

Chapter 1

Querying and SQL Functions

“

“Any unique image that you desire probably already exists on the internet or in some database... The problem today is no longer how to create the right image, but how to find an already existing one”

— Lev Manovich

”



12149CH01

1.1 Introduction

In Class XI, we have understood database concepts and learned how to create databases using MySQL. We have also learnt how to populate, manipulate and retrieve data from a database using SQL queries.

In this chapter, we are going to learn more SQL commands which are required to perform various queries in a database. We will understand how to use single row functions, multiple row functions, arranging records in ascending or descending order, grouping records based on some criteria, and working on multiple tables using SQL.

Let us create a database called CARSHOWROOM, having the schema as

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- » *Operations on Relations*
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shown in Figure 1.1. It has the following four relations:

- **INVENTORY:** Stores name, price, model, year of manufacturing, and fuel type for each car in inventory of the showroom,
- **CUSTOMER:** Stores customer Id, name, address, phone number and email for each customer,
- **SALE:** Stores the invoice number, car Id, customer id, sale date, mode of payment, sales person's employee Id, and selling price of the car sold,
- **EMPLOYEE:** Stores employee Id, name, date of birth, date of joining, designation, and salary of each employee in the showroom.

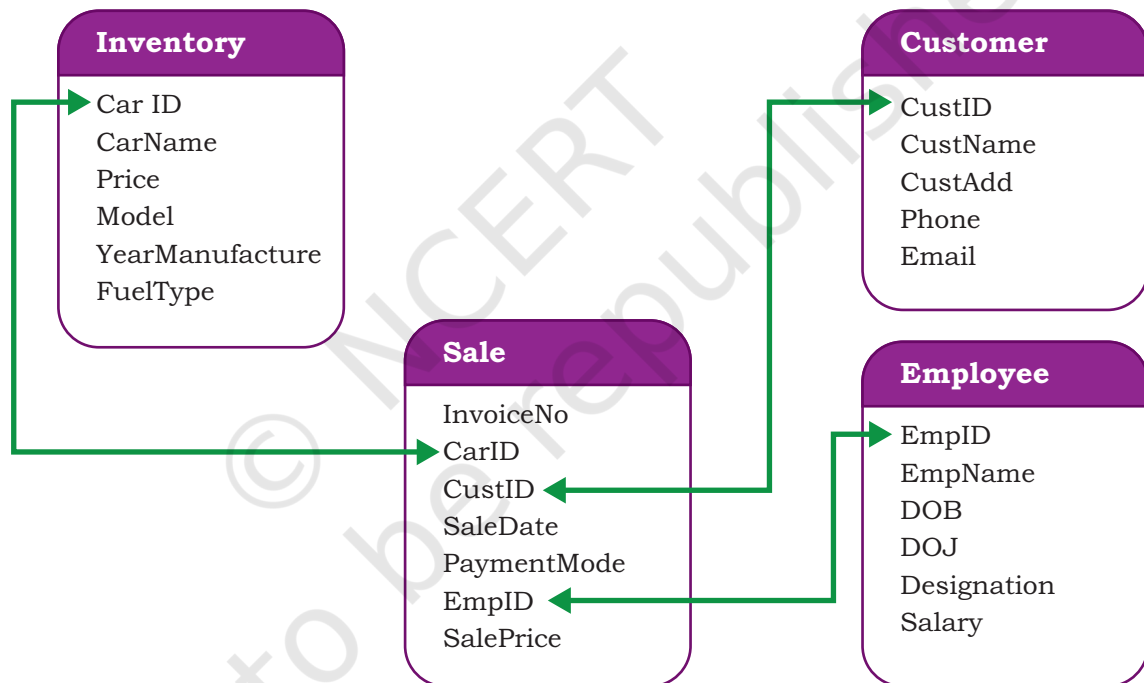


Figure 1.1: Schema diagram of database CARSHOWROOM

The records of the four relations are shown in Tables 1.1, 1.2, 1.3, and 1.4 respectively.

Table 1.1 INVENTORY

```
mysql > SELECT * FROM INVENTORY;
```

| CarId | CarName | Price | Model | YearManufacture | Fuel type |
|-------|---------|-----------|----------|-----------------|-----------|
| D001 | Car1 | 582613.00 | LXI | 2017 | Petrol |
| D002 | Car1 | 673112.00 | VXI | 2018 | Petrol |
| B001 | Car2 | 567031.00 | Sigma1.2 | 2019 | Petrol |
| B002 | Car2 | 647858.00 | Delta1.2 | 2018 | Petrol |

| | | | | | |
|------|------|-----------|-----------|------|--------|
| E001 | Car3 | 355205.00 | 5 STR STD | 2017 | CNG |
| E002 | Car3 | 654914.00 | CARE | 2018 | CNG |
| S001 | Car4 | 514000.00 | LXI | 2017 | Petrol |
| S002 | Car4 | 614000.00 | VXI | 2018 | Petrol |

8 rows in set (0.00 sec)

Table 1.2 CUSTOMER

mysql> SELECT * FROM CUSTOMER;

| CustId | CustName | CustAdd | Phone | Email |
|--------|---------------|-------------------------|------------|---------------------|
| C0001 | Amit Saha | L- 10, Pitampura | 4564587852 | amitsaha2@gmail.com |
| C0002 | Rehnuma | J- 12, SAKET | 5527688761 | rehnuma@hotmail.com |
| C0003 | Charvi Nayyar | 10/9, FF, Rohini | 6811635425 | charvi123@yahoo.com |
| C0004 | Gurpreet | A- 10/2, SF, MayurVihar | 3511056125 | gur_singh@yahoo.com |

4 rows in set (0.00 sec)

Table 1.3 SALE

mysql> SELECT * FROM SALE;

| InvoiceNo | CarId | CustId | SaleDate | PaymentMode | EmpID | SalePrice |
|-----------|-------|--------|------------|--------------|-------|-----------|
| I00001 | D001 | C0001 | 2019-01-24 | Credit Card | E004 | 613247.00 |
| I00002 | S001 | C0002 | 2018-12-12 | Online | E001 | 590321.00 |
| I00003 | S002 | C0004 | 2019-01-25 | Cheque | E010 | 604000.00 |
| I00004 | D002 | C0001 | 2018-10-15 | Bank Finance | E007 | 659982.00 |
| I00005 | E001 | C0003 | 2018-12-20 | Credit Card | E002 | 369310.00 |
| I00006 | S002 | C0002 | 2019-01-30 | Bank Finance | E007 | 620214.00 |

