A day without new knowledge is a lost day.

Database Technologies - MySQL

In this module we are going to learn SQL, PL/SQL and NoSQL(MongoDB)

-
  ```
  sudo apt install build-essential
  ```

MySQL is case-insensitive

Case Sensitivity in Table Names: By default, MySQL's case sensitivity for table names depends on the operating system. On Linux, table names are case-sensitive, whereas on Windows, they are case-insensitive.

Case Sensitivity in Column Names: Column names in MySQL are case-insensitive by default.

Case Sensitivity in Data: By default, string comparisons are case-insensitive because MySQL uses the utf8_general_ci collation (Unicode Transformation Format where "ci" stands for case-insensitive).

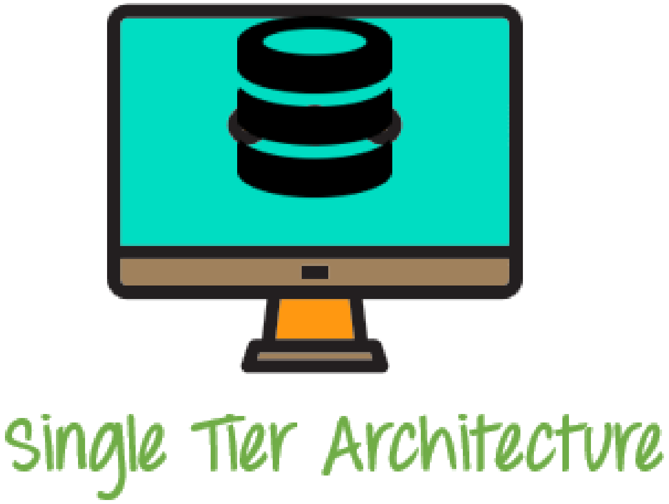
If A and a, B and b, ... are treated in the same way then it is case-insensitive.
MySQL is case-insensitive

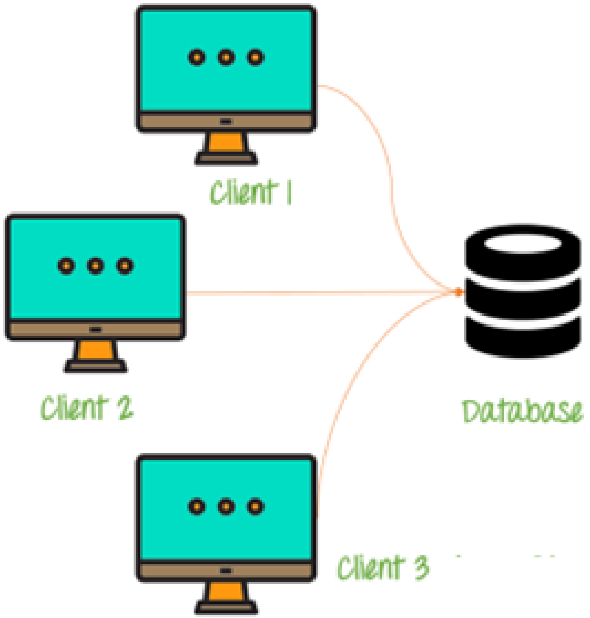
Introduction

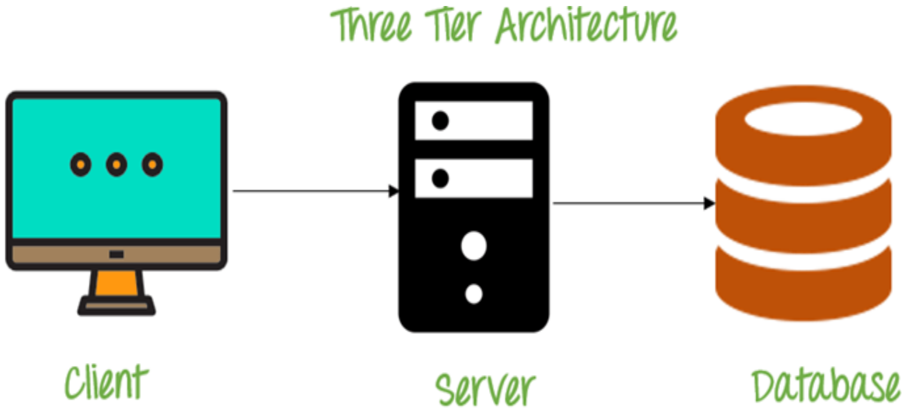
- If anyone who wants to develop a good application
  then he should have the knowledge three major components.

They are . . . . . .

- Presentation Layer [UI]
- Application Layer [Server Application and Client Application]
- Data Layer [Data Access Object (DAO) / Data Access Layer (DAL)] { Flat Files | RDBMS | NoSQL }







Types of Database Architecture

Single-Tier Architecture

1. The database and application reside on the same system.
2. No network communication is required since everything runs locally.
3. Used for small-scale applications.

Two-Tier Architecture (Client-Server)

1. The application (client) communicates with the database server.
2. The client sends queries, and the server processes them and returns results.
3. Used in medium-scale applications.

Three-Tier Architecture

1. Introduces a middle layer (Application Server) between the client and database.
2. The middle layer handles business logic, security, and processing before accessing the database.
3. Used in large-scale web applications.

Introduction

Why do we need databases (Use Case)?

We **need databases** because they organize data in a manner which allows us to store, query, sort, and manipulate data in various ways. Databases allow us to do all this things.

Many companies collects data from different resource (like Weather data, Geographical data, Finance data, Scientific data, Transport data, Cultural data (the ideas, customs, and social behaviour of a particular people or society), etc.)

A foreign key constraint is also known as a referential constraint or referential integrity constraint. A foreign key is a column or group of columns in a relational database table that establishes and enforces a link between data in two tables. It references a primary key in another table and can cascade changes or delete related data if the primary key is updated or deleted.

What is Relation and Relationship?

Reference / Referential key

Remember:

- A ***reference*** is a relationship between two tables where the values in one table refer to the values in another table. This is usually enforced using a foreign key constraint to maintain referential integrity.
- A ***referential key*** is a column or set of columns in a table that refers to the primary key of another table. It establishes a relationship between two tables, where one table is called the parent table, and the other is called the child table.

relation and relationship?

Relation ***(in Relational Algebra "R" stands for relation)*****:** In Database, a relation represents a **table** or an **entity** than contain attributes. In Relational Algebra, a relation is a table with rows and columns, just like in a Relational Database Management System (RDBMS). It represents a set of tuples (records) that share the same structure. Relation is a Logical Instantiation/Model of a TABLE.

Relationship: In database, relationship is that how the two entities are **connected** to each other, i.e. what kind of ***relationship type*** they hold between them.

Primary/Foreign key is used to specify this relationship.

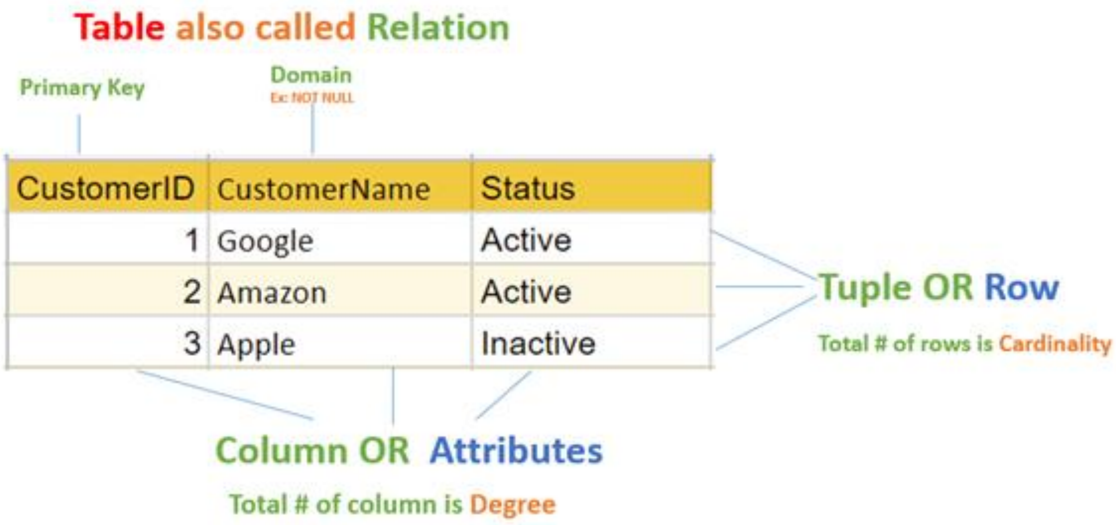


Table also called Relation
Primary Key
Domain
Ex: NOT NULL
Tuple OR Row
Total # of rows is Cardinality
Column OR Attributes
Total # of column is Degree

CustomerID	CustomerName	Status
1	Google	Active
2	Amazon	Active
3	Apple	Inactive

Remember:

Foreign Key is also known as

- referential constraint
- referential integrity constraint. (Ensures that a foreign key value in one table must always reference an existing primary key value in another table.)

Note:

- **Table -** The physical instantiation of a relation in the database schema.
- **Relation -** A logical construct that organizes data into rows and columns.

File Systems is the traditional way to keep your data organized.

File System
vs
DBMS

file-oriented system

File Anomalies

```
struct Employee {
   int emp_no;
   char emp_name[50];
   int salary;
} emp[1000];
```

```
struct Employee {
   int emp_no;
   char emp_name[50];
   int salary;
};
struct Employee emp[1000];
```

c:\employee.txt

```
1   suraj 4000
2   ramesh 6000
3   rajan 4500
.         |
.         |
.         |
500 sam 3500
.         |
.         |
.         |
1000 amit 2300
```

c:\employee.txt

```
1   suraj 4000
2   ramesh 6000
3   rajan 4500
.         |
.         |
.         |
500 sam 3500
.         |
.         |
1000 amit 2300
.         |
.         |
2000 jerry 4500
.         |
.         |
```

c:\employee.txt

```
1   suraj 4000
2   ramesh 6000
3   rajan 4500
.         |
.         |
500  sam 3500
.         |
3   rajan 4500
.         |
500  sam 3500
.         |
.         |
1000 amit 2300
```

c:\employee.txt

```
1   suraj 4000
2   ramesh 6000
3   rajan 4500
.         |
.         |
sam 500 3500
.         |
ram  550 5000
.         |
1000 amit 2300
```

c:\employee.txt

```
1   suraj 4000
2   ramesh 6000
3   rajan 4500
.         |
500 sam 3500
.         |
600 neel 4500
```

file-oriented system

File Anomalies

- Create/Open an existing file
- Reading from file
- Writing to a file
- Closing a file

c:\employee.txt

```
1   suraj 4000
2   ramesh 6000
3   rajan 4500
.
.
.
500 sam 3500
.
.
.
1000 amit 2300
```

file attributes

- File Name
- Type
- Location

file permissions

- File permissions
- Share permissions

search empl ID=1

```
1 suraj 4000
2 ramesh 6000
3 rajan 4500
.
.
.
500 sam 3500
.
.
.
1000 amit 2300
```

search emp_name

```
1 suraj 4000
2 ramesh 6000
3 rajan 4500
.
.
.
500 sam 3500
.
.
.
1000 amit 2300
```

advantages & disadvantage of file-oriented system

advantages of file-oriented system

The biggest advantage of file-based storage is as follows.

- **Backup**: It is possible to take faster and automatic back-up of database stored in files of computer-based systems.
- **Data retrieval:** It is possible to retrieve data stored in files in easy and efficient way.
- **Flexibility:** File systems provide flexibility in storing various types of data, including text documents, images, audio, video, and more
- **Cost-Effectiveness**: File systems often do not incur licensing costs, making them cost-effective for basic data storage needs.
- **Editing**: It is easy to edit any information stored in computers in form of files.
- **Remote access**: It is possible to access data from remote location.
- **Sharing**: The files stored in systems can be shared among multiple users at a same time.

disadvantage of file-oriented system

The biggest disadvantage of file-based storage is as follows.

