIMPLE | patients | ALL | fk2 | NULL | NULL | NULL | 5 | Using where; Using join buffer (flat, BNL join) |
| 1 | SIMPLE | working_hospitals | ALL | fk1 | NULL | NULL | NULL | 6 | Using where; Using join buffer (flat, BNL join) |
+-----+-----+-----+-----+-----+-----+-----+-----+
2 rows in set (0.001 sec)

MariaDB [Medicine]> CREATE INDEX Hospital_Ind ON WORKING_HOSPITALS(Hospital_name);
Query OK, 0 rows affected (0.010 sec)
Records: 0 Duplicates: 0 Warnings: 0

MariaDB [Medicine]> SHOW INDEX FROM WORKING_HOSPITALS;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed |
| working_hospitals | 1 | fk1 | 1 | MBBS_Reg_no | A | 6 | NULL | NULL |
| working_hospitals | 1 | Hospital_Ind | 1 | Hospital_name | A | 6 | NULL | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+
2 rows in set (0.011 sec)

MariaDB [Medicine]> EXPLAIN (SELECT * FROM UV5 as view5 LEFT OUTER JOIN UV2 AS view2 on view5.Doctors_MBBS_no = view2.MBBS_Reg_no where (view2.Hospital_name = 'Ragama Gen Hospital')OR(view2.Hospital_name = 'Gampa Gen Hospital'));
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | type | possible_keys | key | key_len | ref | rows | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | SIMPLE | working_hospitals | range | fk1,Hospital_Ind | Hospital_Ind | 22 | NULL | 3 | Using index condition |
+-----+-----+-----+-----+-----+-----+-----+-----+
2 rows in set (0.001 sec)

Windows Taskbar: Type here to search, File Explorer, Edge, File Manager, Mail, Excel, Word, Photos, Camera, Task View, Taskbar icons, System tray: ENG, 5:19 PM, 6/5/2021
```

```
MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" "--defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini" -uroot -p
MariaDB [Medicine]> CREATE INDEX Hospital_Ind ON WORKING_HOSPITALS(Hospital_name);
Query OK, 0 rows affected (0.010 sec)
Records: 0 Duplicates: 0 Warnings: 0

MariaDB [Medicine]> SHOW INDEX FROM WORKING_HOSPITALS;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed |
| working_hospitals | 1 | fk1 | 1 | MBBS_Reg_no | A | 6 | NULL | NULL |
| working_hospitals | 1 | Hospital_Ind | 1 | Hospital_name | A | 6 | NULL | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+
2 rows in set (0.011 sec)

MariaDB [Medicine]> EXPLAIN (SELECT * FROM UV5 as view5 LEFT OUTER JOIN UV2 AS view2 on view5.Doctors_MBBS_no = view2.MBBS_Reg_no where (view2.Hospital_name = 'Ragama Gen Hospital')OR(view2.Hospital_name = 'Gampa Gen Hospital'));
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | type | possible_keys | key | key_len | ref | rows | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | SIMPLE | working_hospitals | range | fk1,Hospital_Ind | Hospital_Ind | 22 | NULL | 3 | Using index condition |
| 1 | SIMPLE | patients | ALL | fk2 | NULL | NULL | NULL | 5 | Using where; Using join buffer (flat, BNL join) |
+-----+-----+-----+-----+-----+-----+-----+-----+
2 rows in set (0.001 sec)

MariaDB [Medicine]>
```

- Tuning of Full outer join operation

```

MariaDB [Medicine]> DROP INDEX Hospital_ind ON WORKING_HOSPITALS;
Query OK, 0 rows affected (0.024 sec)
Records: 0 Duplicates: 0 Warnings: 0

MariaDB [Medicine]> SHOW INDEX FROM PATIENTS;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| patients | 0 | PRIMARY | 1 | Patient_ID | A | 5 | NULL | NULL | YES | BTREE |  |  |
| patients | 1 | fk2 | 1 | Doctors_MBBS_no | A | 5 | NULL | NULL | YES | BTREE |  |  |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
2 rows in set (0.003 sec)

MariaDB [Medicine]> SHOW INDEX FROM WORKING_HOSPITALS;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| working_hospitals | 1 | Fk1 | 1 | MBBS_Reg_no | A | 6 | NULL | NULL | YES | BTREE |  |  |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
1 row in set (0.010 sec)

MariaDB [Medicine]> EXPLAIN (SELECT * FROM Right_outer_join_UV
-> UNION
-> SELECT * FROM Left_outer_join_UV);
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | type | possible_keys | key | key_len | ref | rows | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | PRIMARY | working_hospitals | ALL | NULL | NULL | NULL | NULL | 6 | Using where |
| 1 | PRIMARY | patients | ALL | fk2 | NULL | NULL | NULL | 5 | Using where; Using join buffer (flat, BNL join) |
| 2 | UNION | patients | ALL | fk2 | NULL | NULL | NULL | 5 |  |
| 2 | UNION | working_hospitals | ALL | Fk1 | NULL | NULL | NULL | 6 | Using where; Using join buffer (flat, BNL join) |
| NULL | UNION RESULT | union1,2> | ALL | NULL | NULL | NULL | NULL | NULL |  |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
5 rows in set (0.004 sec)

MariaDB [Medicine]> CREATE INDEX Hospital_ind ON WORKING_HOSPITALS(Hospital_name);
Query OK, 0 rows affected (0.010 sec)
Records: 0 Duplicates: 0 Warnings: 0

MariaDB [Medicine]> SHOW INDEX FROM WORKING_HOSPITALS;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| working_hospitals | 1 | Fk1 | 1 | MBBS_Reg_no | A | 6 | NULL | NULL | YES | BTREE |  |  |
| working_hospitals | 1 | Hospital_ind | 1 | Hospital_name | A | 6 | NULL | NULL | YES | BTREE |  |  |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
2 rows in set (0.021 sec)

MariaDB [Medicine]> EXPLAIN (SELECT * FROM Right_outer_join_UV

```

```

-> UNION
-> SELECT * FROM Left_outer_join_UV);
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | type | possible_keys | key | key_len | ref | rows | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | PRIMARY | working_hospitals | range | Hospital_ind | Hospital_ind | 22 | NULL | 3 | Using index condition |
| 1 | PRIMARY | patients | ALL | fk2 | NULL | NULL | NULL | 5 | Using where; Using join buffer (flat, BNL join) |
| 2 | UNION | working_hospitals | range | fk1,Hospital_ind | Hospital_ind | 22 | NULL | 3 | Using index condition |
| 2 | UNION | patients | ALL | fk2 | NULL | NULL | NULL | 5 | Using where; Using join buffer (flat, BNL join) |
| NULL | UNION RESULT | union1,2> | ALL | NULL | NULL | NULL | NULL | NULL |  |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
5 rows in set (0.003 sec)

MariaDB [Medicine]>
MariaDB [Medicine]>
```

- Tuning of Nested query 1

```

MariaDB [Medicine]> SHOW INDEX FROM DOCTORS;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| doctors | 0 | PRIMARY | 1 | MBBS_Reg_no | A | 5 | NULL | NULL | BTREE |  |  |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
1 row in set (0.003 sec)

MariaDB [Medicine]> SHOW INDEX FROM DRUGS;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| drugs | 0 | PRIMARY | 1 | Trade_name | A | 5 | NULL | NULL | BTREE |  |  |
| drugs | 1 | fk4 | 1 | Prescribed_Doctor_MBBS_no | A | 5 | NULL | NULL | YES | BTREE |  |
| drugs | 1 | fk9 | 1 | Manufacturer_Reg_no | A | 5 | NULL | NULL | BTREE |  |
| drugs | 1 | Tablet_price_ind | 1 | Tablet_price_LKR | A | 5 | NULL | NULL | BTREE |  |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
4 rows in set (0.002 sec)

MariaDB [Medicine]> EXPLAIN (SELECT DR.Name,DR.Speciality FROM DOCTORS AS DR WHERE DR.MBBS_Reg_no IN(SELECT D.Prescribed_doctor_MBBS_no FROM DRUGS AS D WHERE D.common_name = 'Paracetamol');
ERROR 1064 (42000): You have an error in your SQL syntax; check the manual that corresponds to your MariaDB server version for the right syntax to use near '' at line 1
MariaDB [Medicine]>
MariaDB [Medicine]> EXPLAIN (SELECT DR.Name,DR.Speciality FROM DOCTORS AS DR WHERE DR.MBBS_Reg_no IN(SELECT D.Prescribed_doctor_MBBS_no FROM DRUGS AS D WHERE D.common_name = 'Paracetamol'));
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | type | possible_keys | key | key_len | ref | rows | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | PRIMARY | DR | ALL | PRIMARY | NULL | 5 |  |  |  |
| 1 | PRIMARY | <subquery2> | eq_ref | distinct_key | distinct_key | 5 | func | 1 |  |
| 2 | MATERIALIZED | D | ALL | fk4 | NULL | 5 |  | 5 | Using where |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
3 rows in set (0.001 sec)

MariaDB [Medicine]> CREATE INDEX Common_drug_name_ind on DRUGS(common_name);
Query OK, 0 rows affected (0.011 sec)
Records: 0 Duplicates: 0 Warnings: 0

MariaDB [Medicine]> SHOW INDEX FROM DRUGS;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| drugs | 0 | PRIMARY | 1 | Trade_name | A | 5 | NULL | NULL | BTREE |  |  |
| drugs | 1 | fk4 | 1 | Prescribed_Doctor_MBBS_no | A | 5 | NULL | NULL | YES | BTREE |  |
| drugs | 1 | fk9 | 1 | Manufacturer_Reg_no | A | 5 | NULL | NULL | BTREE |  |
| drugs | 1 | Tablet_price_ind | 1 | Tablet_price_LKR | A | 5 | NULL | NULL | BTREE |  |
| drugs | 1 | Common_drug_name_ind | 1 | common_name | A | 5 | NULL | NULL | YES | BTREE |  |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
5 rows in set (0.112 sec)

MariaDB [Medicine]> EXPLAIN (SELECT DR.Name,DR.Speciality FROM DOCTORS AS DR WHERE DR.MBBS_Reg_no IN(SELECT D.Prescribed_doctor_MBBS_no FROM DRUGS AS D WHERE D.common_name = 'Paracetamol'));
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | type | possible_keys | key | key_len | ref | rows | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | PRIMARY | DR | ALL | PRIMARY | NULL | 5 |  |  |  |
| 1 | PRIMARY | <subquery2> | eq_ref | distinct_key | distinct_key | 5 | func | 1 |  |
| 2 | MATERIALIZED | D | ref | fk4,Common_drug_name_ind | Common_drug_name_ind | 28 | const | 2 | Using index condition |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
3 rows in set (0.001 sec)