6 rows in set (0.00 sec)

Table 1.4 EMPLOYEE

mysql> SELECT * FROM EMPLOYEE;

| EmpID | EmpName | DOB | DOJ | Designation | Salary |
|-------|----------|------------|------------|--------------|--------|
| E001 | Rushil | 1994-07-10 | 2017-12-12 | Salesman | 25550 |
| E002 | Sanjay | 1990-03-12 | 2016-06-05 | Salesman | 33100 |
| E003 | Zohar | 1975-08-30 | 1999-01-08 | Peon | 20000 |
| E004 | Arpit | 1989-06-06 | 2010-12-02 | Salesman | 39100 |
| E006 | Sanjucta | 1985-11-03 | 2012-07-01 | Receptionist | 27350 |
| E007 | Mayank | 1993-04-03 | 2017-01-01 | Salesman | 27352 |
| E010 | Rajkumar | 1987-02-26 | 2013-10-23 | Salesman | 31111 |

7 rows in set (0.00 sec)

1.2 FUNCTIONS IN SQL

We know that a function is used to perform some particular task and it returns zero or more values as a result. Functions are useful while writing SQL queries also. Functions can be applied to work on single or multiple records (rows) of a table. Depending on their application in one or multiple rows, SQL functions are categorised as Single row functions and Aggregate functions.

1.2.1 Single Row Functions

These are also known as Scalar functions. Single row functions are applied on a single value and return a single value. Figure 1.2 lists different single row functions under three categories — Numeric (Math), String, Date and Time.

Math functions accept numeric value as input, and return a numeric value as a result. String functions accept character value as input, and return either character or numeric values as output. Date and time functions accept date and time values as input, and return numeric or string, or date and time values as output.

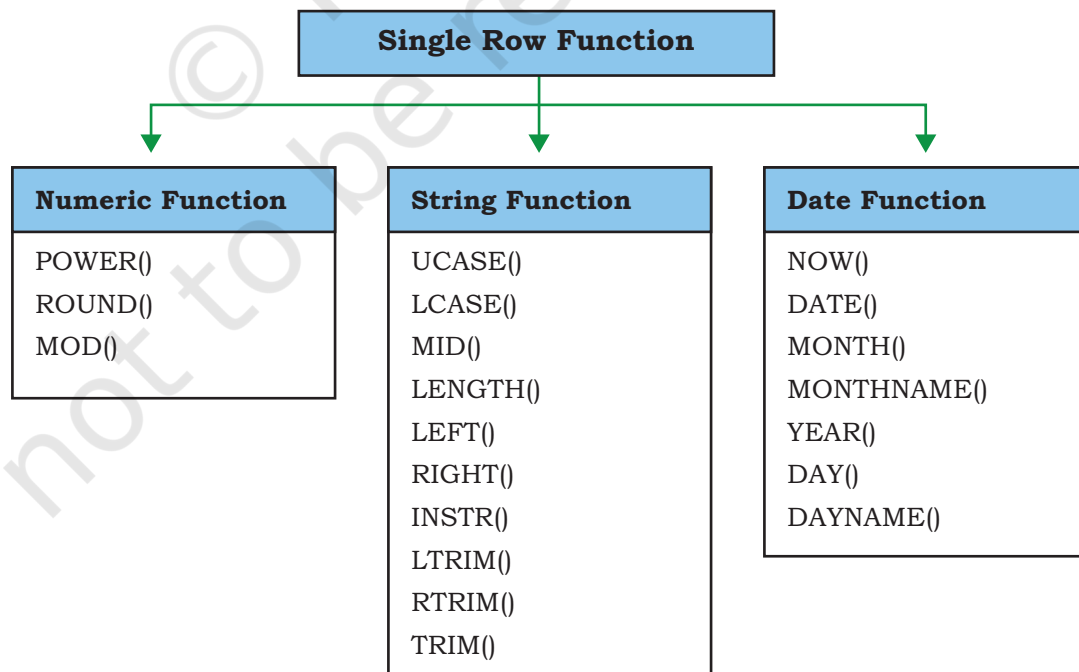


Figure 1.2: Three categories of single row functions in SQL

(A) Numeric Functions

Three commonly used numeric functions are POWER(), ROUND() and MOD(). Their usage along with syntax is given in Table 1.5.

Table 1.5 Math Functions

| Function | Description | Example with output |
|--|---|---|
| POWER(X,Y) can also be written as POW(X,Y) | Calculates X to the power Y. | mysql > SELECT POWER(2, 3); Output: 8 |
| ROUND(N,D) | Rounds off number N to D number of decimal places. Note: If D=0, then it rounds off the number to the nearest integer. | mysql > SELECT ROUND(2912.564, 1); Output: 2912.6 mysql > SELECT ROUND(283.2); Output: 283 |
| MOD(A, B) | Returns the remainder after dividing number A by number B. | mysql > SELECT MOD(21, 2); Output: 1 |

Example 1.1

In order to increase sales, suppose the car dealer decides to offer his customers to pay the total amount in 10 easy EMIs (equal monthly installments). Assume that EMIs are required to be in multiples of 10,000. For that, the dealer wants to list the CarID and Price along with the following data from the Inventory table:

- a) Calculate GST as 12% of Price and display the result after rounding it off to one decimal place.

```
mysql> SELECT ROUND(12/100*Price,1) "GST"
FROM INVENTORY;
```

```
+-----+
| GST   |
+-----+
| 69913.6 |
| 80773.4 |
| 68043.7 |
| 77743.0 |
| 42624.6 |
| 78589.7 |
| 61680.0 |
| 73680.0 |
+-----+
```

8 rows in set (0.00 sec)