- **Data redundancy***:* It is possible that the same information may be duplicated in different files. This leads to data redundancy results in memory wastage.
  (Suppose a customer having both kind of accounts - **saving** and **current** account. In such a situation a customer detail are stored in both the file, saving.txt- file and current.txt- file , which leads to Data Redundancy.)
- **Data inconsistency***:* Because of data redundancy, it is possible that data may not be in consistent state.
  (Suppose customer changed his/her address. There might be a possibility that address is changed in only one file (saving.txt) and other (current.txt) remain unchanged.)
- **Limited data sharing***:* Data are scattered in various files and also different files may have different formats (for example: .txt, .csv, .tsv and .xml) and these files may be stored in different folders so, due to this it is difficult to share data among different applications also if the saving account department wants to share data with loan department, they need to manually copy files, leading to delays because File Systems do not support multi-user environments.
- **Data Isolation:** Because data are scattered in various files, and files may be in different formats (for example: .txt, .csv, .tsv and .xml), writing new application programs to retrieve the appropriate data is difficult.
- (Suppose a loan data is in one file and account holder data in another, there is no easy way to analyze account holder data with his loan status.)
- **Data security:** Data should be secured from unauthorized access, for example a account holder in a bank should not be able to see the account details of another account holder, such kind of security constraints are difficult to apply in file processing systems.

disadvantage of file-oriented system

The biggest disadvantage of file-based storage is as follows.

- **Data Integrity**: Data integrity refers to the accuracy and consistency of data. In a file-oriented system, enforcing data integrity is difficult because there are no built-in mechanisms to ensure that data is valid or consistent across multiple files.
  (the balance field value must be grater than 5000.)
- **Concurrency Issues:** When multiple users or applications try to access and modify a file at the same time, concurrency problems can arise.
  (if two users attempt to update the same file simultaneously, it can lead to data corruption or loss of data.)
- **Lack of Flexibility:** Modifying the structure of files, such as adding new fields or changing data formats, can be difficult and time-consuming. Changes might require manual updates to each file or even rewriting entire applications that interact with the files.
- **Poor Scalability:** As the amount of data grows, file-based systems become less efficient and more difficult to manage. Searching through large files can be slow, and as more files are added, the complexity of managing the system increases.

***Relation Schema*:** A relation schema represents name of the relation with its attributes, every attribute would have an associated domain.

e.g.

- **Student**(rollNo:INT, name:VARCHAR(20), address:VARCHAR(50), phone:VARCHAR(12), age:INT, PRIMARY KEY(rollNo)) is relation schema for STUDENT
- **Customers**(CustomerID:INT, Name:VARCHAR(50), Email:VARCHAR(100), City:VARCHAR(50), PRIMARY KEY(CustomerID)) is relation schema for CUSTOMERS

DBMS

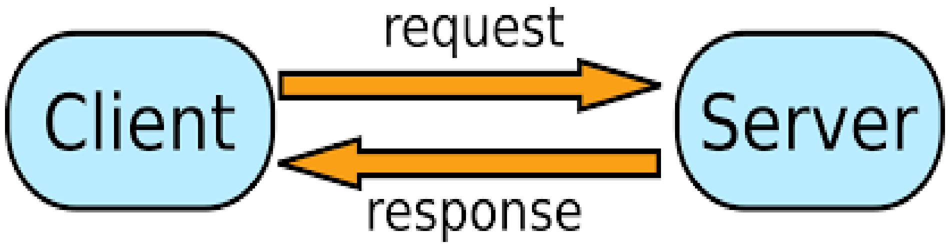
- **database:** Is the collection of **related data** which is **organized,** database can store and retrieve large amount of data easily, which is stored in one or more data files by one or more users, it is called as **structured data.**
- **management system**: it is a software, designed to **define**, **manipulate**, **retrieve** and **manage** data in a database.

relational database management system?

A RDBMS is a database management system (DBMS) that is based on the **relational model** introduced by Edgar Frank Codd at IBM in 1970.

RDBMS supports

- *client/server Technology*
- *Highly Secured*
- *Relationship (PK/FK)*



- **A server** is a computer program or a device that provides service to another computer program, also known as the client.
- In the **client/server programming** model, a server program awaits and fulfills requests from client programs, which might be running in the same, or other computers.

object relational database management system?

An object database is a database management system in which information is represented in the form of objects.

PostgreSQL is the most popular pure ORDBMS. Some popular databases including Microsoft SQL Server, Oracle, and IBM DB2 also support objects and can be considered as ORDBMS.

Advantage of ORDBMS

- Function/Procedure overloading.
- Extending server functionality with external functions written in C or Java.
- User defined data types.
- Inheritance of tables under other tables.

- CREATE or REPLACE TYPE ***city*** AS VARRAY(3) OF VARCHAR(10);
- CREATE TABLE x (id INT, ename VARCHAR(10), c ***city***);
- INSERT INTO x values(1, 'saleel', ***city***('baroda', 'surat', 'bharuch'));
- SELECT n.id, n.ename, nn.column_value FROM x n, TABLE(n.c) nn;

relational model concepts

and

properties of relational table

relational model concepts

Relational model organizes data into one or more tables (or "relations") of columns and rows. Rows are also called records or tuples. Columns are also called attributes.

- **Relation (Table)** – In relational model, relations are saved in the form of Tables. A table has rows and columns.
- **Attribute (Column)** – Attributes are the properties that define a relation. **e.g.** (**roll_no, name, address, age, . . .**)
- **Tuple (Row/Record)** – A single row of a table, which contains a single record for that relation is called a tuple.
- **Relation schema** – A relation schema describes the Relation Name (Table Name), Attributes (Column Names), Domain of Attributes (Data Types & Allowed values), Constraints (Primary Key, Foreign Key, etc.).

  e.g. Customers(CustomerID:INT, Name:VARCHAR(50), Email:VARCHAR(100), City:VARCHAR(50), PRIMARY KEY(CustomerID)) is relation schema for CUSTOMERS
- **Attribute domain** – An attribute domain in a relational database refers to the set of allowed values for an attribute (column). It defines the data type and constraints that restrict the values an attribute can take.

Remember:

- In database management systems, **NULL (absence of a value)** is used to represent **MISSING** or **UNKNOWN** data in a table column.

properties of relational table

ID	job	firstName	DoB	salary
1	manager	Saleel Bagde	yyyy-mm-dd	●●●●●●
3	salesman	Sharmin	yyyy-mm-dd	●●●●●●
4	accountant	Vrushali	yyyy-mm-dd	●●●●●●
2	salesman	Ruhan	yyyy-mm-dd	●●●●●●
5	9500	manager	yyyy-mm-dd	●●●●●●
5	Salesman	Rahul Patil	yyyy-mm-dd	●●●●●●

Relational tables have six properties:

- Values are atomic.
- Column values are of the same kind. (***Attribute Domain*:** Every attribute has some pre-defined datatypes, format, constraints of a column, and defines the range of values that are valid for that column known as attribute domain.)
- Each row is unique.
- The sequence of columns is insignificant – (unimportant).
- The sequence of rows is insignificant – (unimportant).
- Each attribute/column must have a unique name.

What is data?

what is data?

Data is any facts that can be stored and that can be processed by a computer.

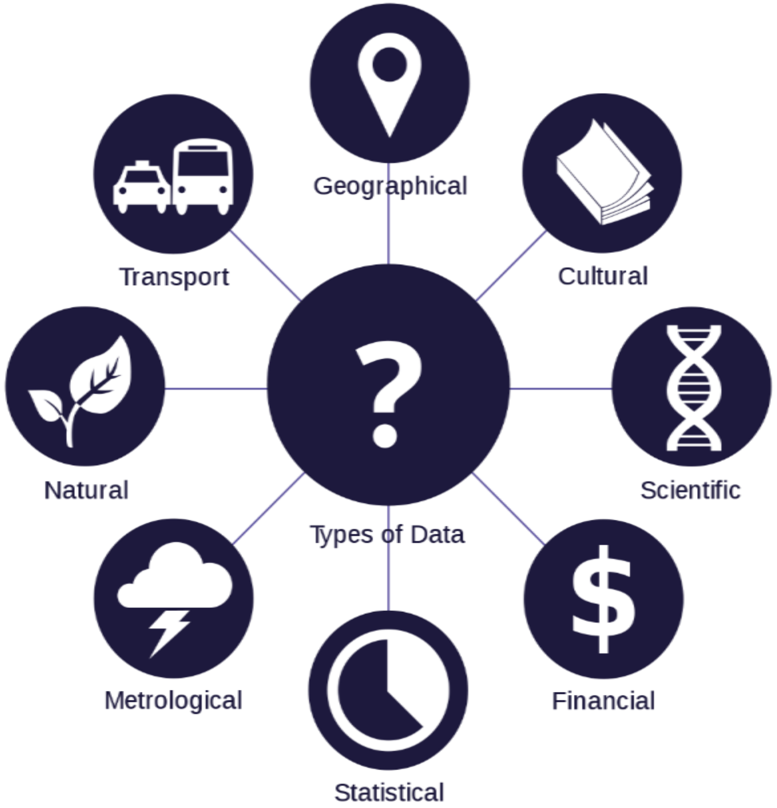
Data can be in the form of Text or Multimedia

e.g.

- number, characters, or symbol
- images, audio, video, or signal

Remember:

- A **Binary Large Object (BLOB)** is a MySQL data type that can store binary data such as multimedia, and PDF files.
- A **Character Large Object(CLOB)** is aa MySQL data type which is used to store large amount of textual data. Using this datatype, you can store data up to 2,147,483,647 characters.
- A number is a mathematical value used to count, measure, and label.



What is Entity Relationship Diagram?

Entity Relationship Diagram (ER Diagram)

Use E-R model to get a high-level graphical view to describe the **"ENTITIES"** and their **"RELATIONSHIP"**

The basic constructs/components of ER Model are **Entity**, **Attributes** and **Relationships**.

An entity can be a **real-world object.**

What is Entity?

An entity in DBMS is a real-world object that has certain properties called attributes that define the nature of the entity.

entity

In relation to a database , an entity is a

- Person(student, teacher, employee, client, department, …)
- Place(classroom, building, …) --a particular position or area
- Thing(computer, lab equipment, …) --an object that is not named (represents a tangible object)
- Concept(course, batch, student's attendance, …) -- an idea,

about which data can be stored. All these entities have some **attributes** or **properties** that give them their **identity**.

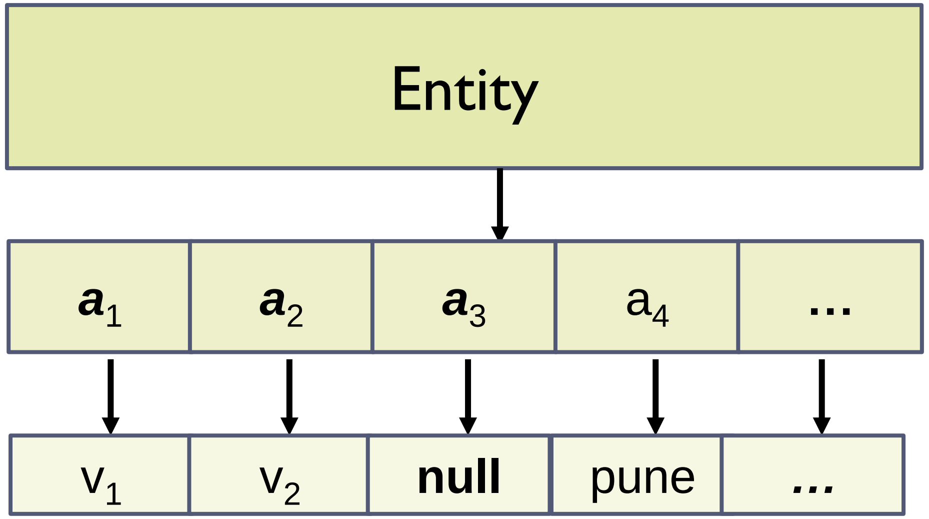
Every entity has its own characteristics.

In database management systems, **null** (***absence of a value***) is used to represent **missing** or **unknown** data in a table column.

What is an Attribute?

Attributes are the properties that define a relation.

e.g. **Student**(***rollNo***:INT, ***name***:VARCHAR(20), ***address***:VARCHAR(50), ***age***:INT)



Entity

$\boldsymbol{a}_1$	$\boldsymbol{a}_2$	$\boldsymbol{a}_3$	a_4	**…**
v_1	v_2	**null**	pune	**…**

attributes

In Entity Relationship(ER) Model attributes can be classified into the following types.

- Simple/Atomic and Composite Attribute
- Single Valued and Multi Valued attribute
- Stored and Derived Attributes
- Complex Attribute

Remember:

In SQL, the same name can be used for two (or more) attributes as long as the attributes are in different relations.

attributes

- **Simple / Atomic Attribute** **--VS--** **Composite Attribute**
  (Can’t be divided further) (Can be divided further)
- **Single Value Attribute** **--VS--** **Multi Valued Attribute**
  (Only One value) (Multiple values)
- **Stored Attribute** **--VS--** **Derived Attribute**
  (Only One value) (Virtual)
- **Complex Attribute**
  (Composite & Multivalued)

Employee ID: An employee ID can be a composite attribute, which is composed of sub-attributes such as department code, job code, and employee number.