MariaDB [Medicine]>
```

```

MariaDB [Medicine]> CREATE INDEX Common_drug_name_ind on DRUGS(common_name);
Query OK, 0 rows affected (0.011 sec)
Records: 0 Duplicates: 0 Warnings: 0

MariaDB [Medicine]> SHOW INDEX FROM DRUGS;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| drugs | 0 | PRIMARY | 1 | Trade_name | A | 5 | NULL | NULL | BTREE |  |  |
| drugs | 1 | fk4 | 1 | Prescribed_Doctor_MBBS_no | A | 5 | NULL | NULL | YES | BTREE |  |
| drugs | 1 | fk9 | 1 | Manufacturer_Reg_no | A | 5 | NULL | NULL | BTREE |  |
| drugs | 1 | Tablet_price_ind | 1 | Tablet_price_LKR | A | 5 | NULL | NULL | BTREE |  |
| drugs | 1 | Common_drug_name_ind | 1 | common_name | A | 5 | NULL | NULL | YES | BTREE |  |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
5 rows in set (0.112 sec)

MariaDB [Medicine]> EXPLAIN (SELECT DR.Name,DR.Speciality FROM DOCTORS AS DR WHERE DR.MBBS_Reg_no IN(SELECT D.Prescribed_doctor_MBBS_no FROM DRUGS AS D WHERE D.common_name = 'Paracetamol'));
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | type | possible_keys | key | key_len | ref | rows | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | PRIMARY | DR | ALL | PRIMARY | NULL | 5 |  |  |  |
| 1 | PRIMARY | <subquery2> | eq_ref | distinct_key | distinct_key | 5 | func | 1 |  |
| 2 | MATERIALIZED | D | ref | fk4,Common_drug_name_ind | Common_drug_name_ind | 28 | const | 2 | Using index condition |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
3 rows in set (0.001 sec)

MariaDB [Medicine]>
```

- Tuning of Nested query 2

```

MariaDB [Medicine]> DROP INDEX Chronic_disease_ind ON CHRONIC_DISEASES;
Query OK, 0 rows affected (0.008 sec)
Records: 0 Duplicates: 0 Warnings: 0

MariaDB [Medicine]> SHOW INDEX FROM DOCTORS;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| doctors | 0 | PRIMARY | 1 | MBBS_Reg_no | A | 5 | NULL | NULL | BTREE | | |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
1 row in set (0.003 sec)

MariaDB [Medicine]> SHOW INDEX FROM CHRONIC_DISEASES;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| chronic_diseases | 1 | fk3 | 1 | Patient_id | A | 7 | NULL | NULL | BTREE | | |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
1 row in set (0.018 sec)

MariaDB [Medicine]> SHOW INDEX FROM PATIENTS;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| patients | 0 | PRIMARY | 1 | Patient_ID | A | 5 | NULL | NULL | BTREE | | |
| patients | 1 | fk2 | 1 | Doctors_MBBS_no | A | 5 | NULL | NULL | YES | BTREE | |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
2 rows in set (0.003 sec)

MariaDB [Medicine]> EXPLAIN (SELECT DR.Name,DR.Address,DR.Speciality FROM DOCTORS AS DR WHERE DR.MBBS_Reg_no IN
-> (SELECT P.Doctors_MBBS_no FROM PATIENTS AS P WHERE P.Patient_id IN
-> (SELECT C.Patient_id FROM CHRONIC_DISEASES AS C WHERE C.CHRONIC_DISEASE = 'Diabetes')));
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | type | possible_keys | key | key_len | ref | rows | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | PRIMARY | DR | ALL | PRIMARY | NULL | NULL | NULL | 5 | |
| 1 | PRIMARY | <subquery2> | eq_ref | distinct_key | distinct_key | 5 | func | 1 |
| 2 | MATERIALIZED | P | index | PRIMARY,fk2 | fk2 | 6 | NULL | 5 | Using index |
| 2 | MATERIALIZED | C | ALL | fk3 | NULL | NULL | 7 | Using where; Using join buffer (flat, BNL join) |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
4 rows in set (0.001 sec)

MariaDB [Medicine]> CREATE INDEX Chronic_disease_ind on CHRONIC_DISEASES(Chronic_disease);
Query OK, 0 rows affected (0.010 sec)
Records: 0 Duplicates: 0 Warnings: 0

MariaDB [Medicine]> SHOW INDEX FROM CHRONIC_DISEASES;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
4 rows in set (0.001 sec)

Windows Taskbar: Type here to search, File Explorer, Edge, File History, Mail, OneDrive, Excel, Word, Pictures, Videos, Task View, Taskbar settings, System, Taskbar, ENG, 5:42 PM, 6/5/2021

```

```

MariaDB [Medicine]> CREATE INDEX Chronic_disease_ind on CHRONIC_DISEASES(Chronic_disease);
Query OK, 0 rows affected (0.010 sec)
Records: 0 Duplicates: 0 Warnings: 0

MariaDB [Medicine]> SHOW INDEX FROM CHRONIC_DISEASES;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| chronic_diseases | 1 | fk3 | 1 | Patient_id | A | 7 | NULL | NULL | BTREE | | |
| chronic_diseases | 1 | Chronic_disease_ind | 1 | Chronic_Disease | A | 7 | NULL | NULL | YES | BTREE | |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
2 rows in set (0.012 sec)

MariaDB [Medicine]> EXPLAIN (SELECT DR.Name,DR.Address,DR.Speciality FROM DOCTORS AS DR WHERE DR.MBBS_Reg_no IN
-> (SELECT P.Doctors_MBBS_no FROM PATIENTS AS P WHERE P.Patient_id IN
-> (SELECT C.Patient_id FROM CHRONIC_DISEASES AS C WHERE C.CHRONIC_DISEASE = 'Diabetes')));
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | type | possible_keys | key | key_len | ref | rows | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | PRIMARY | DR | ALL | PRIMARY | NULL | NULL | NULL | 5 | |
| 1 | PRIMARY | <subquery2> | eq_ref | distinct_key | distinct_key | 5 | func | 1 |
| 2 | MATERIALIZED | C | ref | fk3,Chronic_disease_ind | Chronic_disease_ind | 23 | const | 3 | Using index condition |
| 2 | MATERIALIZED | P | eq_ref | PRIMARY,fk2 | PRIMARY | 5 | medicine.C.Patient_id | 1 |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
4 rows in set (0.001 sec)

MariaDB [Medicine]>

Windows Taskbar: Type here to search, File Explorer, Edge, File History, Mail, OneDrive, Excel, Word, Pictures, Videos, Task View, Taskbar settings, System, Taskbar, ENG, 5:43 PM, 6/5/2021

```

- Tuning of Nested query 3

```

MySQL Client (MariaDB 10.5 (x64)) - "C:\Program Files\MariaDB 10.5\bin\mysql.exe" --defaults-file=C:\Program Files\MariaDB 10.5\data\my.ini -uroot -p
MariaDB [Medicine]> SHOW INDEX FROM PHARMACIES;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| pharmacies | 0 | PRIMARY | 1 | Pharmacy_ID | A | 5 | NULL | NULL | BTREE |  |  |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
1 row in set (0.003 sec)

MariaDB [Medicine]> SHOW INDEX FROM PHARMACY OWNERS;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| pharmacy_owners | 1 | fk11 | 1 | Pharmacy_ID | A | 5 | NULL | NULL | BTREE |  |  |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
1 row in set (0.002 sec)

MariaDB [Medicine]> EXPLAIN ( SELECT P.Name,P.Address,P.Contact_no FROM PHARMACIES AS P Where Pharmacy_id IN (SELECT PO.Pharmacy_id FROM PHARMACY OWNERS AS PO WHERE Owner_name = 'Dhammadika Perera'));
ERROR 1064 (42000): You have an error in your SQL syntax; check the manual that corresponds to your MariaDB server version for the right syntax to use near '' at line 1
MariaDB [Medicine]> EXPLAIN ( SELECT P.Name,P.Address,P.Contact_no FROM PHARMACIES AS P Where Pharmacy_id IN (SELECT PO.Pharmacy_id FROM PHARMACY OWNERS AS PO WHERE Owner_name = 'Dhammadika Perera'));
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | type | possible_keys | key | key_len | ref | rows | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | PRIMARY | P | ALL | PRIMARY | NULL | NULL | NULL | 5 |  |
| 1 | PRIMARY | <subquery> | eq_ref | distinct_key | distinct_key | 5 | func | 1 |  |
| 2 | MATERIALIZED | PO | ALL | fk11 | NULL | NULL | NULL | 5 | Using where |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
3 rows in set (0.001 sec)

MariaDB [Medicine]> CREATE INDEX Owner_name_idx ON PHARMACY OWNERS(Owner_name);
Query OK, 0 rows affected (0.012 sec)
Records: 0 Duplicates: 0 Warnings: 0

MariaDB [Medicine]> SHOW INDEX FROM PHARMACY OWNERS;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| pharmacy_owners | 1 | fk11 | 1 | Pharmacy_ID | A | 5 | NULL | NULL | BTREE |  |  |
| pharmacy_owners | 1 | Owner_name_idx | 1 | Owner_name | A | 5 | NULL | NULL | BTREE |  |  |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
2 rows in set (0.019 sec)

MariaDB [Medicine]> EXPLAIN ( SELECT P.Name,P.Address,P.Contact_no FROM PHARMACIES AS P Where Pharmacy_id IN (SELECT PO.Pharmacy_id FROM PHARMACY OWNERS AS PO WHERE Owner_name = 'Dhammadika Perera'));
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | type | possible_keys | key | key_len | ref | rows | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | PRIMARY | P | ALL | PRIMARY | NULL | NULL | NULL | 5 |  |
| 1 | PRIMARY | <subquery> | eq_ref | distinct_key | distinct_key | 5 | func | 1 |  |
| 2 | MATERIALIZED | PO | ref | fk11,Owner_name_idx | Owner_name_idx | 27 | const | 3 | Using index condition |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
3 rows in set (0.001 sec)

```

# PART B - NoSQL DATABASES

## Chapter 1: Aggregation model

Drug\_Manufacturers\_EE15 bucket/collection is created using the table “Drug\_Manufacturers” in the previously created MariaDB relational model in part A.

MariaDB [Medicine]> SELECT * FROM DRUG_MANUFACTURERS;			
Reg_no	Name	Address	No_of_factories
D0001	GSK Pharmaceuticals	No.15,Main rd,Colombo 01	3
D0002	Sun pharmaceuticals	Nugegoda,Colombo	1
D0003	Astron pharmaceuticals	No.96,Kandy rd,Kelaniya	1
D0005	Morisons products	Main rd,Homagama	4
D0006	SPMC products	Kandawala estate,Rathmalana	4

Figure 3 : Equivalent table in relational model

The bucket is created as a key-value store where unique number used as the main key. Various data is used as values such as name, address etc. This aggregation model is created by using PostgreSQL according to the given instructions. Creation of this model, insertion of data and data retrieving queries are shown in below screenshots.