- b) Add a new column FinalPrice to the table inventory, which will have the value as sum of Price and 12% of the GST.

```
mysql> ALTER TABLE INVENTORY ADD Final Price
Numeric(10,1);
Query OK, 8 rows affected (0.03 sec)
Records: 8 Duplicates: 0 Warnings: 0
```

```
mysql> UPDATE INVENTORY SET
Final Price=Price+Round(Price*12/100,1);
Query OK, 8 rows affected (0.01 sec)
Rows matched: 8 Changed: 8 Warnings: 0
```

```
mysql> SELECT * FROM INVENTORY;
```

| CarId | CarName | Price | Model | YearManufacture | Fuel Type | Final Pri c |
|-------|---------|-----------|-----------|-----------------|-----------|-------------|
| D001 | Car1 | 582613.00 | LXI | 2017 | Petrol | 652526.6 |
| D002 | Car1 | 673112.00 | VXI | 2018 | Petrol | 753885.4 |
| B001 | Car2 | 567031.00 | Si gma1.2 | 2019 | Petrol | 635074.7 |
| B002 | Car2 | 647858.00 | Del ta1.2 | 2018 | Petrol | 725601.0 |
| E001 | Car3 | 355205.00 | 5STR STD | 2017 | CNG | 397829.6 |
| E002 | Car3 | 654914.00 | CARE | 2018 | CNG | 733503.7 |
| S001 | Car4 | 514000.00 | LXI | 2017 | Petrol | 575680.0 |
| S002 | Car4 | 614000.00 | VXI | 2018 | Petrol | 687680.0 |

8 rows in set (0.00 sec)

c) Calculate and display the amount to be paid each month (in multiples of 1000) which is to be calculated after dividing the FinalPrice of the car into 10 instalments.

d) After dividing the amount into EMIs, find out the remaining amount to be paid immediately, by performing modular division.

Following SQL query can be used to solve the above mentioned problems:

```
mysql> select CarId, Final Price, ROUND((Final Price-
MOD(Final Price, 10000))/10, 0) "EMI", MOD(Final Price, 10000) "Remai ni ng Amount"
FROM INVENTORY;
```

| CarId | Final Price | EMI | Remai ni ng Amount |
|-------|-------------|-------|--------------------|
| D001 | 652526.6 | 65000 | 2526.6 |
| D002 | 753885.4 | 75000 | 3885.4 |
| B001 | 635074.7 | 63000 | 5074.7 |
| B002 | 725601.0 | 72000 | 5601.0 |
| E001 | 397829.6 | 39000 | 7829.6 |
| E002 | 733503.7 | 73000 | 3503.7 |
| S001 | 575680.0 | 57000 | 5680.0 |
| S002 | 687680.0 | 68000 | 7680.0 |

8 rows in set (0.00 sec)

Example 1.2

- a) Let us now add a new column Commission to the SALE table. The column Commission should have a total length of 7 in which 2 decimal places to be there.

```
mysql> ALTER TABLE SALE ADD(Commis sion
Numeric(7, 2));
Query OK, 6 rows affected (0.34 sec)
Records: 6 Duplicates: 0 Warnings: 0
```

- b) Let us now calculate commission for sales agents as 12 per cent of the SalePrice, insert the values to the newly added column Commission and then display records of the table SALE where commission > 73000.

```
mysql> UPDATE SALE SET
Commis sion=12/100*Sal ePri ce;
Query OK, 6 rows affected (0.06 sec)
Rows matched: 6 Changed: 6 Warnings: 0
```

```
mysql> SELECT * FROM SALE WHERE Commis sion > 73000;
```

| invoiceno | carid | custid | saledate | paymentmode | empid | saleprice | Commis sion |
|-----------|-------|--------|------------|--------------|-------|-----------|-------------|
| I00001 | D001 | C0001 | 2019-01-24 | Credit Card | E004 | 613247.00 | 73589.64 |
| I0000 | D002 | C0001 | 2018-10-15 | Bank Finance | E007 | 659982.00 | 79197.84 |
| I00006 | S002 | C0002 | 2019-01-30 | Bank Finance | E007 | 620214.00 | 74425.68 |

3 rows in set (0.02 sec)

- c) Display InvoiceNo, SalePrice and Commission such that commission value is rounded off to 0.

```
mysql> SELECT Invoi ceNo, Sal ePri ce,
Round(Commis sion, 0) FROM SALE;
```

| Invoi ceNo | Sal ePri ce | Round(Commis sion, 0) |
|------------|-------------|-----------------------|
| I00001 | 613247.00 | 73590 |
| I00002 | 590321.00 | 70839 |
| I00003 | 604000.00 | 72480 |
| I00004 | 659982.00 | 79198 |
| I00005 | 369310.00 | 44317 |
| I00006 | 620214.00 | 74426 |

6 rows in set (0.00 sec)

(B) String Functions

String functions can perform various operations on alphanumeric data which are stored in a table. They can be used to change the case (uppercase to lowercase



Activity 1.1

Using the table SALE of CARSHOWROOM database, write SQL queries for the following:

- Display the InvoiceNo and commission value rounded off to zero decimal places.
- Display the details of SALE where payment mode is credit card..

or vice-versa), extract a substring, calculate the length of a string and so on. String functions and their usage are shown in Table 1.6.

Table 1.6 String Functions

| Function | Description | Example with output |
|---|---|--|
| UCASE(string) OR UPPER(string) | Converts string into uppercase. | mysql > SELECT UCASE("Informati cs Practi cs"); Output: INFORMATICS PRACTICES |
| LOWER(string) OR LCASE(string) | Converts string into lowercase. | mysql > SELECT LOWER("Informati cs Practi cs"); Output: informatics practices |
| MID(string, pos, n) OR SUBSTRING(string, pos, n) OR SUBSTR(string, pos, n) | Returns a substring of size n starting from the specified position (pos) of the string. If n is not specified, it returns the substring from the position pos till end of the string. | mysql > SELECT MID("Informati cs", 3, 4); Output: form mysql > SELECT MID('Informati cs', 7); Output: atics |
| LENGTH(string) | Return the number of characters in the specified string. | mysql > SELECT LENGTH("Informati cs"); Output: 11 |
| LEFT(string, N) | Returns N number of characters from the left side of the string. | mysql > SELECT LEFT("Computer", 4); Output: Comp |
| RIGHT(string, N) | Returns N number of characters from the right side of the string. | mysql > SELECT RIGHT("SCIENCE", 3); Output: NCE |
| INSTR(string, substring) | Returns the position of the first occurrence of the substring in the given string. Returns 0, if the substring is not present in the string. | mysql > SELECT INSTR("Informati cs", "ma"); Output: 6 |
| LTRIM(string) | Returns the given string after removing leading white space characters. | mysql > SELECT LENGTH(" DELHI "), LENGTH(LTRIM(" DELHI ")); Output: +-----+-----+ 7 5 +-----+-----+ 1 row in set (0.00 sec) |

| | | |
|---------------|---|---|
| RTRIM(string) | Returns the given string after removing trailing white space characters. | <pre>mysql>SELECT LENGTH("PEN ") LENGTH(RTRIM("PEN "));</pre> <p>Output:</p> <pre>+-----+-----+ 5 3 +-----+-----+ 1 row in set (0.00 sec)</pre> |
| TRIM(string) | Returns the given string after removing both leading and trailing white space characters. | <pre>mysql> SELECT LENGTH(" MADAM "), LENGTH(TRIM(" MADAM "));</pre> <p>Output:</p> <pre>+-----+-----+ 9 5 +-----+-----+ 1 row in set (0.00 sec)</pre> |

Example 1.3

Let us use CUSTOMER relation shown in Table 1.2 to understand the working of string functions.