- **Atomic Attribute:** An attribute that cannot be divided into smaller independent attribute is known as atomic attribute.
  e.g. ID’s, PRN, age, gender, zip, marital status cannot further divide.
- **Single Value Attribute:** An attribute that holds exactly one value for a given record at any point in time is known as single valued attribute. Single-valued attributes are typically used to provide a unique identifier for a record.
  e.g. manufactured part can have only one serial number, voter card ID, blood group, branchID can have only one value.
- **Stored Attribute:** The stored attribute are such attributes which are already stored in the database and from which the value of another attribute is derived.
  e.g. (HRA, DA…) can be derive from salary, age can be derived from DoB, total marks or average marks of a student can be derived from marks.

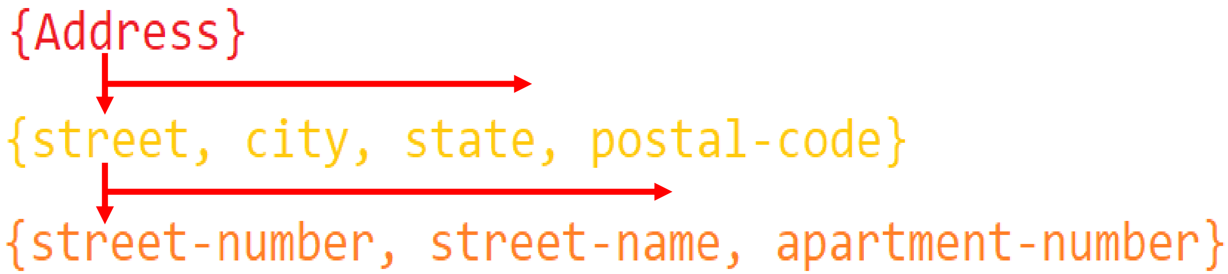
Composite **VS** Multi Valued Attribute

composite / multi valued attributes

Composite Attribute

Person Entity

- *Name* attribute: (`firstName` + `middleName` + `lastName`)
- *PhoneNumber* attribute: (`countryCode` + `cityCode` + `phoneNumber`)
- *Date* attribute: (`Day` + `Month` + `Year`)
- *Dimensions* attribute: (`Length` + `Width` + `Height`)



{Address}

{street, city, state, postal-code}

{street-number, street-name, apartment-number}

Multi Valued Attribute

Person Entity

- *Hobbies* attribute: [reading, hiking, hockey, skiing, photography, . . .]
- *SpokenLanguages* attribute: [Hindi, Marathi, Gujarati, English, . . .]
- *Degrees* attribute: [10th , 12th, BE, ME, PhD, . . .]
- *emailID* attribute: [saleel@gmail.com, salil@yahoomail.com, . . .]
- *Skills* attribute: [MySQL, Oracle, Redis, MongoDB, Java, . . .]

What is an Prime, Non-Prime Attribute?

attributes

Prime attribute (*Entity integrity*):- An attribute, which is a **part of the prime-key** **(**candidate key**)**, is known as a prime attribute.

Consider a relation Student(StudentID, Name, Email, Phone).

- ***Candidate Keys:*** {StudentID}, {Email}, {Phone}
- ***Prime Attributes:*** StudentID, Email, Phone (since they are part of a Candidate Key).

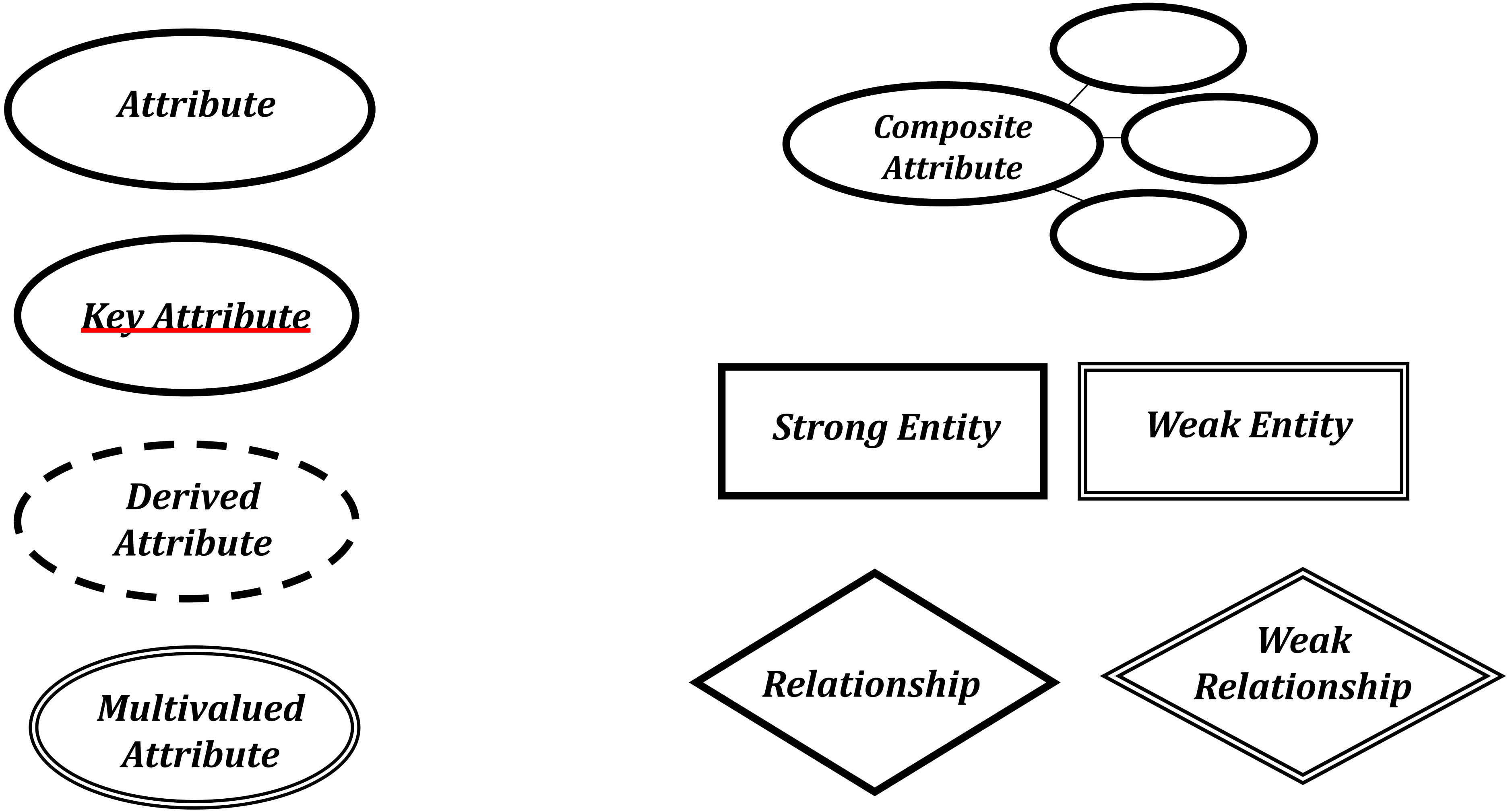
Non-prime attribute:- An attribute, which is **not a part of the prime-key** **(**candidate key**)**, is said to be a non-prime attribute.

In the Student(StudentID, Name, Email, Phone) relation:

- ***Candidate Keys:*** {StudentID}, {Email}, {Phone}
- ***Prime Attributes:*** StudentID, Email, Phone
- ***Non-Prime Attribute:*** Name (because it is not part of any Candidate Key).

Entity Relationship Diagram Symbols

entity relationship diagram symbols



Attribute

Composite Attribute

Key Attribute

Strong Entity

Weak Entity

Derived Attribute

Multivalued Attribute

Relationship

Weak Relationship

strong and weak entity

An entity may participate in a relation either totally or partially.

Strong Entity: A strong entity is not dependent on any other entity in the schema. A strong entity will always have a primary key. Strong entities are represented by a single rectangle.

Weak Entity: A weak entity is dependent on a strong entity to ensure its existence. Unlike a strong entity, a weak entity does not have any primary key. A weak entity is represented by a double rectangle. The relation between one strong and one weak entity is represented by a double diamond. This relationship is also known as identifying relationship.

Example 1 – A loan entity can not be created for a customer if the customer doesn’t exist

Example 2 – A payment entity can not be created for a loan if the loan doesn’t exist

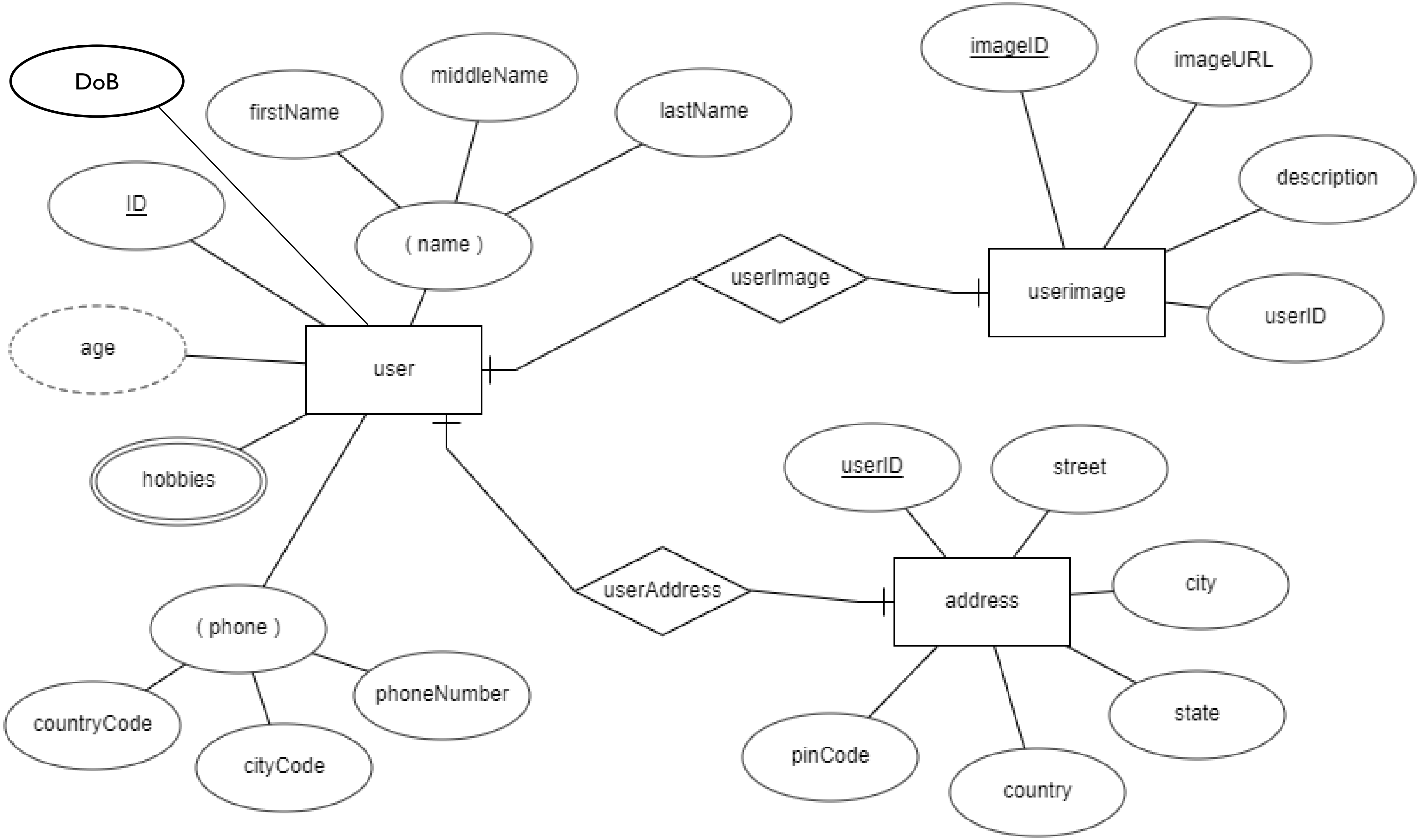
Example 3 – A customer address entity can not be created for the customer if the customer doesn’t exist

Example 4 – A prescription entity can not be created for a patient if the patient doesn’t exist

strong and weak entity

Strong Entity	Weak Entity
— Order (OrderID)	— OrderItem (ItemID, OrderID)
— University (UniID)	— Scholarship (ScholarshipID, UniID)
— Patient (PatientID)	— MedicalRecord (RecordID, PatientID)
— Account (AccountID)	— Transaction (TransactionID,AccountID)
— Student (StudentID)	— Grade (GradeID, StudentID)
— Vehicle (VehicleID)	— InsurancePolicy (PolicyID,VehicleID)
— Hotel (HotelID)	— RoomBooking (BookingID, HotelID)
— Product (ProductID)	— WarrantyClaim (ClaimID, ProductID)
— Student (StudentID)	— AttendanceRecord (RecordID, StudentID)

entity relationship diagram



What is a degree, cardinality and union in database?