```
PS SQL Shell (psql)
Server [localhost]:
Database [postgres]:
Port [5432]:
Username [postgres]:
Password for user postgres:
psql (13.3)
WARNING: Console code page (437) differs from Windows code page (1252)
8-bit characters might not work correctly. See psql reference
page "Notes for Windows users" for details.
Type "help" for help.

postgres=# \l
                                         List of databases
   Name    | Owner | Encoding |           Collate           |           Ctype            | Access privileges
----+-----+-----+-----+-----+-----+-----+
postgres | postgres | UTF8 | English_United States.1252 | English_United States.1252 | =c/postgres             +
template0 | postgres | UTF8 | English_United States.1252 | English_United States.1252 | =c/postgres=CTc/postgres
template1 | postgres | UTF8 | English_United States.1252 | English_United States.1252 | =c/postgres             +
test     | postgres | UTF8 | English_United States.1252 | English_United States.1252 | =c/postgres=CTc/postgres
(4 rows)

postgres=# CREATE DATABASE medicine;
CREATE DATABASE
postgres=# \c medicine
You are now connected to database "medicine" as user "postgres".
medicine=# CREATE TABLE DRUG_MANUFACTURERS_EE15 ( Main_key int NOT NULL PRIMARY KEY,Value JSON );
CREATE TABLE
medicine=# INSERT INTO DRUG_MANUFACTURERS_EE15 (Main_key,Value) VALUES (1,'{"Reg_no":"D0001","Name":"GSK Pharmaceuticals","Address":"No.15,Main rd,Colombo 01","No_of_factories":3}');
INSERT 0 1
medicine=# INSERT INTO DRUG_MANUFACTURERS_EE15 (Main_key,Value) VALUES (2,'{"Reg_no":"D0002","Name":"Sun Pharmaceuticals","Address":"Nugegoda,Colombo","No_of_factories":1}');
INSERT 0 1
medicine=# INSERT INTO DRUG_MANUFACTURERS_EE15 (Main_key,Value) VALUES (3,'{"Reg_no":"D0003","Name":"Astron Pharmaceuticals","Address":"No.96,Kandy rd,Kelaniya","No_of_factories":1}');
INSERT 0 1
medicine=# INSERT INTO DRUG_MANUFACTURERS_EE15 (Main_key,Value) VALUES (4,'{"Reg_no":"D0004","Name":"CIC pvt ltd","Address":"Colombo rd,Welisara","No_of_factories":2}');
INSERT 0 1
medicine=# INSERT INTO DRUG_MANUFACTURERS_EE15 (Main_key,Value) VALUES (5,'{"Reg_no":"D0005","Name":"Morisons Products","Address":"Main rd,Homagama","No_of_factories":4}');
INSERT 0 1
medicine=# INSERT INTO DRUG_MANUFACTURERS_EE15 (Main_key,Value) VALUES (6,'{"Reg_no":"D0006","Name":"SPMC Products","Address":"Kandawala estate,Rathmalana","No_of_factories":4}');

11:44 PM
01-Jun-21
```

```

SQL Shell (psql)
medicine=# INSERT INTO DRUG_MANUFACTURERS_EE15 (Main_key,Value) VALUES (6, '{"Reg_no":"D0006","Name":"SPMC Products","Address":"Kandawala estate,Rathmalana","No_of_factories":3}');
INSERT 0 1
medicine=# INSERT INTO DRUG_MANUFACTURERS_EE15 (Main_key,Value) VALUES (7, '{"Reg_no":"D0007","Name":"SPC Products","Address":"Galle rd,Dehiwala"}');
INSERT 0 1
medicine=# INSERT INTO DRUG_MANUFACTURERS_EE15 (Main_key,Value) VALUES (8, '{"Reg_no":"D0008","Name":"Hemas Pharmaceuticals"}');
INSERT 0 1
medicine=# INSERT INTO DRUG_MANUFACTURERS_EE15 (Main_key,Value) VALUES (9, '{"Name":"Navesta Pharmaceuticals"}');
INSERT 0 1
medicine=# INSERT INTO DRUG_MANUFACTURERS_EE15 (Main_key,Value) VALUES (10, {"Reg_no":"D0010","Name":"Tabrane Pharmaceuticals","Address":"Highe level rd,Nugegoda","No_of_factories":3});
INSERT 0 1
medicine=#
medicine=#
medicine=#
medicine=#
medicine=#
SELECT * FROM DRUG_MANUFACTURERS_EE15;
 main_key | value
-----+-----
 1 | {"Reg_no":"D0001","Name":"GSK Pharmaceuticals","Address":"No.15,Main rd,Colombo 01","No_of_factories":3}
 2 | {"Reg_no":"D0002","Name":"Sun Pharmaceuticals","Address":"Nugegoda,Colombo","No_of_factories":1}
 3 | {"Reg_no":"D0003","Name":"Astron Pharmaceuticals","Address":"No.96,Kandy rd,Kelaniya","No_of_factories":1}
 4 | {"Reg_no":"D0004","Name":"IIC pvt ltd","Address":"Colombo rd,Welisara","No_of_factories":2}
 5 | {"Reg_no":"D0005","Name":"Morisons Products","Address":"Main rd,Homagama","No_of_factories":4}
 6 | {"Reg_no":"D0006","Name":"SPMC Products","Address":"Kandawala estate,Rathmalana","No_of_factories":3}
 7 | {"Reg_no":"D0007","Name":"SPC Products","Address":"Galle rd,Dehiwala"}
 8 | {"Reg_no":"D0008","Name":"Hemas Pharmaceuticals"}
 9 | {"Name":"Navesta Pharmaceuticals"}
10 | {"Reg_no":"D0010","Name":"Tabrane Pharmaceuticals","Address":"Highe level rd,Nugegoda","No_of_factories":3}
(10 rows)

medicine=# SELECT value FROM DRUG_MANUFACTURERS_EE15 where (id>4);
ERROR: column "id" does not exist
LINE 1: SELECT value FROM DRUG_MANUFACTURERS_EE15 where (id>4);
          ^
medicine=# SELECT value FROM DRUG_MANUFACTURERS_EE15 where (main_key>4);
 value
-----+
 {"Reg_no":"D0005","Name":"Morisons Products","Address":"Main rd,Homagama","No_of_factories":4}
 {"Reg_no":"D0006","Name":"SPMC Products","Address":"Kandawala estate,Rathmalana","No_of_factories":3}
 {"Reg_no":"D0007","Name":"SPC Products","Address":"Galle rd,Dehiwala"}
 {"Reg_no":"D0008","Name":"Hemas Pharmaceuticals"}
 {"Name":"Navesta Pharmaceuticals"}
 {"Reg_no":"D0010","Name":"Tabrane Pharmaceuticals","Address":"Highe level rd,Nugegoda","No_of_factories":3}

```

```

SQL Shell (psql)
medicine=# SELECT value FROM DRUG_MANUFACTURERS_EE15 where (main_key>4);
 value
-----+
 {"Reg_no":"D0005","Name":"Morisons Products","Address":"Main rd,Homagama","No_of_factories":4}
 {"Reg_no":"D0006","Name":"SPMC Products","Address":"Kandawala estate,Rathmalana","No_of_factories":3}
 {"Reg_no":"D0007","Name":"SPC Products","Address":"Galle rd,Dehiwala"}
 {"Reg_no":"D0008","Name":"Hemas Pharmaceuticals"}
 {"Name":"Navesta Pharmaceuticals"}
 {"Reg_no":"D0010","Name":"Tabrane Pharmaceuticals","Address":"Highe level rd,Nugegoda","No_of_factories":3}
(6 rows)

medicine=# SELECT value FROM DRUG_MANUFACTURERS_EE15 where (main_key<4);
 value
-----+
 {"Reg_no":"D0001","Name":"GSK Pharmaceuticals","Address":"No.15,Main rd,Colombo 01","No_of_factories":3}
 {"Reg_no":"D0002","Name":"Sun Pharmaceuticals","Address":"Nugegoda,Colombo","No_of_factories":1}
 {"Reg_no":"D0003","Name":"Astron Pharmaceuticals","Address":"No.96,Kandy rd,Kelaniya","No_of_factories":1}
(3 rows)