- a) Display customer name in lower case and customer email in upper case from table CUSTOMER.

```
mysql> SELECT LOWER(CustName), UPPER(Email) FROM
CUSTOMER;
```

| LOWER(CustName) | UPPER(Email) |
|-----------------|---------------------|
| ami tsaha | AMITSAHA2@GMAIL.COM |
| rehnuma | REHNUMA@HOTMAIL.COM |
| charvi nayar | CHARVI123@YAHOO.COM |
| gurpreet | GUR_SINGH@YAHOO.COM |

4 rows in set (0.00 sec)

- b) Display the length of the email and part of the email from the email ID before the character '@'. Note - Do not print '@'.

```
mysql> SELECT LENGTH(Email), LEFT(Email, INSTR(Email,
"@") - 1) FROM CUSTOMER;
```

| LENGTH(Email) | LEFT(Email, INSTR(Email, "@") - 1) |
|---------------|------------------------------------|
| 19 | ami tsaha2 |
| 19 | rehnuma |
| 19 | charvi 123 |
| 19 | gur_singh |

4 rows in set (0.03 sec)

The function INSTR will return the position of "@" in the email address. So to print email id without "@" we have to use position -1.

Activity 1.2



Using the table INVENTORY from CARSHOWROOM database, write sql queries for the following:

- Convert the CarMake to uppercase if its value starts with the letter 'B'.
- If the length of the car's model is greater than 4 then fetch the substring starting from position 3 till the end from attribute Model.



Activity 1.3

Using the table EMPLOYEE from CARSHOWROOM database, write SQL queries for the following:

- Display employee name and the last 2 characters of his EmpId.
- Display designation of employee and the position of character 'e' in designation, if present.

- Let us assume that four digit area code is reflected in the mobile number starting from position number 3. For example, 2630 is the area code of mobile number 4726309212. Now, write the SQL query to display the area code of the customer living in Rohini.

```
mysql > SELECT MID(Phone, 3, 4) FROM CUSTOMER WHERE
CustAdd Like '%Rohini %';
```

```
+-----+
| MID(Phone, 3, 4) |
+-----+
| 1163             |
+-----+
1 row in set (0.00 sec)
```

- Display emails after removing the domain name extension ".com" from emails of the customers.

```
mysql > SELECT TRIM(".com" FROM Email) FROM
CUSTOMER;
```

```
+-----+
| TRIM(".com" FROM Email) |
+-----+
| amitsaha2@gmail         |
| rehnuma@hotmail        |
| charvi123@yahoo         |
| gur_singh@yahoo         |
+-----+
4 rows in set (0.00 sec)
```

- Display details of all the customers having yahoo emails only.

```
mysql > SELECT * FROM CUSTOMER WHERE Email LIKE
```

```
"%yahoo%";
```

```
+-----+-----+-----+-----+-----+
| CustID | CustName | CustAdd | Phone | Email |
+-----+-----+-----+-----+-----+
| C0003 | Charvi Nayyar | 10/9, FF, Rohini | 6811635425 | charvi123@yahoo.com |
| C0004 | Gurpreet | A-10/2, SF, MayurVihar | 3511056125 | gur_singh@yahoo.com |
+-----+-----+-----+-----+-----+
2 rows in set (0.00 sec)
```

(C) Date and Time Functions

There are various functions that are used to perform operations on date and time data. Some of the operations include displaying the current date, extracting each element of a date (day, month and year), displaying day of the week and so on. Table 1.7 explains various date and time functions.

Table 1.7 Date Functions

| Function | Description | Example with output |
|-----------------|---|--|
| NOW() | It returns the current system date and time. | <code>mysql > SELECT NOW();</code> Output: 2019-07-11 19:41:17 |
| DATE() | It returns the date part from the given date/time expression. | <code>mysql > SELECT DATE(NOW());</code> Output: 2019-07-11 |
| MONTH(date) | It returns the month in numeric form from the date. | <code>mysql > SELECT MONTH(NOW());</code> Output: 7 |
| MONTHNAME(date) | It returns the month name from the specified date. | <code>mysql > SELECT MONTHNAME("2003-11-28");</code> Output: November |
| YEAR(date) | It returns the year from the date. | <code>mysql > SELECT YEAR("2003-10-03");</code> Output: 2003 |
| DAY(date) | It returns the day part from the date. | <code>mysql > SELECT DAY("2003-03-24");</code> Output: 24 |
| DAYNAME(date) | It returns the name of the day from the date. | <code>mysql > SELECT DAYNAME("2019-07-11");</code> Output: Thursday |

Example 1.4

Let us use the EMPLOYEE table of CARSHOWROOM database to illustrate the working of some of the date and time functions.

- a) Select the day, month number and year of joining of all employees.

`mysql > SELECT DAY(DOJ), MONTH(DOJ), YEAR(DOJ) FROM EMPLOYEE;`

| DAY(DOJ) | MONTH(DOJ) | YEAR(DOJ) |
|----------|------------|-----------|
| 12 | 12 | 2017 |
| 5 | 6 | 2016 |
| 8 | 1 | 1999 |
| 2 | 12 | 2010 |
| 1 | 7 | 2012 |
| 1 | 1 | 2017 |
| 23 | 10 | 2013 |

7 rows in set (0.03 sec)

Activity 1.4

Using the table EMPLOYEE of CARSHOWROOM database, list the day of birth for all employees whose salary is more than 25000.

- b) If the date of joining is not a Sunday, then display it in the following format "Wednesday, 26, November, 1979."