What is a degree, cardinality and union in database?

- **Degree d(R) / Arity**: Total number of **attributes/columns** present in a relation/table is called **degree of the relation** and is denoted by $\mathbf{d}(R)$.

- **Cardinality |R|**: Total number of **tuples/rows** present in a relation/table, **is called cardinality of a relation** and is denoted by $|R|$.

  Cardinality is the numerical relationship between rows of one table and rows in another. Common cardinalities include *one-to-one*, *one-to-many*, and *many-to-many*.

- **Union Compatibility**: Two relations *R* and *S* are set to be Union Compatible to each other if and only if:
  1. They have the **same degree** $\mathbf{d(R)}$.
  2. Domains of the respective attributes should also be same.

What is domain constraint and types of data integrity constraints?

Data integrity refers to the correctness and completeness of data.

A domain constraint and types of data integrity constraints

- **Domain Constraint** = data type + Constraints (**not null/unique/primary key/foreign key/check/default**)

  e.g. custID INT, constraint pk_custid PRIMARY KEY(custID)

Three types of integrity constraints: **entity integrity, referential integrity** and **domain integrity**:

- **Entity integrity:** Entity Integrity Constraint is used to ensure the uniqueness of each record the table. There are primarily two types of integrity constraints that help us in ensuring the uniqueness of each row, namely, UNIQUE KEY constraint and PRIMARY KEY constraint.

- **Referential integrity:** Referential Integrity Constraint ensures that there always exists a valid relationship between two tables. This makes sure that if a foreign key exists in a table t_2 relationship then it should always reference a corresponding value in the second table t_1 :- t_1**[PK]** = t_2**[FK]** or it should be null.

- **Domain integrity:** A domain is a set of values of the same type.

Data integrity refers to the correctness and completeness of data.

A domain constraint and types of data integrity constraints

- **Domain Constraint** = data type + Constraints (**not null/unique/primary key/foreign key/check/default**)

  e.g. custID INT, constraint pk_custid PRIMARY KEY(custID)

Domain integrity is enforced using the following constraints:

Constraint	**Description**	**Example**
Data Type	Ensures that values match a specific type (e.g., INT, VARCHAR, DATE).	age INT NOT NULL (Only integers allowed)
NOT NULL	Prevents null (empty) values in a column.	name VARCHAR(50) NOT NULL
CHECK	Restricts values based on a condition.	salary DECIMAL(10,2) CHECK (salary > 0)
DEFAULT	Sets a default value if none is provided.	status VARCHAR(10) DEFAULT 'Active'
ENUM	Limits a column to predefined values.	gender ENUM('Male', 'Female', 'Other')
SET	Allows multiple predefined values.	roles SET('Admin', 'Editor', 'User')

types of Keys?

Keys are used to establish relationships between tables and also to uniquely identify any record in the table.

types of Keys?

r = Employee(EmployeeID, FullName, job, salary, PAN, DateOfBirth, emailID, deptno)

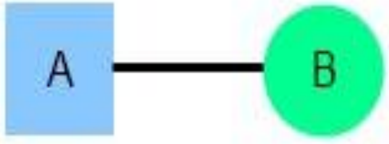
- **Candidate Key:** are individual columns in a table that qualifies for uniqueness of all the rows. Here in Employee table EmployeeID, PAN or emailID are Candidate keys.
- **Primary Key**: is the columns you choose to maintain uniqueness in a table. Here in Employee table you can choose either EmployeeID, PAN or emailID columns, EmployeeID is preferable choice.
- **Alternate Key**: Candidate column other the primary key column, like if EmployeeID is primary key then , PAN or emailID columns would be the Alternate key.
- **Super Key**: If you add any other column to a primary key then it become a super key, like EmployeeID + FullName or EmployeeID + deptno is a Super Key.
- **Composite Key**: If a table do not have any single column that qualifies for a Candidate key, then you have to select 2 or more columns to make a row unique. Like if there is no EmployeeID, PAN or emailID columns, then you can make FullName + DateOfBirth as Composite key. But still there can be a narrow chance of duplicate row. Ensures data uniqueness in many-to-many relationships. e.g. in order_details table we can have multiple products OrderID + ProductID

Common relationships

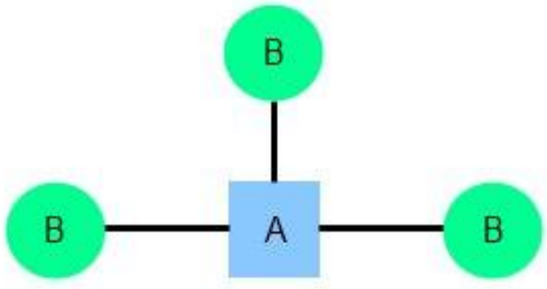
relationships

Common relationship

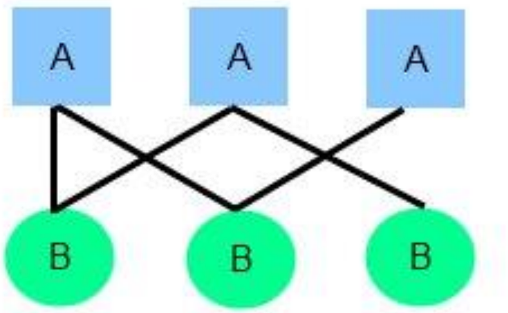
1. one-to-one (1:1)



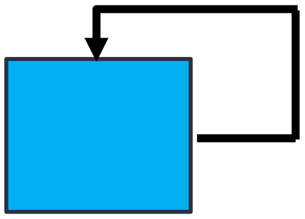
2. one-to-many (1:M)



3. many-to-many (M:N)



4. Self-Referencing (Recursive)

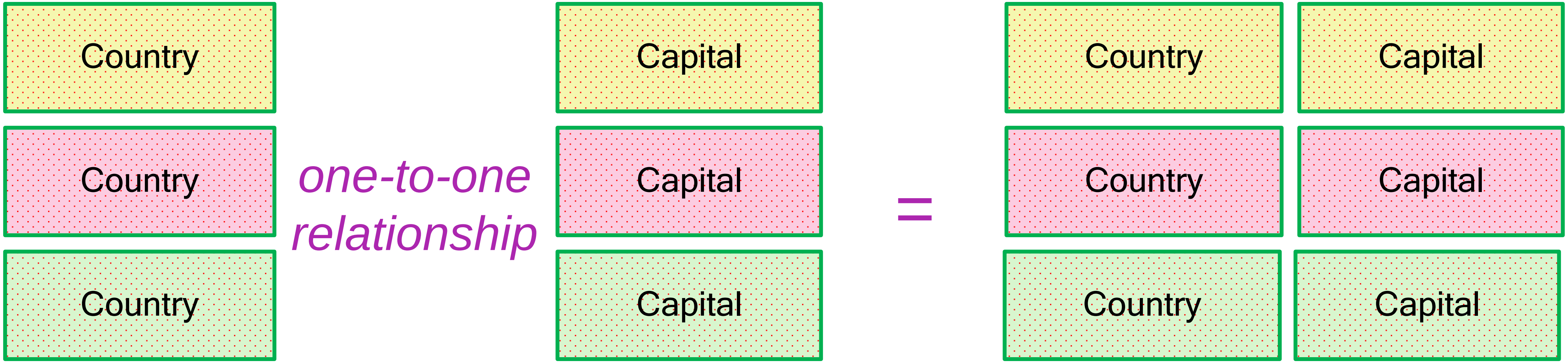


one-to-one relationship

one-to-one relationship

A *one-to-one* relationship between two tables means that a row in one table can only relate to zero/one row in the table on the other side of their relationship. This is the least common database relationship.

A *one-to-one* relationship is a type of cardinality that refers to the relationship between two entities ***R*** and ***S*** in which one element of entity ***R*** may only be linked to zero/one element of entity ***S***, and vice versa.



Country
Country
Country

one-to-one relationship

Capital
Capital
Capital

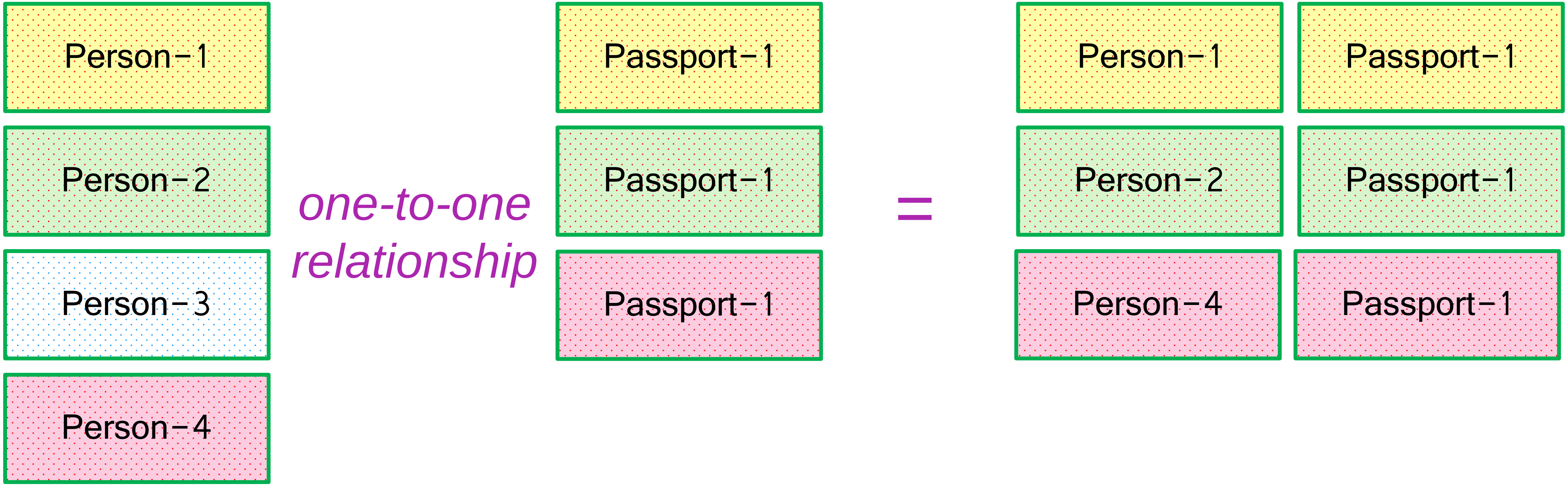
=

Country Capital
Country Capital
Country Capital

one-to-one relationship

A *one-to-one* relationship between two tables means that a row in one table can only relate to zero/one row in the table on the other side of their relationship. This is the least common database relationship.

A *one-to-one* relationship is a type of cardinality that refers to the relationship between two entities ***R*** and ***S*** in which one element of entity ***R*** may only be linked to zero/one element of entity ***S***, and vice versa.