medicine=#

```

# Chapter 2: Graph data model

In this chapter a graph database was created with 10 nodes and 23 edges (links) to represent relationships between a group of students in the university using ArangoDB graph database management system. In this graph Students are represented by nodes and students who are known by a student are connected by edges(links).

Student nodes have five properties inside them. They are,

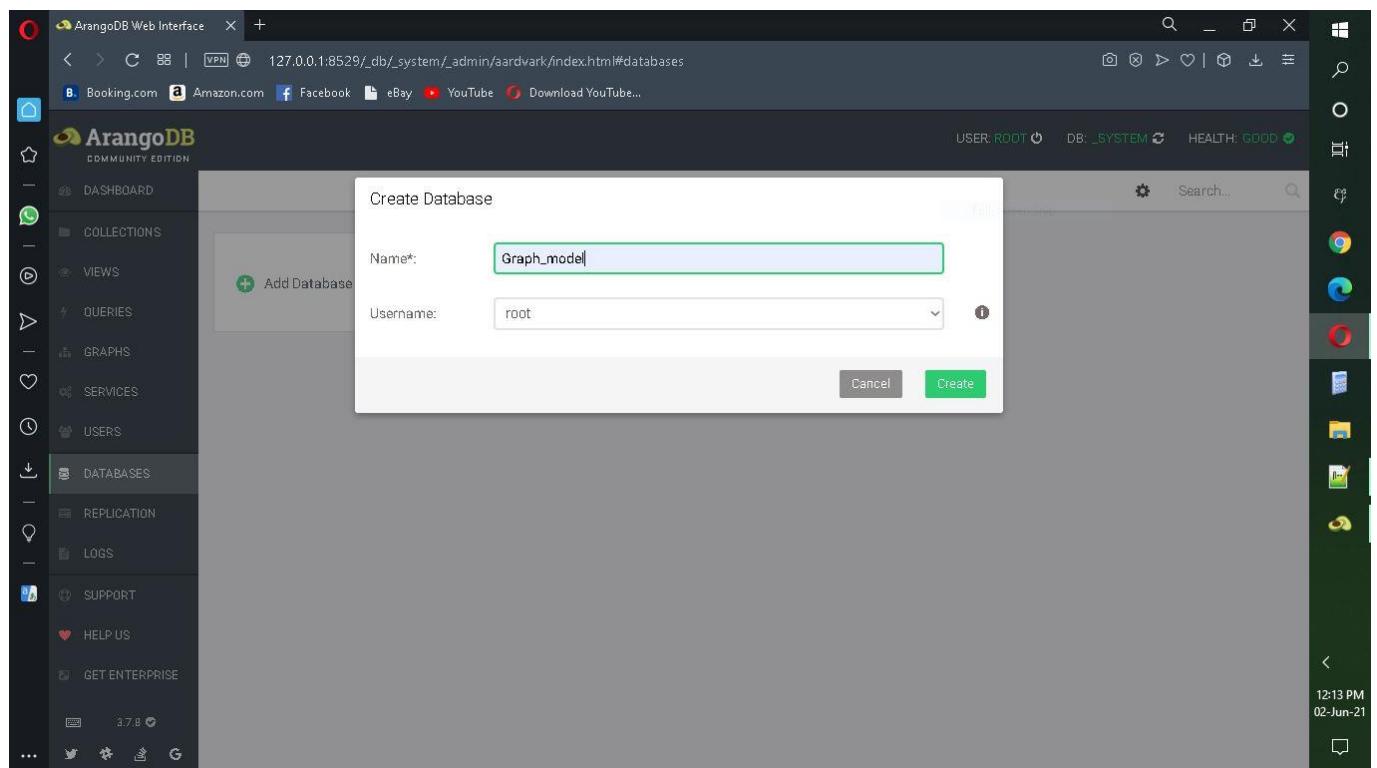
- Name.
- Sex.
- Age
- Home City.
- Current Department which he or she is studying.

Knows edges have three properties inside them. They are,

- Relationship nature.
- First place where two students met.
- Duration of relationship.

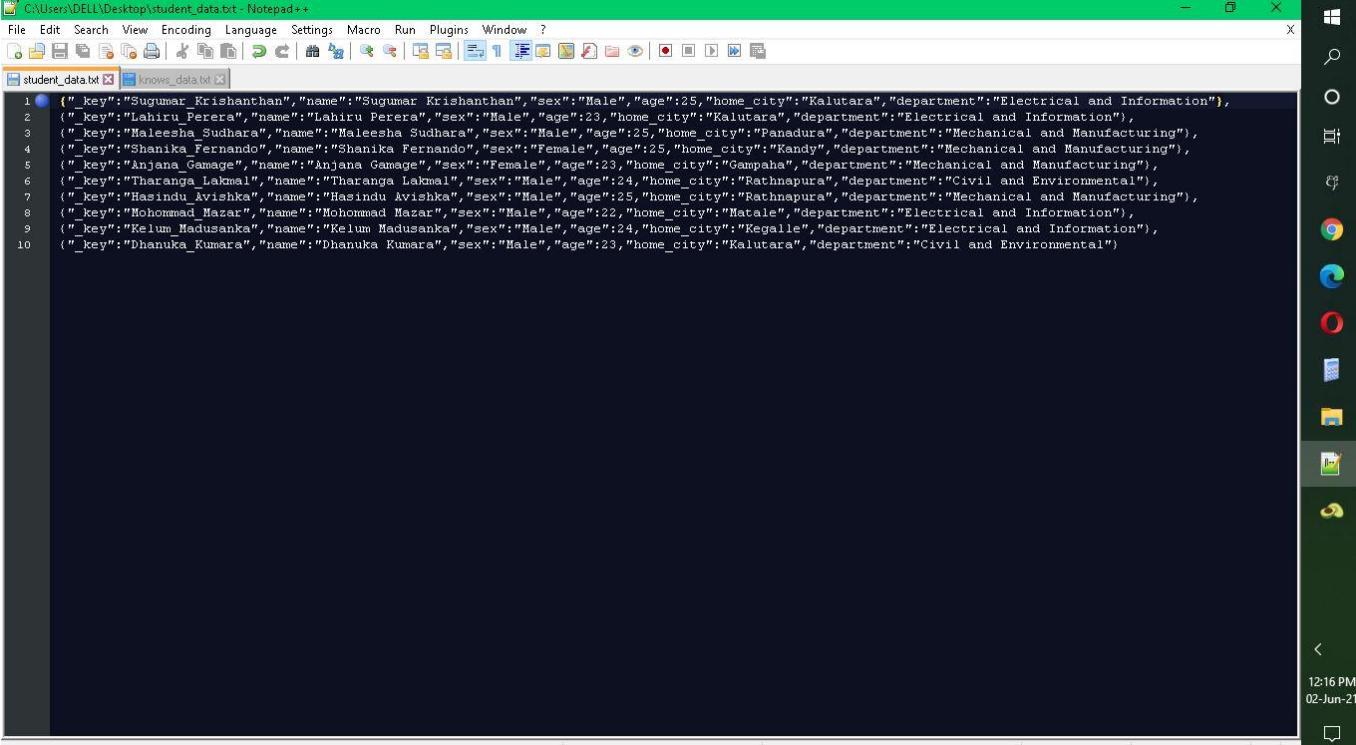
Screenshot are taken in the process of implementing this graph model. They are included below in the order.

## 2.1 Creating a separate database for the graph data model.



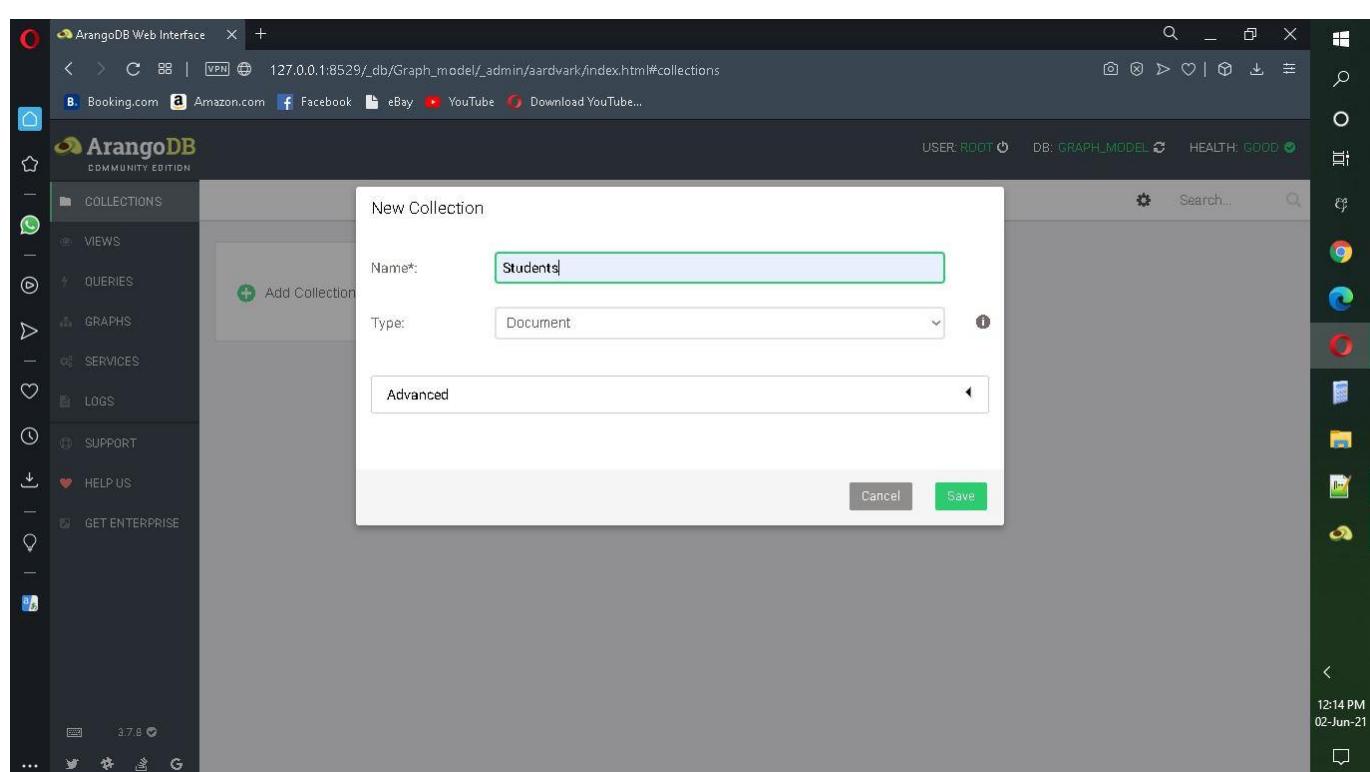
## 2.2 Creating collection for nodes and enter nodes with data

Data for 10 nodes was gathered in a text file with appropriate syntax used in arangodb query language. Then, the data was entered to the created collection using a suitable query.



The screenshot shows a Notepad++ window with the file 'student\_data.txt' open. The content of the file is a JSON array of 10 objects, each representing a student with properties like name, sex, age, home city, and department. The code is as follows:

```
1 {"_key": "Sugumar_Krishanthan", "name": "Sugumar Krishanthan", "sex": "Male", "age": 25, "home_city": "Kalutara", "department": "Electrical and Information"},  
2 {"_key": "Lahiru_Perera", "name": "Lahiru Perera", "sex": "Male", "age": 23, "home_city": "Kalutara", "department": "Electrical and Information"},  
3 {"_key": "Maleesha_Sudhara", "name": "Maleesha Sudhara", "sex": "Male", "age": 25, "home_city": "Panadura", "department": "Mechanical and Manufacturing"},  
4 {"_key": "Shanika_Fernando", "name": "Shanika Fernando", "sex": "Female", "age": 25, "home_city": "Kandy", "department": "Mechanical and Manufacturing"},  
5 {"_key": "Anjana_Gamage", "name": "Anjana Gamage", "sex": "Female", "age": 23, "home_city": "Gampaha", "department": "Mechanical and Manufacturing"},  
6 {"_key": "Tharanga_Lakmal", "name": "Tharanga Lakmal", "sex": "Male", "age": 24, "home_city": "Rathnapura", "department": "Civil and Environmental"},  
7 {"_key": "Hasindu_Avishka", "name": "Hasindu Avishka", "sex": "Male", "age": 25, "home_city": "Rathnapura", "department": "Mechanical and Manufacturing"},  
8 {"_key": "Mohammad_Mazar", "name": "Mohammad Mazar", "sex": "Male", "age": 22, "home_city": "Matale", "department": "Electrical and Information"},  
9 {"_key": "Kelum_Madusanka", "name": "Kelum Madusanka", "sex": "Male", "age": 24, "home_city": "Kegalle", "department": "Electrical and Information"},  
10 {"_key": "Dhanuka_Kumara", "name": "Dhanuka Kumara", "sex": "Male", "age": 23, "home_city": "Kalutara", "department": "Civil and Environmental"}  
11
```



The screenshot shows the ArangoDB Web Interface. On the left, a sidebar lists collections, views, queries, graphs, services, logs, support, help, and enterprise options. The main area has tabs for Editor, Running Queries, and Slow Query History. Under Editor, there's a 'Queries' tab with a code editor containing the following ArangoDB query:

```

1 LET students_data = [
2   {"_key": "Sugumar_Krishnanthan", "name": "Sugumar Krishnanthan", "sex": "Male", "age": 25, "home_city": "Kalutara", "department": "Electrical and Information"}, 
3   {"_key": "Lahiru_Perera", "name": "Lahiru Perera", "sex": "Male", "age": 23, "home_city": "Kalutara", "department": "Electrical and Information"}, 
4   {"_key": "Maleesha_Sudhara", "name": "Maleesha Sudhara", "sex": "Male", "age": 25, "home_city": "Panadura", "department": "Mechanical and Manufacturing"}, 
5   {"_key": "Shanika_Fernando", "name": "Shanika Fernando", "sex": "Female", "age": 25, "home_city": "Kandy", "department": "Mechanical and Manufacturing"}, 
6   {"_key": "Anjana_Gamage", "name": "Anjana Gamage", "sex": "Female", "age": 23, "home_city": "Gampaha", "department": "Mechanical and Manufacturing"}, 
7   {"_key": "Tharanga_Lakmal", "name": "Tharanga Lakmal", "sex": "Male", "age": 24, "home_city": "Rathnapura", "department": "Civil and Environmental"}, 
8   {"_key": "Hasindu_Avishka", "name": "Hasindu Avishka", "sex": "Male", "age": 25, "home_city": "Rathnapura", "department": "Mechanical and Manufacturing"}, 
9   {"_key": "Mohommad_Mazar", "name": "Mohommad Mazar", "sex": "Male", "age": 22, "home_city": "Matale", "department": "Electrical and Information"}, 
10  {"_key": "Kelum_Madusanka", "name": "Kelum Madusanka", "sex": "Male", "age": 24, "home_city": "Kegalle", "department": "Electrical and Information"}, 
11  {"_key": "Dhanuka_Kumara", "name": "Dhanuka Kumara", "sex": "Male", "age": 23, "home_city": "Kalutara", "department": "Civil and Environmental"}]
12 ]
13 FOR s IN students_data
14   INSERT s INTO Students

```

Below the code editor are buttons for Remove all results, Create Debug Package, Profile, Explain, and Execute. The status bar shows the query took 1.751 ms and resulted in 10 writes. A preview pane on the right shows the results with columns Key and Value, and a note that no bind parameters were defined.

## 2.3 Creating collection for edges and enter edges with data

Data for 23 edges was gathered in a text file with appropriate syntax used in arangodb query language. Then, the data was entered to the created collection using a suitable query.

The screenshot shows a Notepad++ window with a file named 'knows\_data.txt'. The file contains 20 documents, each representing an edge between two student nodes. The documents are in JSON format with the following structure:

```

1 [ {"_key": "knows_1", "_from": "Students/Maleesha_Sudhara", "_to": "Students/Dhanuka_Kumara", "relationship_nature": "enemy", "first_met_at": "School", "known_since": "2011"}, 
2 ({"_key": "knows_2", "_from": "Students/Dhanuka_Kumara", "_to": "Students/Maleesha_Sudhara", "relationship_nature": "enemy", "first_met_at": "School", "known_since": "2011"}, 
3 ({"_key": "knows_3", "_from": "Students/Maleesha_Sudhara", "_to": "Students/Kelum_Madusanka", "relationship_nature": "neutral", "first_met_at": "University", "known_since": "2019"}, 
4 ({"_key": "knows_4", "_from": "Students/Maleesha_Sudhara", "_to": "Students/Lahiru_Perera", "relationship_nature": "freind", "first_met_at": "School", "known_since": "2014"}, 
5 ({"_key": "knows_5", "_from": "Students/Lahiru_Perera", "_to": "Students/Maleesha_Sudhara", "relationship_nature": "neutral", "first_met_at": "School", "known_since": "2014"}, 
6 ({"_key": "knows_6", "_from": "Students/Maleesha_Sudhara", "_to": "Students/Sugumar_Krishnanthan", "relationship_nature": "freind", "first_met_at": "University", "known_since": "2019"}, 
7 ({"_key": "knows_7", "_from": "Students/Sugumar_Krishnanthan", "_to": "Students/Maleesha_Sudhara", "relationship_nature": "freind", "first_met_at": "University", "known_since": "2019"}, 
8 ({"_key": "knows_8", "_from": "Students/Dhanuka_Kumara", "_to": "Students/Tharanga_Lakmal", "relationship_nature": "neutral", "first_met_at": "University", "known_since": "2019"}, 
9 ({"_key": "knows_9", "_from": "Students/Tharanga_Lakmal", "_to": "Students/Hasindu_Avishka", "relationship_nature": "enemy", "first_met_at": "School", "known_since": "2009"}, 
10 ({"_key": "knows_10", "_from": "Students/Hasindu_Avishka", "_to": "Students/Tharanga_Lakmal", "relationship_nature": "neutral", "first_met_at": "School", "known_since": "2009"}, 
11 ({"_key": "knows_11", "_from": "Students/Lahiru_Perera", "_to": "Students/Mohommad_Mazar", "relationship_nature": "freind", "first_met_at": "University", "known_since": "2019"}, 
12 ({"_key": "knows_12", "_from": "Students/Mohommad_Mazar", "_to": "Students/Lahiru_Perera", "relationship_nature": "freind", "first_met_at": "University", "known_since": "2019"}, 
13 ({"_key": "knows_13", "_from": "Students/Dhanuka_Kumara", "_to": "Students/Anjana_Gamage", "relationship_nature": "neutral", "first_met_at": "University", "known_since": "2019"}, 
14 ({"_key": "knows_14", "_from": "Students/Anjana_Gamage", "_to": "Students/Shanika_Fernando", "relationship_nature": "freind", "first_met_at": "University", "known_since": "2019"}, 
15 ({"_key": "knows_15", "_from": "Students/Shanika_Fernando", "_to": "Students/Anjana_Gamage", "relationship_nature": "freind", "first_met_at": "University", "known_since": "2019"}, 
16 ({"_key": "knows_16", "_from": "Students/Shanika_Fernando", "_to": "Students/Hasindu_Avishka", "relationship_nature": "neutral", "first_met_at": "University", "known_since": "2019"}, 
17 ({"_key": "knows_17", "_from": "Students/Mohommad_Mazar", "_to": "Students/Dhanuka_Kumara", "relationship_nature": "enemy", "first_met_at": "University", "known_since": "2019"}, 
18 ({"_key": "knows_18", "_from": "Students/Dhanuka_Kumara", "_to": "Students/Mohommad_Mazar", "relationship_nature": "neutral", "first_met_at": "University", "known_since": "2019"}, 
19 ({"_key": "knows_19", "_from": "Students/Kelum_Madusanka", "_to": "Students/Tharanga_Lakmal", "relationship_nature": "freind", "first_met_at": "University", "known_since": "2019"}, 
20 ({"_key": "knows_20", "_from": "Students/Tharanga_Lakmal", "_to": "Students/Kelum_Madusanka", "relationship_nature": "freind", "first_met_at": "University", "known_since": "2019"}]

```

C:\Users\DELL\Desktop\knows\_data.txt - Notepad++

```

File Edit Search View Encoding Language Settings Macro Run Plugins Window ?
student_data.txt knows_data.txt

4 ("key": "knows_4", "from": "Students/Maleesha_Sudhara", "to": "Students/Lahiru_Perera", "relationship_nature": "freind", "first_met_at": "School", "known_since": "2014"),
5 ("key": "knows_5", "from": "Students/Lahiru_Perera", "to": "Students/Maleesha_Sudhara", "relationship_nature": "neutral", "first_met_at": "School", "known_since": "2014"),
6 ("key": "knows_6", "from": "Students/Maleesha_Sudhara", "to": "Students/Sugumar_Krishanthan", "relationship_nature": "freind", "first_met_at": "University", "known_since": "2019"),
7 ("key": "knows_7", "from": "Students/Sugumar_Krishanthan", "to": "Students/Maleesha_Sudhara", "relationship_nature": "freind", "first_met_at": "University", "known_since": "2019"),
8 ("key": "knows_8", "from": "Students/Dhanuka_Kumara", "to": "Students/Tharanga_Lakmal", "relationship_nature": "neutral", "first_met_at": "University", "known_since": "2019"),
9 ("key": "knows_9", "from": "Students/Tharanga_Lakmal", "to": "Students/Hasindu_Avishka", "relationship_nature": "enemy", "first_met_at": "School", "known_since": "2009"),
10 ("key": "knows_10", "from": "Students/Hasindu_Avishka", "to": "Students/Tharanga_Lakmal", "relationship_nature": "neutral", "first_met_at": "School", "known_since": "2009"),
11 ("key": "knows_11", "from": "Students/Lahiru_Perera", "to": "Students/Mohammad_Mazar", "relationship_nature": "freind", "first_met_at": "University", "known_since": "2019"),
12 ("key": "knows_12", "from": "Students/Mohammad_Mazar", "to": "Students/Lahiru_Perera", "relationship_nature": "freind", "first_met_at": "University", "known_since": "2019"),
13 ("key": "knows_13", "from": "Students/Dhanuka_Kumara", "to": "Students/Anjana_Gamage", "relationship_nature": "neutral", "first_met_at": "University", "known_since": "2019"),
14 ("key": "knows_14", "from": "Students/Anjana_Gamage", "to": "Students/Shanika_Fernando", "relationship_nature": "freind", "first_met_at": "University", "known_since": "2019"),
15 ("key": "knows_15", "from": "Students/Shanika_Fernando", "to": "Students/Anjana_Gamage", "relationship_nature": "freind", "first_met_at": "University", "known_since": "2019"),
16 ("key": "knows_16", "from": "Students/Shanika_Fernando", "to": "Students/Hasindu_Avishka", "relationship_nature": "neutral", "first_met_at": "University", "known_since": "2019"),
17 ("key": "knows_17", "from": "Students/Mohammad_Mazar", "to": "Students/Dhanuka_Kumara", "relationship_nature": "enemy", "first_met_at": "University", "known_since": "2019"),
18 ("key": "knows_18", "from": "Students/Dhanuka_Kumara", "to": "Students/Mohammad_Mazar", "relationship_nature": "neutral", "first_met_at": "University", "known_since": "2019"),
19 ("key": "knows_19", "from": "Students/Kelum_Madusanka", "to": "Students/Tharanga_Lakmal", "relationship_nature": "freind", "first_met_at": "University", "known_since": "2019"),
20 ("key": "knows_20", "from": "Students/Tharanga_Lakmal", "to": "Students/Kelum_Madusanka", "relationship_nature": "freind", "first_met_at": "University", "known_since": "2019"),
21 ("key": "knows_21", "from": "Students/Maleesha_Sudhara", "to": "Students/Mohammad_Mazar", "relationship_nature": "freind", "first_met_at": "University", "known_since": "2019"),
22 ("key": "knows_22", "from": "Students/Mohammad_Mazar", "to": "Students/Maleesha_Sudhara", "relationship_nature": "freind", "first_met_at": "University", "known_since": "2019"),
23 ("key": "knows_23", "from": "Students/Anjana_Gamage", "to": "Students/Mohammad_Mazar", "relationship_nature": "neutral", "first_met_at": "University", "known_since": "2019")]

```

Normal text file length: 3,871 lines: 23 Ln:23 Col:1 Sel:0|0 Windows (CRLF) UTF-8 INS

ArangoDB Web Interface 127.0.0.1:8529/\_db/Graph\_model/\_admin/aardvark/index.html#collections

Booking.com Amazon.com Facebook eBay YouTube Download YouTube...

ArangoDB COMMUNITY EDITION

COLLECTIONS

New Collection

Name\*: knows

Type: Edge

Advanced

Cancel Save

USER: ROOT DB: GRAPH\_MODEL HEALTH: GOOD

3.7.0

12:20 PM 02-Jun-21

ArangoDB Web Interface

127.0.0.1:8529/\_db/Graph\_model/\_admin/aardvark/index.html#queries

USER: ROOT DB: GRAPH\_MODEL HEALTH: GOOD

**QUERIES**