Think and Reflect

Can we use arithmetic operators (+, -, *, or /) on date functions?

```
mysql> SELECT DAYNAME(DOJ), DAY(DOJ),
MONTHNAME(DOJ), YEAR(DOJ) FROM EMPLOYEE WHERE
DAYNAME(DOJ) != 'Sunday' ;
```

```
+-----+-----+-----+-----+
|DAYNAME(DOJ)| DAY(DOJ)|MONTHNAME(DOJ)| YEAR(DOJ)|
+-----+-----+-----+-----+
|Tuesday      |      12|December      |    2017|
|Fri day      |       8|January       |    1999|
|Thursday     |       2|December      |    2010|
|Wednesday    |     23|October       |    2013|
+-----+-----+-----+-----+
4 rows in set (0.00 sec)
```

1.2.2 Aggregate Functions

Aggregate functions are also called multiple row functions. These functions work on a set of records as a whole, and return a single value for each column of the records on which the function is applied. Table 1.8 shows the differences between single row functions and multiple row functions. Table 1.9 describes some of the aggregate functions along with their usage. Note that column must be of numeric type.

Table 1.8 Differences between Single row and Multiple row Functions

| Single_row Functions | Multiple_row functions |
|--|---|
| 1. It operates on a single row at a time. | 1. It operates on groups of rows. |
| 2. It returns one result per row. | 2. It returns one result for a group of rows. |
| 3. It can be used in Select, Where, and Order by clause. | 3. It can be used in the select clause only. |
| 4. Math, String and Date functions are examples of single row functions. | 4. Max(), Min(), Avg(), Sum(), Count() and Count(*) are examples of multiple row functions. |

Table 1.9 Aggregate Functions in SQL

| Function | Description | Example with output |
|-------------|--|--|
| MAX(column) | Returns the largest value from the specified column. | mysql> SELECT MAX(Pri ce) FROM I NVENTORY; Output: 673112. 00 |
| MIN(column) | Returns the smallest value from the specified column. | mysql> SELECT MI N(Pri ce) FROM I NVENTORY; Output: 355205. 00 |
| AVG(column) | Returns the average of the values in the specified column. | mysql> SELECT AVG(Pri ce) FROM I NVENTORY; Output: 576091. 625000 |

| | | |
|---------------|--|---|
| SUM(column) | Returns the sum of the values for the specified column. | mysql> SELECT SUM(Price) FROM INVENTORY; Output: 4608733.00 |
| COUNT(column) | Returns the number of values in the specified column ignoring the NULL values. Note: In this example, let us consider a MANAGER table having two attributes and four records. | mysql> SELECT * from MANAGER; Output: +-----+-----+ MNO MEMNAME +-----+-----+ 1 AMIT 2 KAVREET 3 KAVITA 4 NULL +-----+-----+ 4 rows in set (0.00 sec) mysql> SELECT COUNT(MEMNAME) FROM MANAGER; Output: +-----+ COUNT(MEMNAME) +-----+ 3 +-----+ 1 row in set (0.01 sec) |
| COUNT(*) | Returns the number of records in a table. Note: In order to display the number of records that matches a particular criteria in the table, we have to use COUNT(*) with WHERE clause. | mysql> SELECT COUNT(*) from MANAGER; Output: +-----+ count (*) +-----+ 4 +-----+ 1 row in set (0.00 sec) |

Example 1.5

- a) Display the total number of records from table INVENTORY having a model as VXI.

```
mysql> SELECT COUNT(*) FROM INVENTORY WHERE Model="VXI";
```

```
+-----+  
| COUNT(*) |  
+-----+  
| 2 |  
+-----+
```

1 row in set (0.00 sec)

- b) Display the total number of different types of Models available from table INVENTORY.



Activity 1.5

- Find sum of Sale Price of the cars purchased by the customer having ID C0001 from table SALE.
- Find the maximum and minimum commission from the SALE table.

```
mysql> SELECT COUNT(DISTINCT Model) FROM
INVENTORY;
```

```
+-----+
| COUNT(DISTINCT MODEL) |
+-----+
|                      6 |
+-----+
1 row in set (0.09 sec)
```

- Display the average price of all the cars with Model LXI from table INVENTORY.

```
mysql> SELECT AVG(Price) FROM INVENTORY WHERE
Model="LXI";
```

```
+-----+
| AVG(Price) |
+-----+
| 548306.500000 |
+-----+
1 row in set (0.03 sec)
```

1.3 GROUP BY IN SQL

At times we need to fetch a group of rows on the basis of common values in a column. This can be done using a GROUP BY clause. It groups the rows together that contain the same values in a specified column. We can use the aggregate functions (COUNT, MAX, MIN, AVG and SUM) to work on the grouped values. HAVING Clause in SQL is used to specify conditions on the rows with GROUP BY clause.

Consider the SALE table from the CARSHOWROOM database:

```
mysql> SELECT * FROM SALE;
```

```
+-----+-----+-----+-----+-----+-----+-----+
| InvoiceNo | CarId | CustId | SaleDate | PaymentMode | EmpID | SalePrice | Commission |
+-----+-----+-----+-----+-----+-----+-----+
| I00001   | D001  | C0001  | 2019-01-24 | Credit Card | E004  | 613247.00 | 73589.64 |
| I00002   | S001  | C0002  | 2018-12-12 | Online      | E001  | 590321.00 | 70838.52 |
| I00003   | S002  | C0004  | 2019-01-25 | Cheque      | E010  | 604000.00 | 72480.00 |
| I00004   | D002  | C0001  | 2018-10-15 | Bank Finance | E007  | 659982.00 | 79197.84 |
| I00005   | E001  | C0003  | 2018-12-20 | Credit Card | E002  | 369310.00 | 44317.20 |
| I00006   | S002  | C0002  | 2019-01-30 | Bank Finance | E007  | 620214.00 | 74425.68 |
+-----+-----+-----+-----+-----+-----+-----+
```

6 rows in set (0.11 sec)

CarID, CustID, SaleDate, PaymentMode, EmpID, SalePrice are the columns that can have rows with the same values in it. So, GROUP BY clause can be used

in these columns to find the number of records of a particular type (column), or to calculate the sum of the price of each car type.