Person−1
Person−2
Person−3
Person−4

one-to-one relationship

Passport−1
Passport−1
Passport−1

=

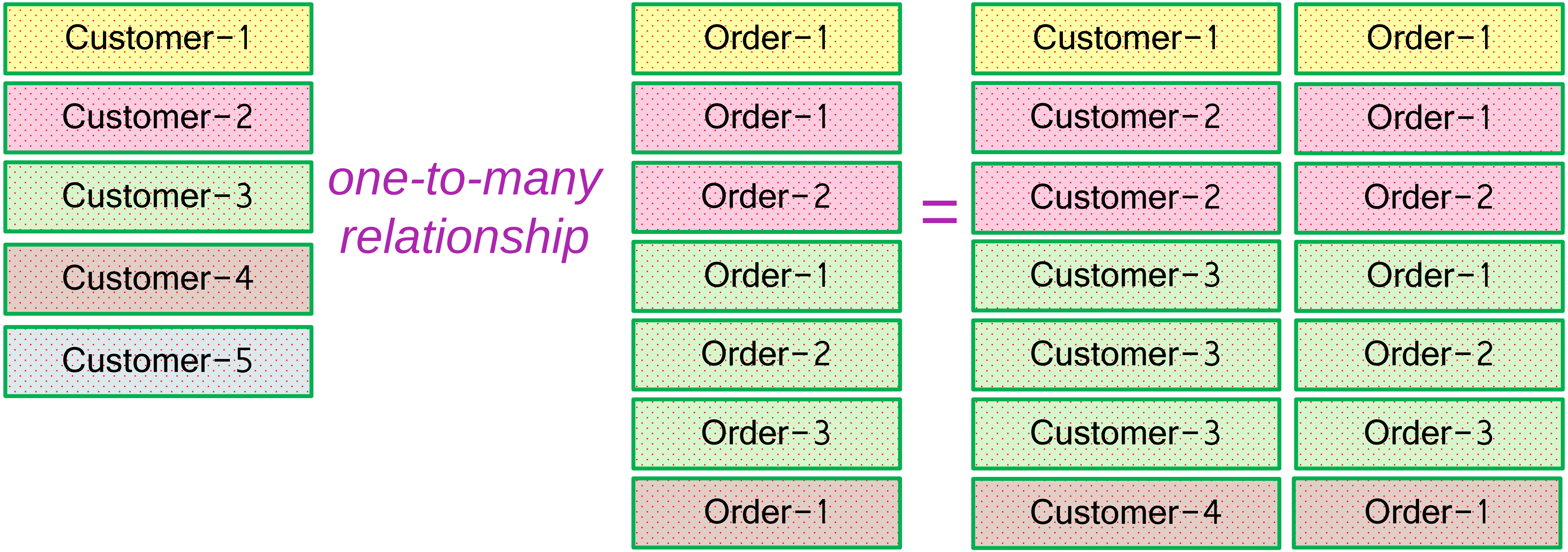
Person−1	Passport−1
Person−2	Passport−1
Person−4	Passport−1

one-to-many relationship

one-to-many relationship

A *one-to-many* relationship between two tables means that a row in one table can have zero or more row in the table on the other side of their relationship.

a *one-to-many* relationship is a type of cardinality that refers to the relationship between two entities ***R*** and ***S*** in which an element of ***R*** may be linked to many elements of ***S***, but a member of ***S*** is linked to only one element of ***R***.



Customer−1
Customer−2
Customer−3
Customer−4
Customer−5

one-to-many relationship

Order−1
Order−1
Order−2
Order−1
Order−2
Order−3
Order−1

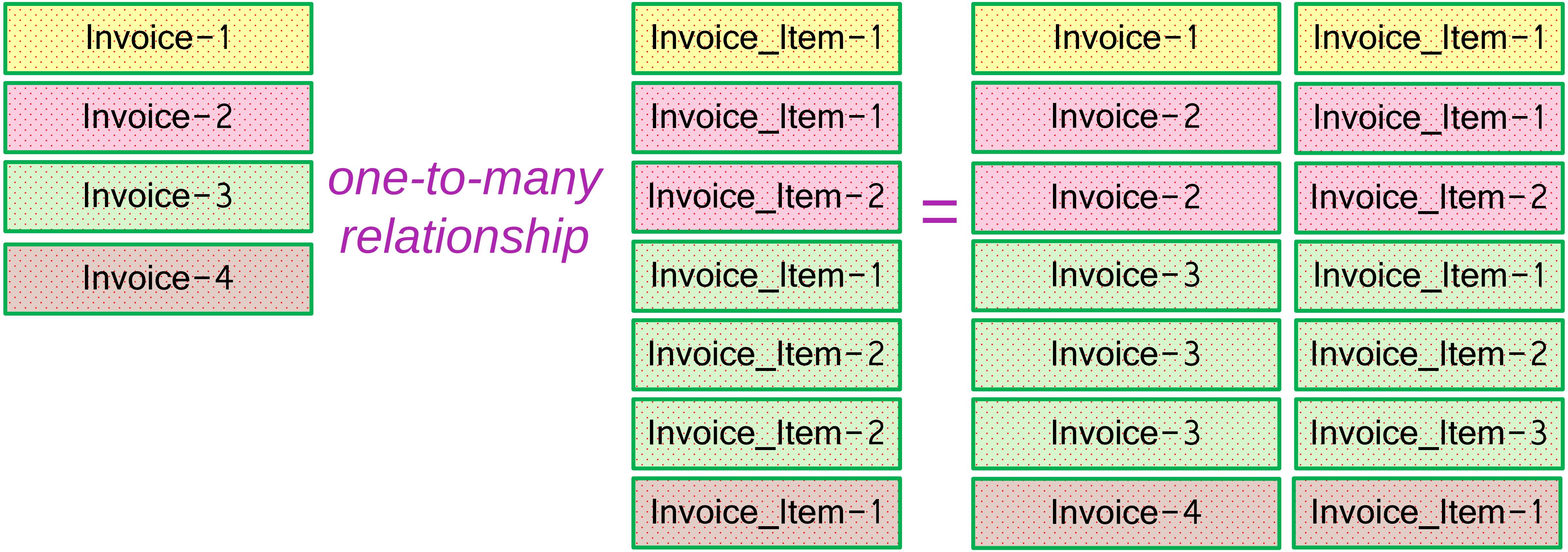
=

Customer−1	Order−1
Customer−2	Order−1
Customer−2	Order−2
Customer−3	Order−1
Customer−3	Order−2
Customer−3	Order−3
Customer−4	Order−1

one-to-many relationship

A *one-to-many* relationship between two tables means that a row in one table can have one or more row in the table on the other side of their relationship.

a *one-to-many* relationship is a type of cardinality that refers to the relationship between two entities ***R*** and ***S*** in which an element of ***R*** may be linked to many elements of ***S***, but a member of ***S*** is linked to only one element of ***R***.



Invoice−1
Invoice−2
Invoice−3
Invoice−4

one-to-many relationship

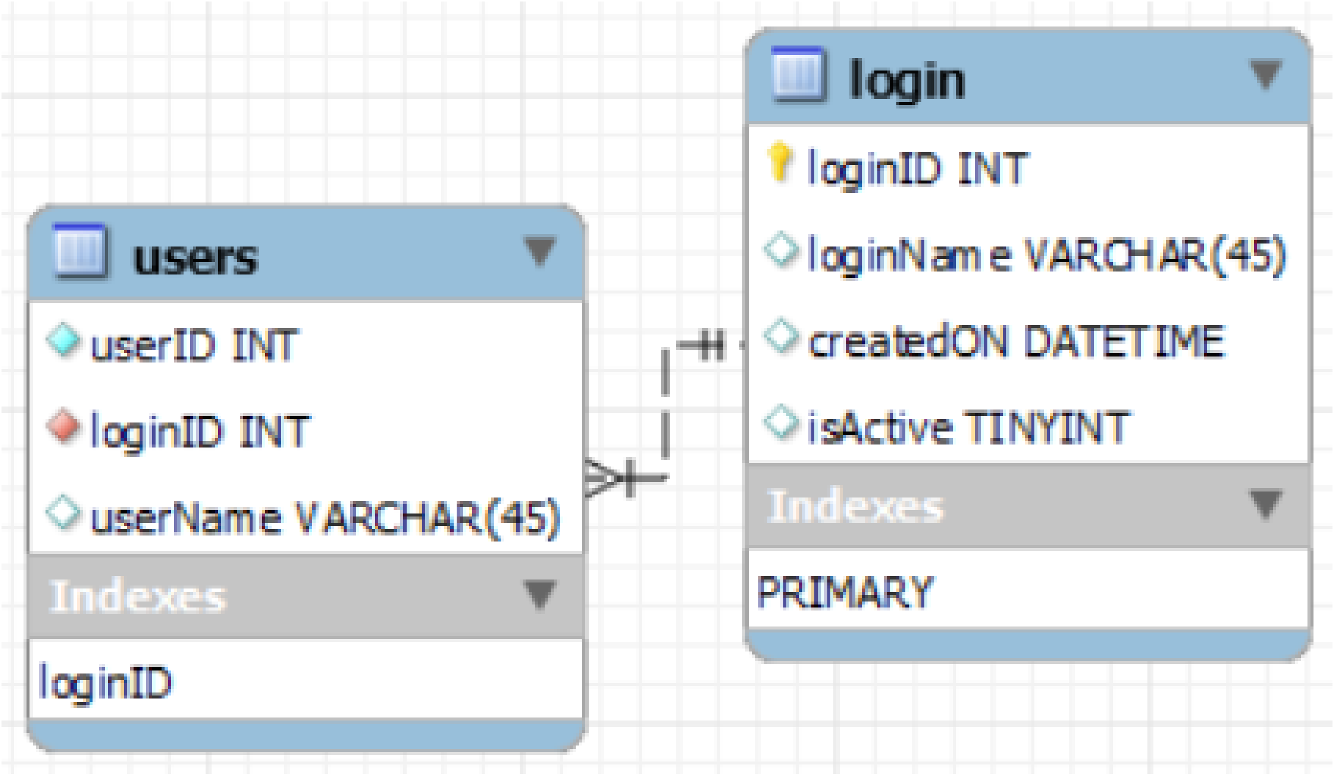
Invoice_Item−1
Invoice_Item−1
Invoice_Item−2
Invoice_Item−1
Invoice_Item−2
Invoice_Item−2
Invoice_Item−1

=

Invoice−1	Invoice_Item−1
Invoice−2	Invoice_Item−1
Invoice−2	Invoice_Item−2
Invoice−3	Invoice_Item−1
Invoice−3	Invoice_Item−2
Invoice−3	Invoice_Item−3
Invoice−4	Invoice_Item−1

many-to-one relationship

many-to-one relationship



users

userID INT

loginID INT

userName VARCHAR(45)

Indexes

loginID

login

loginID INT

loginNam e VARCHAR(45)

createdON DATETIME

isActive TINYINT

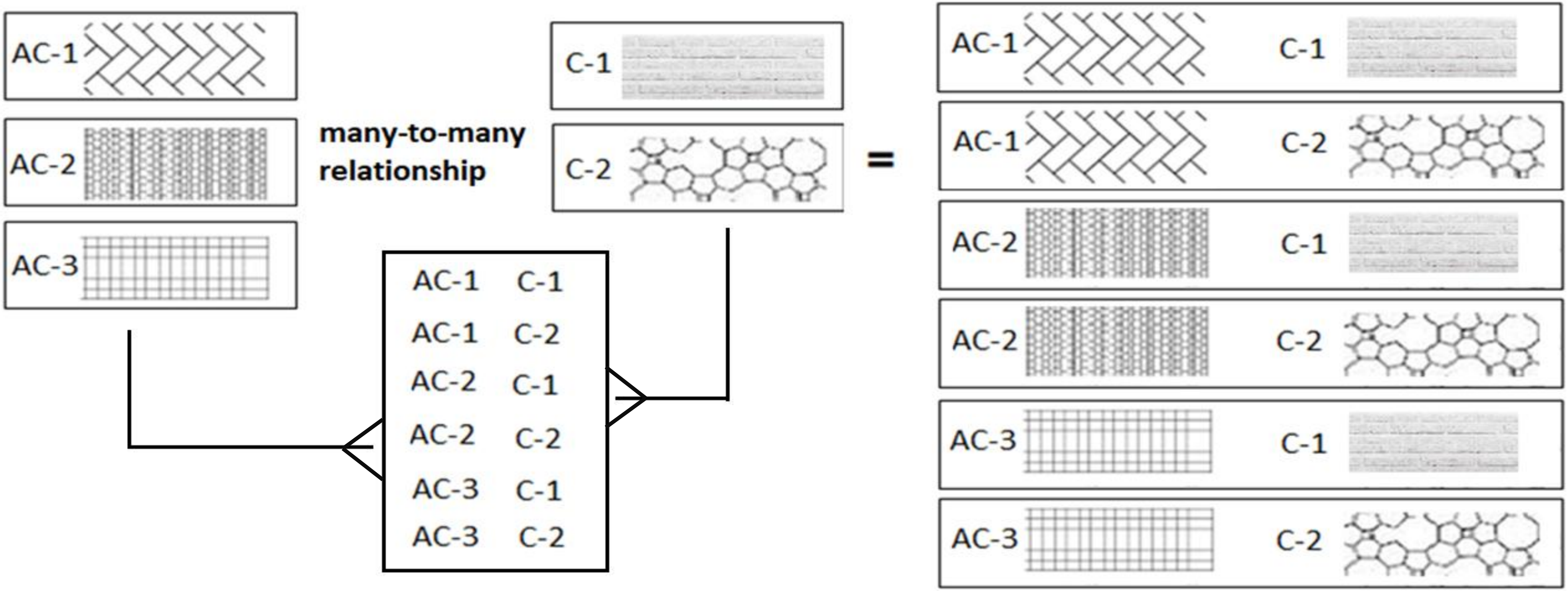
Indexes

PRIMARY

many-to-many relationship

many-to-many relationship

A *many-to-many* relationship is a type of cardinality that refers to the relationship between two entities ***R*** and ***S*** in which ***R*** may contain a parent instance for which there are many children in ***S*** and vice versa.