```

1 LET knows_data = [
2 {"_key": "knows_1", "_from": "Students/Maleesha_Sudhara", "_to": "Students/Dhanuka_Kumara",
3   , "relationship_nature": "enemy", "first_met_at": "School", "known_since": "2011"}, 
4 {"_key": "knows_2", "_from": "Students/Dhanuka_Kumara", "_to": "Students/Maleesha_Sudhara",
5   , "relationship_nature": "enemy", "first_met_at": "School", "known_since": "2011"}, 
6 {"_key": "knows_3", "_from": "Students/Maleesha_Sudhara", "_to": "Students/Kelum_Nadusanka",
7   , "relationship_nature": "neutral", "first_met_at": "University", "known_since": "2019"}, 
8 {"_key": "knows_4", "_from": "Students/Maleesha_Sudhara", "_to": "Students/Lahiru_Perera",
9   , "relationship_nature": "freind", "first_met_at": "School", "known_since": "2014"}, 
10 {"_key": "knows_5", "_from": "Students/Lahiru_Perera", "_to": "Students/Maleesha_Sudhara",
11   , "relationship_nature": "neutral", "first_met_at": "School", "known_since": "2014"}, 
12 {"_key": "knows_6", "_from": "Students/Maleesha_Sudhara", "_to": "Students/Sugumar_Krishnanthan",
13   , "relationship_nature": "freind", "first_met_at": "University", "known_since": "2019"}, 
14 {"_key": "knows_7", "_from": "Students/Sugumar_Krishnanthan", "_to": "Students/Maleesha_Sudhara",
15   , "relationship_nature": "freind", "first_met_at": "University", "known_since": "2019"}, 
16 {"_key": "knows_8", "_from": "Students/Dhanuka_Kumara", "_to": "Students/Tharanga_Lakmal",
17   , "relationship_nature": "neutral", "first_met_at": "University", "known_since": "2019"}, 
18 {"_key": "knows_9", "_from": "Students/Tharanga_Lakmal", "_to": "Students/Hasindu_Avishka",
19   , "relationship_nature": "neutral", "first_met_at": "School", "known_since": "2009"}, 
20 {"_key": "knows_10", "_from": "Students/Hasindu_Avishka", "_to": "Students/Tharanga_Lakmal",
21   , "relationship_nature": "neutral", "first_met_at": "School", "known_since": "2009"}, 
22 {"_key": "knows_11", "_from": "Students/Lahiru_Perera", "_to": "Students/Mohammad_Nazar",
23   , "relationship_nature": "freind", "first_met_at": "University", "known_since": "2019"}, 
24 {"_key": "knows_12", "_from": "Students/Mohammad_Nazar", "_to": "Students/Lahiru_Perera"
25 FOR s IN knows
26   INSERT s INTO knows
27 ]
```

1000 results

Key Value JSON

No bind parameters defined.

Remove all results Create Debug Package Profile Explain Execute

Query 0 elements 2.754 ms 23 writes 0 writes ignored

1 []

12:22 PM 02-Jun-21

ArangoDB Web Interface

127.0.0.1:8529/\_db/Graph\_model/\_admin/aardvark/index.html#queries

USER: ROOT DB: GRAPH\_MODEL HEALTH: GOOD

**QUERIES**