Example 1.6

- a) Display the number of cars purchased by each customer from the SALE table.

```
mysql> SELECT CustID, COUNT(*) "Number of Cars"
FROM SALE GROUP BY CustID;
```

| CustID | Number of Cars |
|--------|----------------|
| C0001 | 2 |
| C0002 | 2 |
| C0003 | 1 |
| C0004 | 1 |

4 rows in set (0.00 sec)

- b) Display the customer Id and number of cars purchased if the customer purchased more than 1 car from SALE table.

```
mysql> SELECT CustID, COUNT(*) FROM SALE GROUP BY
CustID HAVING Count(*)>1;
```

| CustID | COUNT(*) |
|--------|----------|
| C0001 | 2 |
| C0002 | 2 |

2 rows in set (0.30 sec)

- c) Display the number of people in each category of payment mode from the table SALE.

```
mysql> SELECT PaymentMode, COUNT(PaymentMode) FROM
SALE GROUP BY Paymentmode ORDER BY Paymentmode;
```

| PaymentMode | Count (PaymentMode) |
|--------------|---------------------|
| Bank Finance | 2 |
| Cheque | 1 |
| Credit Card | 2 |
| Online | 1 |

4 rows in set (0.00 sec)

- d) Display the PaymentMode and number of payments made using that mode more than once.

```
mysql> SELECT PaymentMode, Count(PaymentMode) FROM
SALE GROUP BY Paymentmode HAVING COUNT(*)>1 ORDER
```



Activity 1.6

- List the total number of cars sold by each employee.
- List the maximum sale made by each employee.

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BY Paymentmode;

| PaymentMode | Count (PaymentMode) |
|--------------|---------------------|
| Bank Finance | 2 |
| Credit Card | 2 |

2 rows in set (0.00 sec)

1.4 OPERATIONS ON RELATIONS

We can perform certain operations on relations like Union, Intersection, and Set Difference to merge the tuples of two tables. These three operations are binary operations as they work upon two tables. Note here, that these operations can only be applied if both the relations have the same number of attributes, and corresponding attributes in both tables have the same domain.

1.4.1 UNION (U)

This operation is used to combine the selected rows of two tables at a time. If some rows are the same in both the tables, then the result of the Union operation will show those rows only once. Figure 1.3 shows union of two sets.

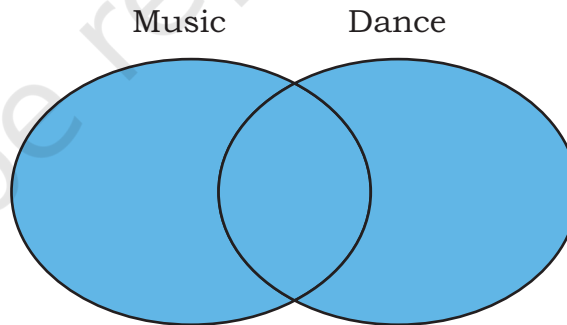


Figure 1.3: Union of two sets

Let us consider two relations DANCE and MUSIC shown in Tables 1.10 and 1.11 respectively.

Table 1.10 DANCE

| SNo | Name | Class |
|-----|--------|-------|
| 1 | Aastha | 7A |
| 2 | Mahira | 6A |
| 3 | Mohit | 7B |
| 4 | Sanjay | 7A |

Table 1.11 MUSIC

| SNo | Name | Class |
|-----|---------|-------|
| 1 | Mehak | 8A |
| 2 | Mahira | 6A |
| 3 | Lavanya | 7A |
| 4 | Sanjay | 7A |
| 5 | Abhay | 8A |

If we need the list of students participating in either of events, then we have to apply UNION operation (represented by symbol \cup) on relations DANCE and MUSIC. The output of UNION operation is shown in Table 1.12.

Table 1.12 DANCE \cup MUSIC

| SNo | Name | Class |
|-----|---------|-------|
| 1 | Aastha | 7A |
| 2 | Mahira | 6A |
| 3 | Mohit | 7B |
| 4 | Sanjay | 7A |
| 1 | Mehak | 8A |
| 3 | Lavanya | 7A |
| 5 | Abhay | 8A |

1.4.2 INTERSECT (\cap)

Intersect operation is used to get the common tuples from two tables and is represented by the symbol \cap . Figure 1.4 shows intersection of two sets.

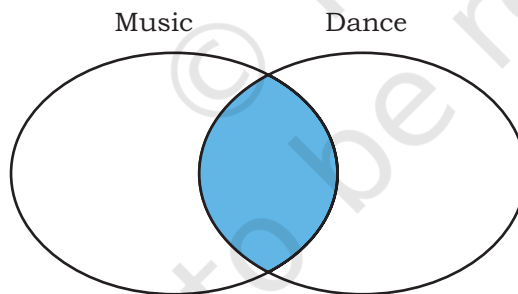


Figure 1.4: Intersection of two sets

Suppose we have to display the list of students who are participating in both the events (DANCE and MUSIC), then intersection operation is to be applied on these two tables. The output of INTERSECT operation is shown in Table 1.13.

Table 1.13 DANCE \cap MUSIC

| SNo | Name | Class |
|-----|--------|-------|
| 2 | Mahira | 6A |
| 4 | Sanjay | 7A |

NOTES

NOTES**1.4.3 MINUS (-)**

This operation is used to get tuples/rows which are in the first table but not in the second table, and the operation is represented by the symbol - (minus). Figure 1.5 shows minus operation (also called set difference) between two sets.

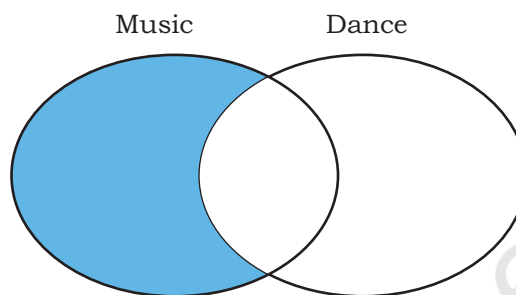


Figure 1.5: Difference of two sets

Suppose, we want the list of students who are only participating in MUSIC and not in DANCE event. Then, we will use the MINUS operation, whose output is given in Table 1.14.

Table 1.14 DANCE - MUSIC

| SNo | Name | Class |
|-----|---------|-------|
| 1 | Mehak | 8A |
| 3 | Lavanya | 7A |
| 5 | Abhay | 8A |

1.4.4 Cartesian Product

Cartesian product operation combines tuples from two relations. It results in all pairs of rows from the two input relations, regardless of whether or not they have the same values on common attributes. It is denoted as 'X'.