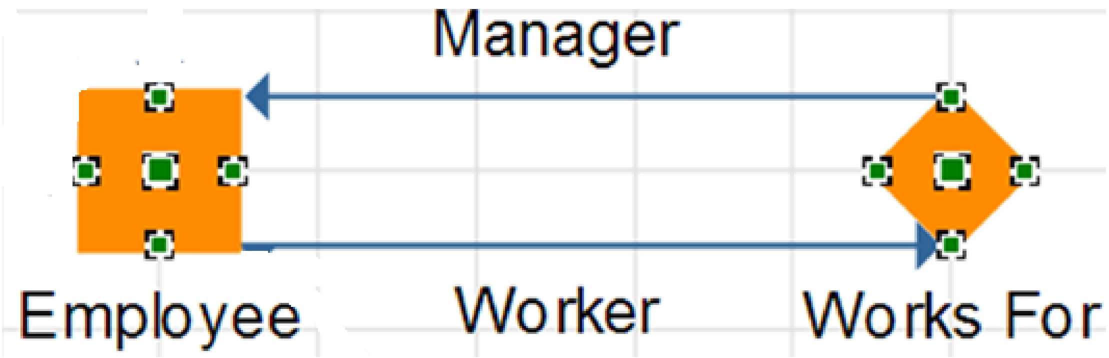


AC-1	C-1
AC-1	C-2
AC-2	C-1
AC-2	C-2
AC-3	C-1
AC-3	C-2

self-referencing relationship

self-referencing relationship

A *"self-referencing"* or *"recursive"* relationship in databases or data structures means that a record within a table can reference another record in the same table.



Product Categories and Subcategories

CategoryID	CategoryName	ParentCategoryID
1	Electronics	NULL
2	Phones	1
3	Laptops	1
4	Smartphones	2
5	Gaming Laptops	3

MySQL

MySQL is the most popular **Open Source** Relational Database Management System.

MySQL was created by a Swedish company - MySQL AB that was founded in 1995. It was acquired by Sun Microsystems in 2008; Sun was in turn acquired by Oracle Corporation in 2010.

When you use MySQL, you're actually using at least two programmes. One program is the MySQL server (*mysqld.exe*) and other program is MySQL client program (*mysql.exe*) that connects to the database server.

What is SQL?

what is sql?

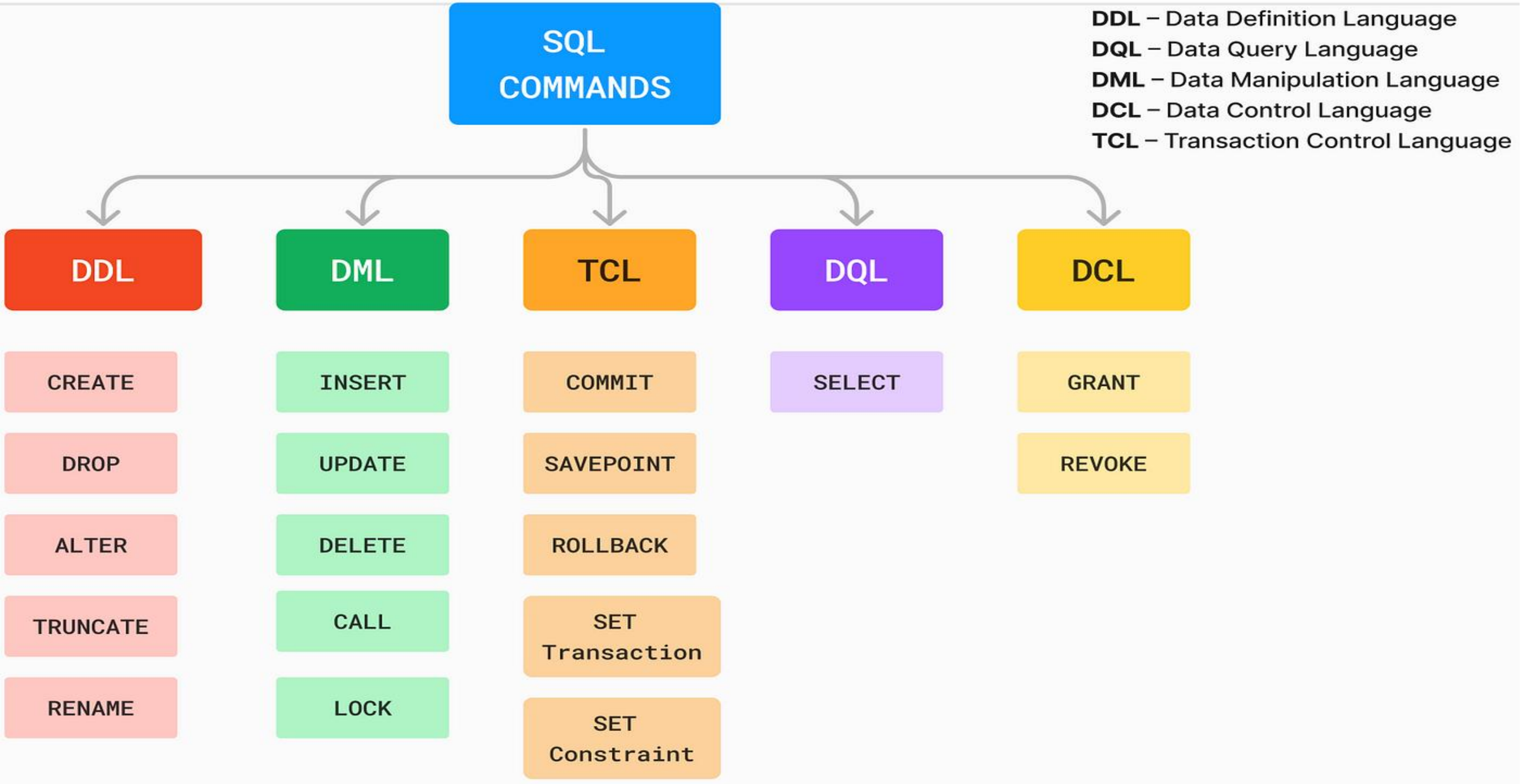
Remember:

- **EXPLICIT or IMPLICIT commit will commit the data.**

SQL (Structured Query Language) is a database language designed and developed for managing data in relational database management systems (RDBMS). SQL is common language for all Relational Databases.

Remember:

- An ***implicit commit*** occurs ***automatically*** in MySQL ***without the need of COMMIT command***. This means changes made by the SQL statement are immediately saved to the database and ***cannot be rolled back***.
- An ***explicit commit*** is done by the user issuing a ***COMMIT*** command to ***manually save all changes*** made in the current transaction.



DDL – Data Definition Language
DQL – Data Query Language
DML – Data Manipulation Language
DCL – Data Control Language
TCL – Transaction Control Language

SQL COMMANDS

DDL: CREATE, DROP, ALTER, TRUNCATE, RENAME

DML: INSERT, UPDATE, DELETE, CALL, LOCK

TCL: COMMIT, SAVEPOINT, ROLLBACK, SET Transaction, SET Constraint

DQL: SELECT

DCL: GRANT, REVOKE

comments in mysql

- From a # character to the end of the line.
- From a **--** sequence to the end of the line.
- From a /* sequence to the following */ sequence.

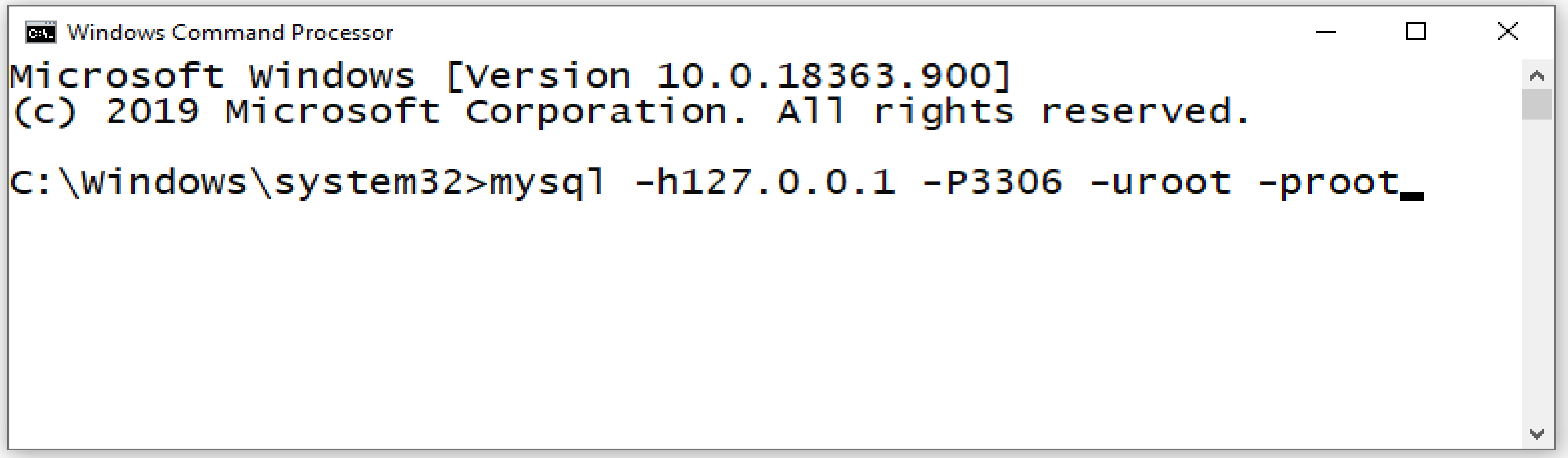
Reconnect to the server	**\r**
Execute a system shell command	**\!**
Exit mysql	**\q**
Change your mysql prompt.	**prompt str or \R str**

Login to MySQL

Default port for MySQL Server: **3306**

login

- C:\> mysql -hlocalhost -P3307 -uroot -p
- C:\> mysql -h127.0.0.1 -P3307 -uroot -p [*database_name*]
- C:\> mysql -h192.168.100.14 -P3307 -uroot -psaleel [*database_name*]
- C:\> mysql --host localhost --port 3306 --user root --password=ROOT [*database_name*]
- C:\> mysql --host=localhost --port=3306 --user=root --password=ROOT [*database_name*]



```
Microsoft Windows [Version 10.0.18363.900]
(c) 2019 Microsoft Corporation. All rights reserved.

C:\Windows\system32>mysql -h127.0.0.1 -P3306 -uroot -proot_
```

The **char** is a fixed-length character data type,
The **varchar** is a variable-length character data type.

```
CREATE TABLE temp (c1 CHAR(10), c2 VARCHAR(10));

INSERT INTO temp VALUES('SALEEL', 'SALEEL');

SELECT * FROM temp WHERE c1 LIKE 'SALEEL';
```

datatypes

ENAME CHAR (10)	S	A	L	E	E	L					LENGTH -> 10
ENAME VARCHAR2(10)	S	A	L	E	E	L					LENGTH -> 6

In MySQL

When CHAR values are retrieved, the trailing spaces are removed (unless the ***PAD_CHAR_TO_FULL_LENGTH*** SQL mode is enabled)

ENAME CHAR (10)	S	A	L	E	E	L					LENGTH -> 6
ENAME VARCHAR(10)	S	A	L	E	E	L					LENGTH -> 6

Note:

The BINARY and VARBINARY types are similar to CHAR and VARCHAR, except that they store binary strings rather than nonbinary strings. That is, they store byte strings rather than character strings.

datatype - string

Datatypes	Size	Description
CHAR [(length)]	0-255	
VARCHAR (length)	0 to 65,535	The maximum row size (65,535 bytes, which is shared among all columns.
TINYTEXT [(length)]	$(2^8 - 1)$ bytes	
TEXT [(length)]	$(2^{16} -1)$ bytes	65,535 bytes ~ 64kb
MEDIUMTEXT [(length)]	$(2^{24} -1)$ bytes	16,777,215 bytes ~16MB
LONGTEXT [(length)]	$(2^{32} -1)$ bytes	4,294,967,295 bytes ~4GB
ENUM('value1', 'value2',...)	65,535 members	
SET('value1', 'value2',...)	64 members	
BINARY[(length)]	255	
VARBINARY(length)		

By default, trailing spaces are trimmed from CHAR column values on retrieval. If ***PAD_CHAR_TO_FULL_LENGTH*** is enabled, trimming does not occur and retrieved CHAR values are padded to their full length.