```

15 {"_key": "knows_14", "_from": "Students/Anjana_Gamage", "_to": "Students/Shanika_Fernando",
16   , "relationship_nature": "freind", "first_met_at": "University", "known_since": "2019"}, 
17 {"_key": "knows_15", "_from": "Students/Shanika_Fernando", "_to": "Students/Anjana_Gamage",
18   , "relationship_nature": "freind", "first_met_at": "University", "known_since": "2019"}, 
19 {"_key": "knows_16", "_from": "Students/shanika_Fernando", "_to": "Students/Hasindu_Avishka",
20   , "relationship_nature": "neutral", "first_met_at": "University", "known_since": "2019"}, 
21 {"_key": "knows_17", "_from": "Students/Hasindu_Avishka", "_to": "Students/Dhanuka_Kumara",
22   , "relationship_nature": "neutral", "first_met_at": "University", "known_since": "2019"}, 
23 {"_key": "knows_18", "_from": "Students/Dhanuka_Kumara", "_to": "Students/Mohammad_Nazar",
24   , "relationship_nature": "enemy", "first_met_at": "University", "known_since": "2019"}, 
25 {"_key": "knows_19", "_from": "Students/Dhanuka_Kumara", "_to": "Students/Mohammad_Nazar",
26   , "relationship_nature": "neutral", "first_met_at": "University", "known_since": "2019"}, 
27 {"_key": "knows_20", "_from": "Students/Mohammad_Nazar", "_to": "Students/Kelum_Nadusanka",
28   , "relationship_nature": "freind", "first_met_at": "University", "known_since": "2019"}, 
29 {"_key": "knows_21", "_from": "Students/Mohammad_Nazar", "_to": "Students/Maleesha_Sudhara",
30   , "relationship_nature": "freind", "first_met_at": "University", "known_since": "2019"}, 
31 {"_key": "knows_22", "_from": "Students/Maleesha_Sudhara", "_to": "Students/Mohammad_Nazar",
32   , "relationship_nature": "freind", "first_met_at": "University", "known_since": "2019"}, 
33 {"_key": "knows_23", "_from": "Students/Maleesha_Sudhara", "_to": "Students/Anjana_Gamage",
34   , "relationship_nature": "neutral", "first_met_at": "University", "known_since": "2019"}]
```

1000 results

Key Value JSON

No bind parameters defined.

Remove all results Create Debug Package Profile Explain Execute

Query 0 elements 2.754 ms 23 writes 0 writes ignored

1 []

12:23 PM 02-Jun-21

## 2.4 View created collections

- Students collection

The screenshot shows the ArangoDB Web Interface with the URL `127.0.0.1:8529/_db/Graph_model/_admin/aardvark/index.html#collection/Students/documents/1`. The interface has a left sidebar with various navigation options like Collections, Views, Queries, Graphs, Services, Logs, Support, Help Us, and Get Enterprise. The main content area is titled "ArangoDB Collection: Students" and shows the "Content" tab selected. It displays a list of 10 student documents. Each document entry includes the document ID, key, revision, age, and department. The interface also shows pagination at the bottom with 10 doc(s) and page numbers 1 through 7.

Content	_key
{"_id": "Students/Sugumar_Krishanthan", "_key": "Sugumar_Krishanthan", "_rev": "_car4euS---", "age": 25, "department": "Mechanical"} {"_id": "Students/Lahiru_Perera", "_key": "Lahiru_Perera", "_rev": "_car4euS--A", "age": 23, "department": "Electrical"} {"_id": "Students/Maleesha_Sudhara", "_key": "Maleesha_Sudhara", "_rev": "_car4euS--C", "age": 25, "department": "Mechanical"} {"_id": "Students/Shanika_Fernando", "_key": "Shanika_Fernando", "_rev": "_car4euS--E", "age": 25, "department": "Mechanical"} {"_id": "Students/Anjana_Gamage", "_key": "Anjana_Gamage", "_rev": "_car4euS--G", "age": 23, "department": "Mechanical"} {"_id": "Students/Tharanga_Lakmal", "_key": "Tharanga_Lakmal", "_rev": "_car4euS--I", "age": 24, "department": "Civil and Structural"} {"_id": "Students/Hasindu_Avishka", "_key": "Hasindu_Avishka", "_rev": "_car4euW--_", "age": 25, "department": "Mechanical"} {"_id": "Students/Mohommad_Mazar", "_key": "Mohommad_Mazar", "_rev": "_car4euW--B", "age": 22, "department": "Electrical"} {"_id": "Students/Kelum_Madusanka", "_key": "Kelum_Madusanka", "_rev": "_car4euW--D", "age": 24, "department": "Electrical"} {"_id": "Students/Dhanuka_Kumara", "_key": "Dhanuka_Kumara", "_rev": "_car4euW--F", "age": 23, "department": "Civil and Structural"}	Sugumar_Krishanthan Lahiru_Perera Maleesha_Sudhara Shanika_Fernando Anjana_Gamage Tharanga_Lakmal Hasindu_Avishka Mohommad_Mazar Kelum_Madusanka Dhanuka_Kumara

This screenshot is identical to the one above, showing the ArangoDB Web Interface with the same URL and content. It displays the same 10 student documents with their respective keys, revisions, ages, and departments. The interface includes the same sidebar and pagination controls.

Content	_key
{"_id": "Students/Sugumar_Krishanthan", "_key": "Sugumar_Krishanthan", "_rev": "_car4euS---", "age": 25, "department": "Mechanical"} {"_id": "Students/Lahiru_Perera", "_key": "Lahiru_Perera", "_rev": "_car4euS--A", "age": 23, "department": "Electrical"} {"_id": "Students/Maleesha_Sudhara", "_key": "Maleesha_Sudhara", "_rev": "_car4euS--C", "age": 25, "department": "Mechanical"} {"_id": "Students/Shanika_Fernando", "_key": "Shanika_Fernando", "_rev": "_car4euS--E", "age": 25, "department": "Mechanical"} {"_id": "Students/Anjana_Gamage", "_key": "Anjana_Gamage", "_rev": "_car4euS--G", "age": 23, "department": "Mechanical"} {"_id": "Students/Tharanga_Lakmal", "_key": "Tharanga_Lakmal", "_rev": "_car4euS--I", "age": 24, "department": "Civil and Structural"} {"_id": "Students/Hasindu_Avishka", "_key": "Hasindu_Avishka", "_rev": "_car4euW--_", "age": 25, "department": "Mechanical"} {"_id": "Students/Mohommad_Mazar", "_key": "Mohommad_Mazar", "_rev": "_car4euW--B", "age": 22, "department": "Electrical"} {"_id": "Students/Kelum_Madusanka", "_key": "Kelum_Madusanka", "_rev": "_car4euW--D", "age": 24, "department": "Electrical"} {"_id": "Students/Dhanuka_Kumara", "_key": "Dhanuka_Kumara", "_rev": "_car4euW--F", "age": 23, "department": "Civil and Structural"}	Sugumar_Krishanthan Lahiru_Perera Maleesha_Sudhara Shanika_Fernando Anjana_Gamage Tharanga_Lakmal Hasindu_Avishka Mohommad_Mazar Kelum_Madusanka Dhanuka_Kumara

- Knows collection

The screenshot shows the ArangoDB Web Interface with the 'knows' collection selected. The left sidebar includes links for Collections, Views, Queries, Graphs, Services, Logs, Support, Help Us, and Get Enterprise. The main content area displays the 'Content' of the 'knows' collection, listing 23 edge documents. Each document has fields: '\_from', '\_id', '\_key', '\_rev', and '\_to'. The '\_key' column lists values like 'knows\_1' through 'knows\_8'. The interface features a dark theme with light-colored text and icons.

Content	_key
{"_from": "Students/Maleesha_Sudhara", "_id": "knows/knows_1", "_key": "knows_1", "_rev": "_car813i---", "_to": "Students/Lahiru_Perera"}	knows_1
{"_from": "Students/Dhanuka_Kumara", "_id": "knows/knows_2", "_key": "knows_2", "_rev": "_car813i--A", "_to": "Students/Hasindu_Avishka"}	knows_2
{"_from": "Students/Maleesha_Sudhara", "_id": "knows/knows_3", "_key": "knows_3", "_rev": "_car813i--C", "_to": "Students/Tharanga_Lakmal"}	knows_3
{"_from": "Students/Maleesha_Sudhara", "_id": "knows/knows_4", "_key": "knows_4", "_rev": "_car813i--E", "_to": "Students/Anjana_Gamage"}	knows_4
{"_from": "Students/Lahiru_Perera", "_id": "knows/knows_5", "_key": "knows_5", "_rev": "_car813i--G", "_to": "Students/Dhanuka_Kumara"}	knows_5
{"_from": "Students/Maleesha_Sudhara", "_id": "knows/knows_6", "_key": "knows_6", "_rev": "_car813i--I", "_to": "Students/Shanika_Fernando"}	knows_6
{"_from": "Students/Sugumar_Krishanthan", "_id": "knows/knows_7", "_key": "knows_7", "_rev": "_car813i--K", "_to": "Students/Mohammad_Nazar"}	knows_7
...	...
23 edge(s)	

This screenshot shows the same ArangoDB interface after some changes have been made. The 'Content' table now lists 15 edge documents, starting from 'knows\_8' up to 'knows\_15'. The '\_key' column continues the sequence from the previous screenshot. The interface remains consistent with the first screenshot, featuring a dark theme and standard web browser navigation controls.

Content	_key
{"_from": "Students/Dhanuka_Kumara", "_id": "knows/knows_8", "_key": "knows_8", "_rev": "_car813i--N", "_to": "Students/Lahiru_Perera"}	knows_8
{"_from": "Students/Tharanga_Lakmal", "_id": "knows/knows_9", "_key": "knows_9", "_rev": "_car813i--O", "_to": "Students/Hasindu_Avishka"}	knows_9
{"_from": "Students/Hasindu_Avishka", "_id": "knows/knows_10", "_key": "knows_10", "_rev": "_car813i--Q", "_to": "Students/Anjana_Gamage"}	knows_10
{"_from": "Students/Lahiru_Perera", "_id": "knows/knows_11", "_key": "knows_11", "_rev": "_car813i--S", "_to": "Students/Dhanuka_Kumara"}	knows_11
{"_from": "Students/Mohammad_Nazar", "_id": "knows/knows_12", "_key": "knows_12", "_rev": "_car813i--U", "_to": "Students/Shanika_Fernando"}	knows_12
{"_from": "Students/Dhanuka_Kumara", "_id": "knows/knows_13", "_key": "knows_13", "_rev": "_car813i--W", "_to": "Students/Anjana_Gamage"}	knows_13
{"_from": "Students/Anjana_Gamage", "_id": "knows/knows_14", "_key": "knows_14", "_rev": "_car813i--Y", "_to": "Students/Mohammad_Nazar"}	knows_14
{"_from": "Students/Shanika_Fernando", "_id": "knows/knows_15", "_key": "knows_15", "_rev": "_car813i--a", "_to": "Students/Dhanuka_Kumara"}	knows_15
...	...
23 edge(s)	

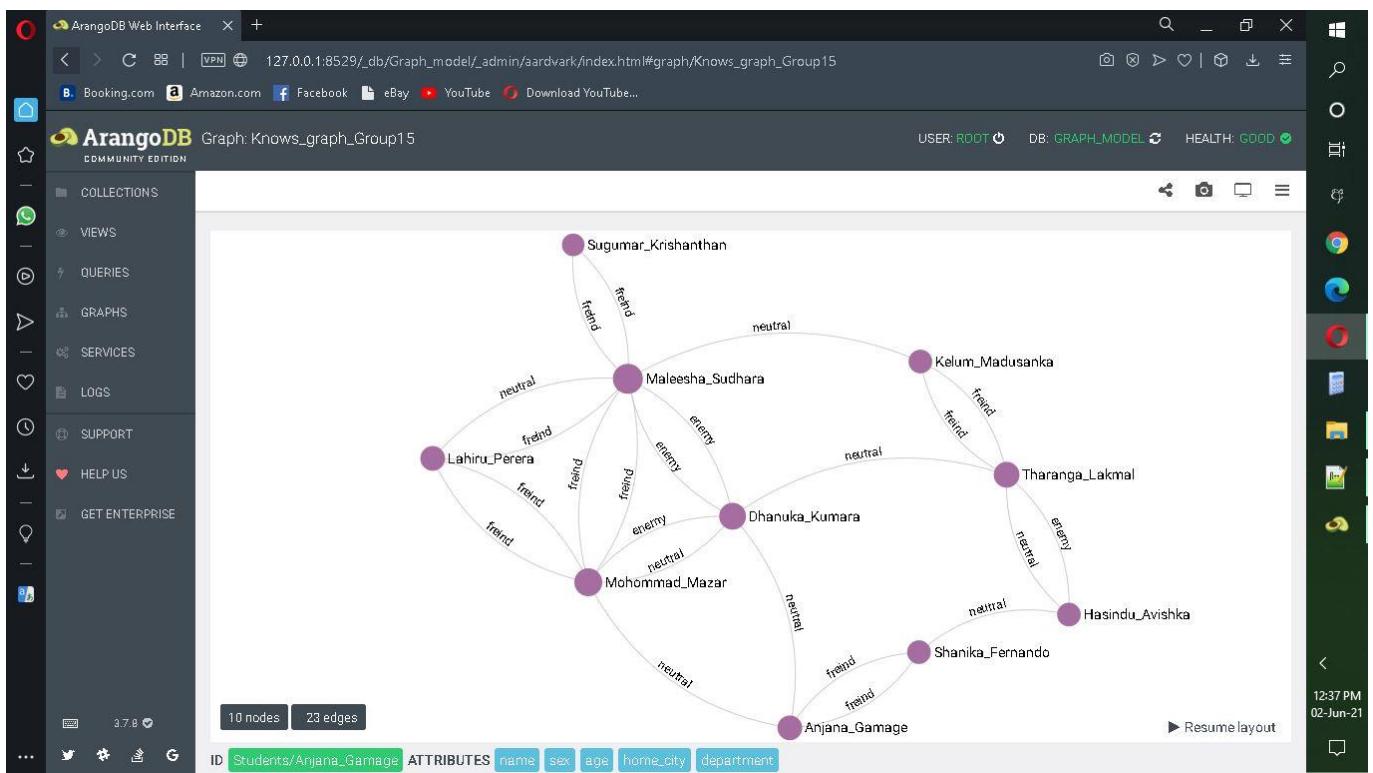
The screenshot shows the ArangoDB Web Interface with the URL `127.0.0.1:8529/_db/Graph_model/_admin/aardvark/index.html#collection/knows/documents/1`. The left sidebar includes links for Collections, Views, Queries, Graphs, Services, Logs, Support, Help Us, and Get Enterprise. The main content area displays the 'Content' tab for the 'knows' collection, showing 23 edge documents. Each document is a JSON object with fields: '\_from', '\_id', '\_key', '\_rev', and '\_to'. The '\_key' field is listed on the right. A toolbar at the top right includes icons for search, refresh, and export.

_key
knows_16
knows_17
knows_18
knows_19
knows_20
knows_21
knows_22
knows_23

## 2.5 Create and implement the graph model

The screenshot shows the ArangoDB Web Interface with the URL `127.0.0.1:8529/_db/Graph_model/_admin/aardvark/index.html#graphs`. The left sidebar includes links for Collections, Views, Queries, Graphs, Services, Logs, Support, Help Us, and Get Enterprise. A modal dialog titled 'Create Graph' is open in the center. It has tabs for 'Examples' and 'Graph', with 'Graph' selected. The form fields are: Name\*: 'Knows\_graph\_Group15', Edge definitions\*: 'knows', fromCollections\*: 'Students', toCollections\*: 'Students', and Vertex collections: 'Students'. At the bottom are 'Cancel' and 'Create' buttons. The status bar at the bottom right shows the date and time: '12:27 PM 02-Jun-21'.

In this graph student nodes are labeled by their keys and knows edges are labeled by their relationship nature property.



## 2.6 Performed queries for mentioned data retrievals

- Query to return whole graph (nodes and edges are retrieved separately)