The degree of the resulting relation is calculated as the sum of the degrees of both the relations under consideration. The cardinality of the resulting relation is calculated as the product of the cardinality of relations on which cartesian product is applied. Let us use the relations DANCE and MUSIC to show the output of cartesian product. Note that both relations are of degree 3. The cardinality of relations DANCE and MUSIC is 4 and 5 respectively. Applying cartesian product on these two relations will result in a relation of degree 6 and cardinality 20, as shown in Table 1.15.

Table 1.15 DANCE X MUSIC

| SNo | Name | Class | SNo | Name | Class |
|-----|--------|-------|-----|---------|-------|
| 1 | Aastha | 7A | 1 | Mehak | 8A |
| 2 | Mahira | 6A | 1 | Mehak | 8A |
| 3 | Mohit | 7B | 1 | Mehak | 8A |
| 4 | Sanjay | 7A | 1 | Mehak | 8A |
| 1 | Aastha | 7A | 2 | Mahira | 6A |
| 2 | Mahira | 6A | 2 | Mahira | 6A |
| 3 | Mohit | 7B | 2 | Mahira | 6A |
| 4 | Sanjay | 7A | 2 | Mahira | 6A |
| 1 | Aastha | 7A | 3 | Lavanya | 7A |
| 2 | Mahira | 6A | 3 | Lavanya | 7A |
| 3 | Mohit | 7B | 3 | Lavanya | 7A |
| 4 | Sanjay | 7A | 3 | Lavanya | 7A |
| 1 | Aastha | 7A | 4 | Sanjay | 7A |
| 2 | Mahira | 6A | 4 | Sanjay | 7A |
| 3 | Mohit | 7B | 4 | Sanjay | 7A |
| 4 | Sanjay | 7A | 4 | Sanjay | 7A |
| 1 | Aastha | 7A | 5 | Abhay | 8A |
| 2 | Mahira | 6A | 5 | Abhay | 8A |
| 3 | Mohit | 7B | 5 | Abhay | 8A |
| 4 | Sanjay | 7A | 5 | Abhay | 8A |

20 rows in set (0.03 sec)

NOTES

1.5 USING TWO RELATIONS IN A QUERY

Till now, we have written queries in SQL using a single relation only. In this section, we will learn to write queries using two relations.

1.5.1 Cartesian product on two tables

From the previous section, we learnt that application of operator cartesian product on two tables results in a table having all combinations of tuples from the underlying tables. When more than one table is to be used in a query, then we must specify the table names by separating commas in the FROM clause, as shown in Example 1.7. On execution of such a query, the DBMS (MySQL) will first apply cartesian product on specified tables to have a single table. The following query of Example 1.7 applies cartesian product on the two tables DANCE and MUSIC:

Example 1.7

- a) Display all possible combinations of tuples of relations DANCE and MUSIC

```
mysql> SELECT * FROM DANCE, MUSIC;
```

As we are using SELECT * in the query, the output will be the Table 1.15 having degree 6 and cardinality 20.

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- b) From the all possible combinations of tuples of relations DANCE and MUSIC, display only those rows such that the attribute name in both have the same value.

```
mysql> SELECT * FROM DANCE D, MUSIC M WHERE D.Name
= M.Name;
```

Table 1.16 Tuples with same name

| Sno | Name | Class | Sno | Name | Class |
|-----|--------|-------|-----|--------|-------|
| 2 | Mahira | 6A | 2 | Mahira | 6A |
| 4 | Sanjay | 7A | 4 | Sanjay | 7A |

2 rows in set (0.00 sec)

Note that in this query we have used table aliases (D for DANCE and M for MUSIC), just like column aliases to refer to tables by shortened names. It is important to note that table alias is valid only for current query and the original table name cannot be used in the query if its alias is given in FROM clause.

1.5.2 JOIN on two tables

JOIN operation combines tuples from two tables on specified conditions. This is unlike cartesian product, which make all possible combinations of tuples. While using the JOIN clause of SQL, we specify conditions on the related attributes of two tables within the FROM clause. Usually, such an attribute is the primary key in one table and foreign key in another table. Let us create two tables UNIFORM (UCode, UName, UColor) and COST (UCode, Size, Price) in the SchoolUniform database. UCode is Primary Key in table UNIFORM. UCode and Size is the Composite Key in table COST. Therefore, Ucode is a common attribute between the two tables which can be used to fetch the common data from both the tables. Hence, we need to define Ucode as foreign key in the Price table while creating this table.

Table 1.17 Uniform table

| Ucode | Uname | Ucolor |
|-------|-------|--------|
| 1 | Shirt | White |
| 2 | Pant | Grey |
| 3 | Tie | Blue |

Table 1.18 Cost table

| Ucode | Size | Price |
|-------|------|-------|
| 1 | L | 580 |
| 1 | M | 500 |
| 2 | L | 890 |
| 2 | M | 810 |

Example 1.7

List the UCode, UName, UColor, Size and Price of related tuples of tables UNIFORM and COST.

The given query may be written in three different ways as given below:

- a) Using condition in where clause

```
mysql> SELECT * FROM UNIFORM U, COST C WHERE
U. UCode = C. UCode;
```

Table 1.19 Output of the query

| UCode | UName | UColor | Ucode | Size | Price |
|-------|--------|--------|-------|------|-------|
| 1 | Shi rt | Whi te | 1 | L | 580 |
| 1 | Shi rt | Whi te | 1 | M | 500 |
| 2 | Pant | Grey | 2 | L | 890 |
| 2 | Pant | Grey | 2 | M | 810 |

4 rows in set (0.08 sec)

As the attribute Ucode is in both tables, we need to use table alias to remove ambiguity. Hence, we have used qualifier with attribute UCode in SELECT and FROM clauses to indicate its scope.

- b) Explicit use of JOIN clause

```
mysql> SELECT * FROM UNIFORM U JOIN COST C ON
U. Ucode=C. Ucode;
```

The output of the query is the same as shown in Table 1.19. In this query, we have used JOIN clause explicitly along with condition in FROM clause. Hence, no condition needs to be given in WHERE clause.

- c) Explicit use of NATURAL JOIN clause

The output of queries (a) and (b) shown in Table 1.19 has a repetitive column Ucode having exactly the same values. This redundant column provides no additional information. There is an extension of JOIN operation called NATURAL JOIN which works similar to JOIN clause in SQL, but removes the redundant attribute. This operator can be used

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to join the contents of two tables iff there is one common attribute in both the tables. The above SQL query using NATURAL JOIN is shown below:

```
mysql> SELECT * FROM UNIFORM NATURAL JOIN COST;
```

| UCode | UName | UCol or | Si ze | Pri ce |
|-------|--------|---------|-------|--------|
| 1 | Shi rt | Whi te | L | 580 |
| 1 | Shi rt | Whi te | M | 500 |
| 2 | Pant | Grey | L | 890 |
| 2 | Pant | Grey | M | 810 |

4 rows in set (0.17 sec)

It is clear from the output that the result of this query is same as that of queries written in (a) and (b), except that the attribute Ucode appears only once.