- *SET sql_mode = '';*
- *SET sql_mode = 'PAD_CHAR_TO_FULL_LENGTH';*

example of char and varchar

Datatypes	Size	Description
CHAR [(length)]	0-255	
VARCHAR (length)	0 to 65,535	The maximum row size (65,535 bytes, which is shared among all columns.

Try Out

```
CREATE TABLE x (x1 CHAR(4), x2 VARCHAR(4));

INSERT INTO x VALUE('', '');
INSERT INTO x VALUE('ab', 'ab');
INSERT INTO x VALUE('abcd', 'abcd');

SELECT x1, LENGTH(x1), x2, LENGTH(x2) FROM x;

SET sql_mode = 'PAD_CHAR_TO_FULL_LENGTH';

SELECT x1, LENGTH(x1), x2, LENGTH(x2) FROM x;

SET sql_mode = '';

SELECT x1, LENGTH(x1), x2, LENGTH(x2) FROM x;
```

* In CHAR, if a table contains value 'a', an attempt to store 'a ' causes a duplicate-key error.

```
CREATE TABLE x (x1 CHAR(4) PRIMARY KEY, x2 VARCHAR(4));

INSERT INTO x VALUE('a', 'a');
INSERT INTO x VALUE('a ', 'a ');
```

```
CREATE TABLE x (x1 CHAR(4), x2 VARCHAR(4) PRIMARY KEY);

INSERT INTO x VALUE('a', 'a');
INSERT INTO x VALUE('a ', 'a ');
```

datatype - numeric

Datatypes	Size	Description
TINYINT	1 byte	-128 to +127 **(The unsigned range is 0 to 255).**
SMALLINT [(length)]	2 bytes	-32768 to 32767. **(The unsigned range is 0 to 65535).**
MEDIUMINT [(length)]	3 bytes	-8388608 to 8388607. **(The unsigned range is 0 to 16777215).**
INT, INTEGER [(length)]	4 bytes	-2147483648 to 2147483647. **(The unsigned range is 0 to 4294967295).**
BIGINT [(length)]	8 bytes	-9,223,372,036,854,775,808 to 9,223,372,036,854,775,807
FLOAT [(length[,decimals])]	4 bytes	**FLOAT(255,30)**
DOUBLE [PRECISION] [(length[,decimals])], REAL [(length[,decimals])]	8 bytes	**REAL(255,30) / DOUBLE(255,30)** REAL will get converted to DOUBLE
DECIMAL [(length[,decimals])], NUMERIC [(length[,decimals])]		**DECIMAL(65,30) / NUMERIC(65,30)** NUMERIC will get converted in DECIMAL

For: float(M,D), double(M,D) or decimal(M,D), M must be >= D

Here, **(M,D)** means than values can be stored with up to ***M*** digits in total, of which ***D*** digits may be after the decimal point.

UNSIGNED prohibits negative values.

datatype – date and time

Datatypes	Size	Description
YEAR	1 byte	YYYY
DATE	3 bytes	YYYY-MM-DD
TIME	3 bytes	HH:MM:SS
DATETIME	8 bytes	YYYY-MM-DD hh:mm:ss

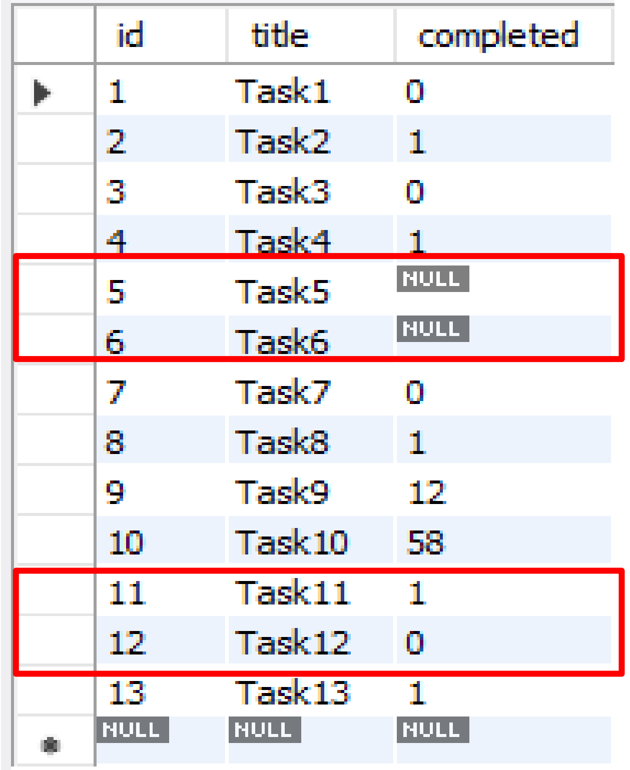
datatype – boolean

A value of zero is considered false. Nonzero values are considered true.

```
CREATE TABLE temp (col1 INT ,col2 BOOL,  col3 BOOLEAN);

CREATE TABLE tasks ( id INT AUTO_INCREMENT PRIMARY KEY, title VARCHAR(255) NOT NULL, completed BOOLEAN);
```

- INSERT INTO tasks VALUE(default, 'Task1', 0);
- INSERT INTO tasks VALUE(default, 'Task2', 1);
- INSERT INTO tasks VALUE(default, 'Task3', False);
- INSERT INTO tasks VALUE(default, 'Task4', True);
- INSERT INTO tasks VALUE(default, 'Task5', null);
- INSERT INTO tasks VALUE(default, 'Task6', default);
- INSERT INTO tasks VALUE(default, 'Task7’, 1 > 2);
- INSERT INTO tasks VALUE(default, 'Task8’, 1 < 2);
- INSERT INTO tasks VALUE(default, 'Task9', 12);
- INSERT INTO tasks VALUE(default, 'Task10', 58);
- INSERT INTO tasks VALUE(default, 'Task11', .75);
- INSERT INTO tasks VALUE(default, 'Task12', .15);
- INSERT INTO tasks VALUE(default, 'Task13', 'a' = 'a');



	id	title	completed
▶	1	Task1	0
	2	Task2	1
	3	Task3	0
	4	Task4	1
	5	Task5	NULL
	6	Task6	NULL
	7	Task7	0
	8	Task8	1
	9	Task9	12
	10	Task10	58
	11	Task11	1
	12	Task12	0
	13	Task13	1
✱	NULL	NULL	NULL

Note:

- BOOL and BOOLEAN are **synonym of TINYINT(1)**

datatype – enum

NOTE:

- An ENUM column can have a maximum of **65,535** distinct elements.
- Each ENUM value is stored as a number internally, starting from 1.
- ENUM values are sorted based on their index numbers, which depend on the order in which the enumeration members were listed in the column specification.
- Default value, NULL if the column can be NULL, first enumeration value if NOT NULL

- CREATE TABLE temp (col1 INT, COL2 ENUM('A','B','C'));
- INSERT INTO temp (col1, col2) VALUES(1, 1);
- INSERT INTO temp(col1) VALUES (1); // NULL

- CREATE TABLE temp (col1 INT, col2 ENUM('A','B','C') NOT NULL);
- INSERT INTO temp(col1) VALUES (1); // First element from the ENUM datatype

- CREATE TABLE temp (col1 INT, col2 ENUM('') NOT NULL);
- INSERT INTO temp (col1, col2) VALUES (1,'This is the test'); // NULL

- CREATE TABLE temp (col1 INT, COL2 ENUM('A','B','C') default 'C'); // Valid default value for 'COL2'
- CREATE TABLE temp (col1 INT, COL2 ENUM('A','B','C') default 'D'); // Invalid default value for 'COL2'

IMP:

- MySQL maps [membership ENUM('Silver', 'Gold', 'Diamond', 'Platinum')] these enumeration member to a numeric index where Silver=1, Gold=2, Diamond=3, Platinum=4 respectively.

datatype – enum

- An ENUM column can have a maximum of **65,535** distinct elements.

```
size ENUM('small', 'medium', 'large', 'x-large')

membership ENUM('Silver', 'Gold', 'Diamond', 'Platinum')

interest ENUM('Movie', 'Music', 'Concert')

zone ENUM('North', 'South', 'East', 'West')

season ENUM('Winter', 'Summer', 'Monsoon', 'Autumn')

sortby ENUM('Popularity', 'Price -- Low to High', 'Price -- High to Low', 'Newest First')

status ENUM('active', 'inactive', 'pending', 'expired', 'shipped', 'in-process', 'resolved', 'on-hold', 'cancelled', 'disputed')
```

Note:

- You cannot use user variable as an enumeration value. This pair of statements do not work:

```
SET @mysize = 'medium';
CREATE TABLE sizes ( size ENUM('small', @mysize, 'large'));   // error
```

datatype – set

NOTE:

- A SET column can have a maximum of **64** distinct members.
- Prevents invalid or duplicate values from being inserted.
- A SET is a string object that can have zero or more values, each of which must be chosen from a list of permitted values specified when the table is created.
- SET column values that consist of multiple set members are specified with members separated by commas (,) without leaving a spaces.

```
CREATE TABLE clients(id INT AUTO_INCREMENT PRIMARY KEY, name VARCHAR(10), membership ENUM('Silver', 'Gold', 'Premium', 'Diamond'), interest SET('Movie', 'Music', 'Concert'));

INSERT INTO clients (name, membership, interest) VALUES('Saleel', 'Gold', 'Music');

INSERT INTO clients (name, membership, interest) VALUES('Saleel', 'Premium', 'Movie,Concert');
```

```
FIND_IN_SET(str, { strlist | Field } )
```

```
SELECT FIND_IN_SET('Concert', 'Movie,Music,Concert');

SELECT * FROM clients WHERE FIND_IN_SET('Music', interest);
```

IMP:

- The SET data type allows you to specify a list of values to be inserted in the column, like ENUM. But, unlike the ENUM data type, which lets you choose only one value, the SET data type allows you to choose multiple values from the list of specified values.

Use a CREATE TABLE statement to specify the layout of your table.

```
CREATE TABLE `123` (c1 INT, c2 VARCHAR(10));
```

Remember:

- Max 4096 columns per table provided the row size <= 65,535 Bytes.
- The NULL value is different from values such as 0 for numeric types or the empty string for string types.

create table

Use a **CREATE TABLE** statement to specify the layout of your table.

Note:

- **USER TABLES**: This is a collection of tables created and maintained by the user. Contain USER information.

- **DATA DICTIONARY**: This is a collection of tables created and maintained by the MySQL Server. It contains database information. All data dictionary tables are owned by the SYS user.

create table

Use a **CREATE TABLE** statement to specify the layout of your table.

Remember:

- by default, tables are created in the default database, using the InnoDB storage engine.
- table name should not begin with a number or special symbols.
- table name can start with _table_name (underscore) or $table_name (dollar sign)
- table name and column name can have max 64 char.
- multiple words as table_name is invalid, if you want to give multiple words as table_name then give it in \`table_name\` (backtick)
- error occurs if the table exists.
- error occurs if there is no default database.
- error occurs if the database does not exist.

Note:

- Table names are stored in lowercase on disk. MySQL converts all table names to lowercase on storage. This behavior also applies to database names and table aliases.
  e.g. show variables like 'lower_case_table_names';

create table

syntax

```
CREATE [TEMPORARY] TABLE [IF NOT EXISTS] tbl_name
    (create_defineation, . . .)
    [table_options]
    [partition_options]
```

create_definition:

```
    col_name column_definition
```

column_definition:

```
    data_type [NOT NULL | NULL] [DEFAULT default_value]
      [AUTO_INCREMENT] [UNIQUE [KEY] | [PRIMARY] KEY]
      [reference_definition]
  | data_type [GENERATED ALWAYS] AS (expression)  [VIRTUAL]
     [VISIBLE | INVISIBLE]
```

table_options:

```
AUTO_INCREMENT = <number>  // must be used with AUTO_INCREMENT definition
ENGINE [=] engine_name
```

e.g.

-
  ```
  CREATE TABLE student(
    ID INT,
    firstName VARCHAR(45),
    lastName VARCHAR(45),
    DoB DATE,
    emailID VARCHAR(128)
  );
  ```

```
show engines;
set default_storage_engine = memory;
```

- Literals, built-in functions (both deterministic and nondeterministic), and operators are permitted.
- Subqueries, parameters, variables, and stored functions are not permitted.
- An expression default value cannot depend on a column that has the AUTO_INCREMENT attribute.

default value

The DEFAULT specifies a default value for the column.