```

1 LET profile = DOCUMENT("Students/Lahiru_Perera")
2 LET edge = (
3   FOR v IN 1..10 OUTBOUND profile knows
4     RETURN DISTINCT know //return all edges
5   )
6
7 LET node = (
8   FOR v IN 1..10 OUTBOUND profile knows
9     RETURN DISTINCT v //return all nodes
10  )
11
12 RETURN {node,edge}
13
14
15
16
17

```

Key	Value
No bind parameters defined.	

Query 1 elements 1.158 s

node	edge
------	------

The screenshot shows the ArangoDB Web Interface with a query results page. The left sidebar includes links for Collections, Views, Queries (selected), Graphs, Services, Logs, Support, Help Us, and Get Enterprise. The main area has tabs for Query (selected), JSON, and Table. A toolbar at the top includes Remove all results, Create Debug Package, Profile, Explain, and Execute buttons.

**Query** 1 elements 0.1.58 s

node	edge
[{"_key": "Maleesha_Sudhara", "id": "Students/Maleesha_Sudhara", "rev": "_car4euSC", "name": "Maleesha Sudhara", "sex": "Male", "age": 25, "home_city": "Panadura", "department": "Mechanical and Manufacturing"}, {"_key": "Dhanuka_Kumara", "id": "Students/Dhanuka_Kumara", "rev": "_car4euWF", "name": "Dhanuka Kumara", "sex": "Male", "age": 23, "home_city": "Kalutara", "department": "Civil and Environmental"}, {"_key": "Kelum_Madusanka", "id": "Students/Kelum_Madusanka", "rev": "_car4euWD", "name": "Kelum Madusanka", "sex": "Male", "age": 24, "home_city": "Kegalle", "department": "Electrical and Information"}, {"_key": "Tharanga_Lakma", "id": "Students/Tharanga_Lakma", "rev": "_car4euS1", "name": "Tharanga Lakma"}]	[{"_key": "knows_1", "id": "knows/knows_1", "from": "Students/Maleesha_Sudhara", "relationship_nature": "enemy", "first_met_at": "School", "known_since": "2011"}, {"_key": "knows_2", "id": "knows/knows_2", "from": "Students/Dhanuka_Kumara", "relationship_nature": "enemy", "first_met_at": "School", "known_since": "2011"}, {"_key": "knows_3", "id": "knows/knows_3", "from": "Students/Maleesha_Sudhara", "relationship_nature": "neutral", "first_met_at": "University", "known_since": "2014"}, {"_key": "knows_4", "id": "knows/knows_4", "from": "Students/Maleesha_Sudhara", "relationship_nature": "freind", "first_met_at": "School", "known_since": "2014"}, {"_key": "knows_5", "id": "knows/knows_5", "from": "Students/Lahiru_Perera", "t": "G", "relationship_nature": "neutral", "first_met_at": "School", "known_since": "2014"}, {"_key": "knows_6", "id": "knows/knows_6", "from": "Students/Maleesha_Sudhara", "relationship_nature": "freind", "first_met_at": "University", "known_since": "2019"}, {"_key": "knows_7", "id": "knows/knows_7", "from": "Students/Sugumar_Krishan", "relationship_nature": "freind", "first_met_at": "University", "known_since": "2011"}, {"_key": "knows_8", "id": "knows/knows_8", "from": "Students/Dhanuka_Kumara", "relationship_nature": "neutral", "first_met_at": "University", "known_since": "2010"}, {"_key": "knows_9", "id": "knows/knows_9", "from": "Students/Tharanga_Lakma", "relationship_nature": "neutral", "first_met_at": "University", "known_since": "2011"}]

Download CSV Copy To Editor

The screenshot shows the ArangoDB Web Interface with a query results table. The table has columns for '\_key', '\_id', 'knows', '\_from', 'relationship\_nature', 'first\_met\_at', and 'known\_since'. The data includes various student records and their relationships, such as 'Tharanga Lakma' and 'Hasindu Avishka' being enemies, and 'Lahiru Perera' and 'Anjana Gamage' being neutral. The interface also features a sidebar with navigation links like 'COLLECTIONS', 'QUERIES', 'GRAPHS', 'SERVICES', 'LOGS', 'SUPPORT', 'HELP US', and 'GET ENTERPRISE'.

_key	_id	knows	_from	relationship_nature	first_met_at	known_since
"_key": "knows_9", "id": "knows/knows_9", "from": "Students/Tharanga_Lakma 0", "relationship_nature": "enemy", "first_met_at": "School", "known_since": "2009"						
"_key": "knows_10", "id": "knows/knows_10", "from": "Students/Hasindu_Avish Q", "relationship_nature": "neutral", "first_met_at": "School", "known_since": "2009"						
"_key": "knows_11", "id": "knows/knows_11", "from": "Students/Lahiru_Perera", "S", "relationship_nature": "freind", "first_met_at": "University", "known_since": "2011						
"_key": "knows_12", "id": "knows/knows_12", "from": "Students/Mohammad_M U", "relationship_nature": "freind", "first_met_at": "University", "known_since": "2011						
"_key": "knows_13", "id": "knows/knows_13", "from": "Students/Dhanuka_Kumi W", "relationship_nature": "neutral", "first_met_at": "University", "known_since": "2010						
"_key": "knows_14", "id": "knows/knows_14", "from": "Students/Anjana_Gamag Y", "relationship_nature": "freind", "first_met_at": "University", "known_since": "2010						
"_key": "knows_15", "id": "knows/knows_15", "from": "Students/Shanika_Ferna a", "relationship_nature": "freind", "first_met_at": "University", "known_since": "2010						
"_key": "knows_16", "id": "knows/knows_16", "from": "Students/Shanika_Ferna c", "relationship_nature": "neutral", "first_met_at": "University", "known_since": "2010						
"_key": "knows_17", "id": "knows/knows_17", "from": "Students/Mohammad_M A", "relationship_nature": "enemy", "first_met_at": "University", "known_since": "2010						
"_key": "knows_18", "id": "knows/knows_18", "from": "Students/Dhanuka_Kumi n", "relationship_nature": "neutral", "first_met_at": "University", "known_since": "2010						

The screenshot shows the ArangoDB Web Interface with a query results page. The left sidebar includes links for Collections, Views, Queries (selected), Graphs, Services, Logs, Support, Help Us, and Get Enterprise. The main area displays a query result with 1 element, executed in 1.158 seconds. The result is a JSON array of edges representing friendships between students. The interface includes tabs for JSON and Table, and buttons for Remove all results, Create Debug Package, Profile, Explain, Execute, Download, CSV, and Copy To Editor.

```

[{"_key": "knows_14", "_id": "Students/Mohammad_Mazar", "from": "Students/Mohammad_Mazar", "to": "Students/Anjana_Gamage", "edge": {"relationship_nature": "freind", "first_met_at": "University", "known_since": "2011"}, "label": "Knows", "order": 1}, {"_key": "knows_15", "_id": "Students/Anjana_Gamage", "from": "Students/Anjana_Gamage", "to": "Students/Shanika_Fernando", "edge": {"relationship_nature": "freind", "first_met_at": "University", "known_since": "2011"}, "label": "Knows", "order": 2}, {"_key": "knows_16", "_id": "Students/Shanika_Fernando", "from": "Students/Shanika_Fernando", "to": "Students/Mohammad_Mel", "edge": {"relationship_nature": "neutral", "first_met_at": "University", "known_since": "2011"}, "label": "Knows", "order": 3}, {"_key": "knows_17", "_id": "Students/Mohammad_Mel", "from": "Students/Mohammad_Mel", "to": "Students/Dhanuka_Kumari", "edge": {"relationship_nature": "enemy", "first_met_at": "University", "known_since": "2011"}, "label": "Knows", "order": 4}, {"_key": "knows_18", "_id": "Students/Dhanuka_Kumari", "from": "Students/Dhanuka_Kumari", "to": "Students/Kelum_Madusuri", "edge": {"relationship_nature": "neutral", "first_met_at": "University", "known_since": "2011"}, "label": "Knows", "order": 5}, {"_key": "knows_19", "_id": "Students/Kelum_Madusuri", "from": "Students/Kelum_Madusuri", "to": "Students/Tharanga_Lakrishi", "edge": {"relationship_nature": "freind", "first_met_at": "University", "known_since": "2019"}, "label": "Knows", "order": 6}, {"_key": "knows_20", "_id": "Students/Tharanga_Lakrishi", "from": "Students/Tharanga_Lakrishi", "to": "Students/Maleesha_Sudhara", "edge": {"relationship_nature": "neutral", "first_met_at": "University", "known_since": "2011"}, "label": "Knows", "order": 7}, {"_key": "knows_21", "_id": "Students/Maleesha_Sudhara", "from": "Students/Maleesha_Sudhara", "to": "Students/Mohammad_Mel", "edge": {"relationship_nature": "freind", "first_met_at": "University", "known_since": "2011"}, "label": "Knows", "order": 8}, {"_key": "knows_22", "_id": "Students/Mohammad_Mel", "from": "Students/Mohammad_Mel", "to": "Students/Anjana_Gamage", "edge": {"relationship_nature": "freind", "first_met_at": "University", "known_since": "2011"}, "label": "Knows", "order": 9}, {"_key": "knows_23", "_id": "Students/Anjana_Gamage", "from": "Students/Anjana_Gamage", "to": "Students/Mohammad_Mel", "edge": {"relationship_nature": "neutral", "first_met_at": "University", "known_since": "2011"}, "label": "Knows", "order": 10}

```

- Query to return friends of a student (friends are chosen by relationship nature property)

The screenshot shows the ArangoDB Web Interface with a query editor. The left sidebar includes links for Collections, Views, Queries (selected), Graphs, Services, Logs, Support, Help Us, and Get Enterprise. The main area shows the query editor with the following AQL code:

```

LET know = (
  FOR v,e in 1..1 OUTBOUND 'Students/Maleesha_Sudhara'
  GRAPH 'Knows_graph_Group15'
  RETURN e //return all edges outbound from selected node
)
LET freinds= (FOR r in know
  FILTER r.relationship_nature=="freind"
  return r._to//return freinds of selected node
)
RETURN freinds

```

The results pane shows 1000 results with the message: "No bind parameters defined." The interface includes tabs for JSON and Table, and buttons for Remove all results, Create Debug Package, Profile, Explain, Execute, Download, CSV, and Copy To Editor.

The screenshot shows the ArangoDB Web Interface. The left sidebar contains navigation links: Home, Collections, Views, Queries (selected), Graphs, Services, Logs, Support, Help Us, and Get Enterprise. The main area displays a query editor with the following AQL code:

```
1 FOR r IN 1..1 Relationships
2   FILTER r._from == "Students/Lahiru_Perera"
3   GRAPH "Knows_graph_Group15"
4   RETURN e //return all edges outbound from selected node
5
6
7 LET freinds= (FOR r in know
8   FILTER r.relationship_nature=="freind"
9   return r._to//return freinds of selected node
10 )
11
12
13 RETURN freinds
```

The results pane shows the output of the query:

```
Query 1 elements 75.547 ms JSON
1 [
2   [
3     "Students/Lahiru_Perera",
4     "Students/Sugumar_Krishnanthan",
5     "Students/Hohomad_Mazar"
6   ]
7 ]
```

Below the results, there are buttons for Remove all results, Create Debug Package, Profile, Explain, Execute, Download, and Copy To Editor. The status bar at the bottom right indicates the time as 12:41 PM on 02-Jun-21.