Following are some of the points to be considered while applying JOIN operations on two or more relations:

- If two tables are to be joined on equality condition on the common attribute, then one may use JOIN with ON clause or NATURAL JOIN in FROM clause. If three tables are to be joined on equality condition, then two JOIN or NATURAL JOIN are required.
- In general, N-1 joins are needed to combine N tables on equality condition.
- With JOIN clause, we may use any relational operators to combine tuples of two tables.

SUMMARY

- A Function is used to perform a particular task and return a value as a result.
- Single row functions work on a single row to return a single value.
- Multiple row functions work on a set of records as a whole and return a single value.
- Numeric functions perform operations on numeric values and return numeric values.
- String functions perform operations on character type values and return either character or numeric values.

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- Date and time functions allow us to deal with date type data values.
- GROUP BY function is used to group the rows together that contain similar values in a specified column. Some of the group functions are COUNT, MAX, MIN, AVG and SUM.
- Join is an operation which is used to combine rows from two or more tables based on one or more common fields between them.

Exercise

1. Answer the following questions:
 - a) Define RDBMS. Name any two RDBMS software.
 - b) What is the purpose of the following clauses in a select statement?
 - i) ORDER BY
 - ii) HAVING
 - c) Site any two differences between Single_row functions and Aggregate functions.
 - d) What do you understand by Cartesian Product?
 - e) Write the name of the functions to perform the following operations:
 - i) To display the day like “Monday”, “Tuesday”, from the date when India got independence.
 - ii) To display the specified number of characters from a particular position of the given string.
 - iii) To display the name of the month in which you were born.
 - iv) To display your name in capital letters.
2. Write the output produced by the following SQL commands:
 - a) `SELECT POW(2,3);`
 - b) `SELECT ROUND(123.2345, 2),
ROUND(342.9234,-1);`
 - c) `SELECT LENGTH("Informatics Practices");`
 - d) `SELECT YEAR("1979/11/26"),
MONTH("1979/11/26"),
DAY("1979/11/26"),`

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MONTHNAME("1979/11/26");

e) SELECT LEFT("INDIA",3), RIGHT("Computer Science",4);

f) SELECT MID("Informatics",3,4),
SUBSTR("Practices",3);

3. Consider the following table named "Product", showing details of products being sold in a grocery shop.

| PCode | PName | UPrice | Manufacturer |
|-------|----------------|--------|--------------|
| P01 | Washing Powder | 120 | Surf |
| P02 | Tooth Paste | 54 | Colgate |
| P03 | Soap | 25 | Lux |
| P04 | Tooth Paste | 65 | Pepsodant |
| P05 | Soap | 38 | Dove |
| P06 | Shampoo | 245 | Dove |

- a) Write SQL queries for the following:

i. Create the table Product with appropriate data types and constraints.

ii. Identify the primary key in Product.

iii. List the Product Code, Product name and price in descending order of their product name. If PName is the same then display the data in ascending order of price.

iv. Add a new column Discount to the table Product.

v. Calculate the value of the discount in the table Product as 10 per cent of the UPrice for all those products where the UPrice is more than 100, otherwise the discount will be 0.

vi. Increase the price by 12 per cent for all the products manufactured by Dove.

vii. Display the total number of products manufactured by each manufacturer.

- b) Write the output(s) produced by executing the following queries on the basis of the information given above in the table Product:

i. SELECT PName, Average(UPrice) FROM Product GROUP BY Pname;

ii. SELECT DISTINCT Manufacturer FROM Product;

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- iii. `SELECT COUNT(DISTINCT PName) FROM Product;`
- iv. `SELECT PName, MAX(UPrice), MIN(UPrice) FROM Product GROUP BY PName;`
4. Using the CARSHOWROOM database given in the chapter, write the SQL queries for the following:
 - a) Add a new column Discount in the INVENTORY table.
 - b) Set appropriate discount values for all cars keeping in mind the following:
 - (i) No discount is available on the LXI model.
 - (ii) VXi model gives a 10% discount.
 - (iii) A 12% discount is given on cars other than LXI model and VXi model.
 - c) Display the name of the costliest car with fuel type "Petrol".
 - d) Calculate the average discount and total discount available on Car4.
 - e) List the total number of cars having no discount.
5. Consider the following tables Student and Stream in the Streams_of_Students database. The primary key of the Stream table is StCode (stream code) which is the foreign key in the Student table. The primary key of the Student table is AdmNo (admission number).

| AdmNo | Name | StCode |
|-------|----------|--------|
| 211 | Jay | NULL |
| 241 | Aditya | S03 |
| 290 | Diksha | S01 |
| 333 | Jasqueen | S02 |
| 356 | Vedika | S01 |
| 380 | Ashpreet | S03 |

| StCode | Stream |
|--------|------------|
| S01 | Science |
| S02 | Commerce |
| S03 | Humanities |

Write SQL queries for the following:

- a) Create the database Streams_Of_Students.

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- b) Create the table Student by choosing appropriate data types based on the data given in the table.
- c) Identify the Primary keys from tables Student and Stream. Also, identify the foreign key from the table Stream.
- d) Jay has now changed his stream to Humanities. Write an appropriate SQL query to reflect this change.
- e) Display the names of students whose names end with the character 'a'. Also, arrange the students in alphabetical order.
- f) Display the names of students enrolled in Science and Humanities stream, ordered by student name in alphabetical order, then by admission number in ascending order (for duplicating names).
- g) List the number of students in each stream having more than 1 student.
- h) Display the names of students enrolled in different streams, where students are arranged in descending order of admission number.
- i) Show the Cartesian product on the Student and Stream table. Also mention the degree and cardinality produced after applying the Cartesian product.
- j) Add a new column "TeacherIncharge" in the Stream table. Insert appropriate data in each row.
- k) List the names of teachers and students.
- l) If Cartesian product is again applied on Student and Stream tables, what will be the degree and cardinality of this modified table?