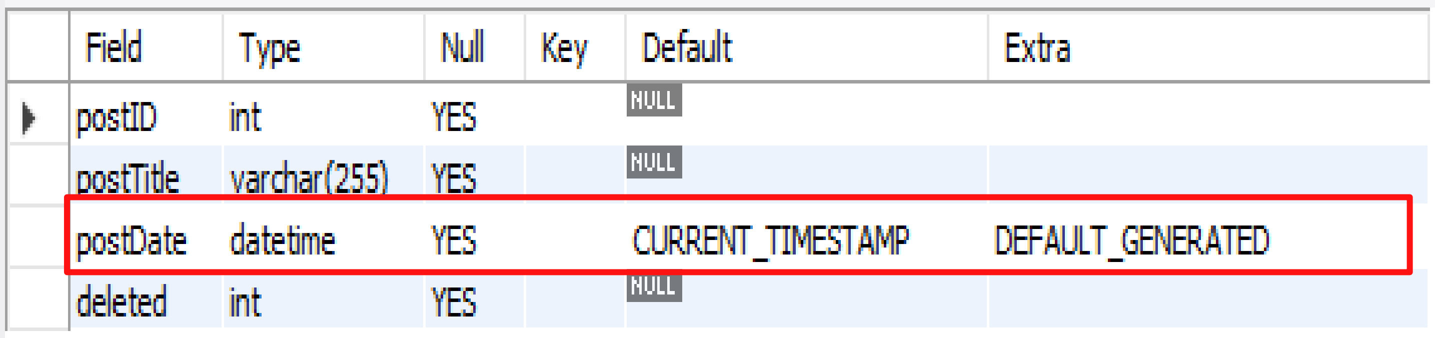
- `CREATE TABLE temp (c1 INT PRIMARY KEY AUTO_INCREMENT, c2 INT DEFAULT(c1 + c2));  // Error`
- `CREATE TABLE temp (c1 INT, c2 INT DEFAULT(c1 < c2)); // Error`
- `CREATE TABLE temp (c1 INT, c2 INT , c3 INT DEFAULT(c1 < c2)); // OK`

default value

col_name data_type DEFAULT value

The **DEFAULT** specifies a **default** value for the column.

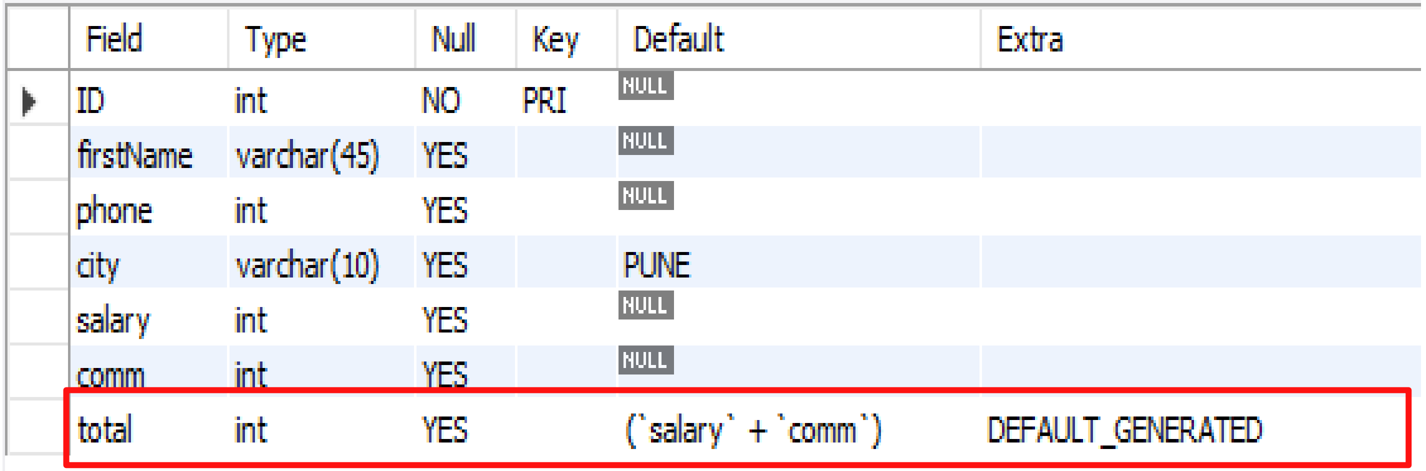
-
  ```
  CREATE TABLE posts(
    postID INT,
    postTitle VARCHAR(255),
    postDate DATETIME DEFAULT NOW(),
    deleted INT
  );
  ```



Field	Type	Null	Key	Default	Extra
postID	int	YES		NULL	
postTitle	varchar(255)	YES		NULL	
postDate	datetime	YES		CURRENT_TIMESTAMP	DEFAULT_GENERATED
deleted	int	YES		NULL	

# version 8.0 and above.

-
  ```
  CREATE TABLE empl(
    ID INT PRIMARY KEY,
    firstName VARCHAR(45),
    phone INT,
    city VARCHAR(10) DEFAULT 'PUNE',
    salary INT,
    comm INT,
    total INT DEFAULT(salary + comm)
  );
  ```

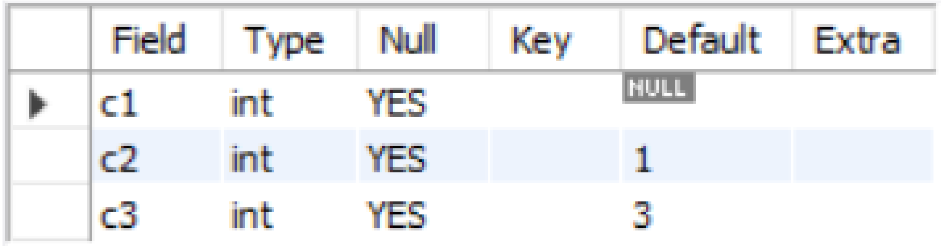


Field	Type	Null	Key	Default	Extra
ID	int	NO	PRI	NULL	
firstName	varchar(45)	YES		NULL	
phone	int	YES		NULL	
city	varchar(10)	YES		PUNE	
salary	int	YES		NULL	
comm	int	YES		NULL	
total	int	YES		(`salary` + `comm`)	DEFAULT_GENERATED

default value - insert

The **DEFAULT** example.

-
  ```
  CREATE TABLE r(
    c1 INT,
    c2 INT DEFAULT 1,
    c3 INT DEFAULT 3,
  );
  ```



	Field	Type	Null	Key	Default	Extra
▶	c1	int	YES		NULL	
	c2	int	YES		1	
	c3	int	YES		3	

- `INSERT INTO r VALUES();`
- `INSERT INTO r VALUES(-1, DEFAULT, DEFAULT);`
- `INSERT INTO r VALUES(-2, DEFAULT(c2), DEFAULT(c3));`
- `INSERT INTO r VALUES(-3, DEFAULT(c3), DEFAULT(c2));`

default value - update

The **DEFAULT** example.

-
  ```
  CREATE TABLE temp(
    c1 INT,
    c2 INT,
    c3 INT DEFAULT(c1 + c2),
    c4 INT DEFAULT(c1 * c2)
  );
  ```

-
  ```
  INSERT INTO temp (c1, c2, c3, c4) VALUES(1, 1, 1, 1);
  ```

-
  ```
  INSERT INTO temp (c1, c2, c3, c4) VALUES(2, 2, 2, 2);
  ```

-
  ```
  UPDATE temp SET c3 = DEFAULT;
  ```

-
  ```
  UPDATE temp SET c4 = DEFAULT;
  ```

insert rows

INSERT is used to add a single or multiple tuple to a relation. We must specify the relation name and a list of values for the tuple. **The values should be listed in the same order in which the corresponding attributes were specified in the CREATE TABLE command.**

You can insert data using following methods:

- INSERT ... VALUES
- INSERT ... SET
- INSERT ... SELECT

INSERT can violate for any of the four types of constraints.

Important:

- If an attribute value is not of the appropriate data type.
- Entity integrity can be violated if a key value in the new tuple *t* already exists in another tuple in the relation r(R).
- Entity integrity can be violated if any part of the primary key of the new tuple *t* is NULL.
- Referential integrity can be violated if the value of any foreign key in *t* refers to a tuple that does not exist in the referenced relation.

INSERT will also fail in following cases.

Important :

- Your database table has **X** columns, Where as the **VALUES** you are passing are for (**X-1**) or (**X+1**). This mismatch of column-values will giving you the error.
- Inserting a string into a string column that exceeds the column maximum length. Data too long for column error will be raise.
- Inserting data into a column than does not exists, then Unknown column error will raise.
- INSERT INTO *tbl_name* (col1,col2) VALUES(15,col1*2); // is legal.
- INSERT INTO *tbl_name* (col1,col2) VALUES(col2*2,15); // is not legal, because the value for col1 refers to col2, which is assigned after col1.

- **INSERT** is used to add a single or multiple tuple to a relation. We must specify the relation name and a list of values for the tuple. **The values should be listed in the same order in which the corresponding attributes were specified in the CREATE TABLE command.**
- A second form of the **INSERT** statement allows the user to specify explicit attribute names that correspond to the values provided in the **INSERT** command. This is useful if a relation has many attributes but only a few of those attributes are assigned values in the new tuple. However, the values must include all attributes with **NOT NULL** specification and no default value. Attributes with **NULL** allowed or **DEFAULT** values are the ones that can be left out.

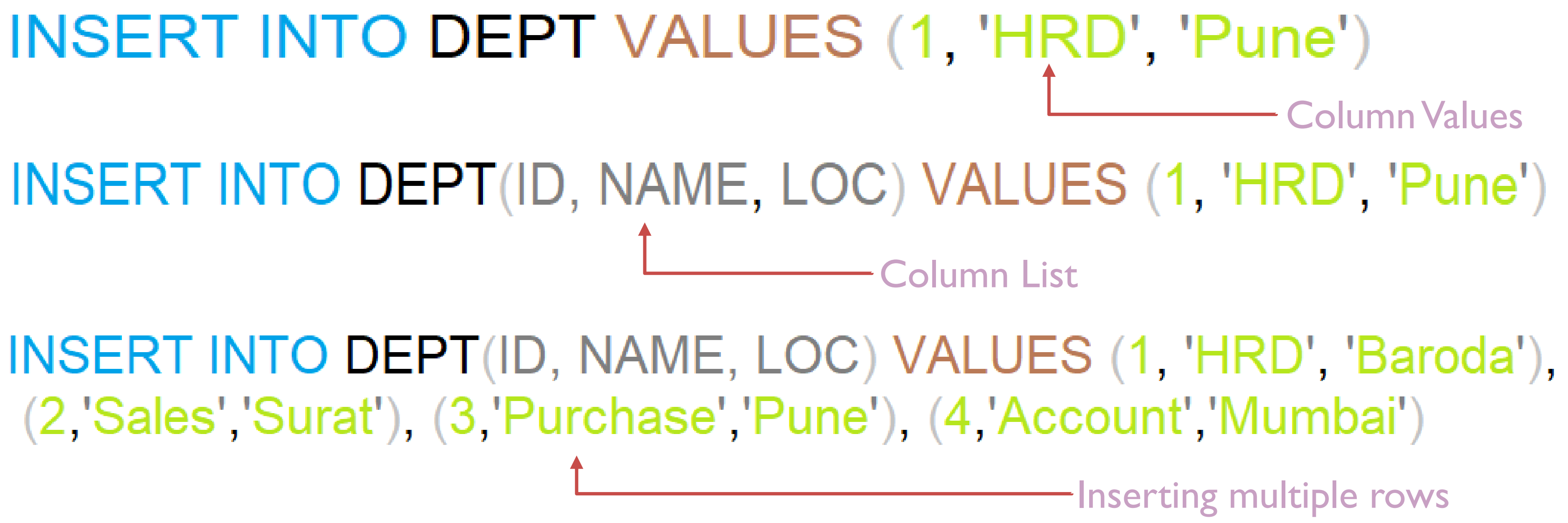
insert rows using values

dml- insert … values

INSERT inserts new row(s) into an existing table. The INSERT ... VALUES

INSERT [IGNORE] [INTO] tbl_name [PARTITION (*partition_name* [, *partition_name*] ...)] [(*field_name*, . . .)]
{ VALUES | VALUE } [ROW] ({ *expr* | *DEFAULT* }, . . .), [ROW] (. . .), [ROW] . . . [ON DUPLICATE KEY UPDATE
assignment_list]

The affected-rows value for an INSERT can be obtained using the ROW_COUNT() function.



```
INSERT INTO DEPT VALUES (1, 'HRD', 'Pune')
```

Column Values

```
INSERT INTO DEPT(ID, NAME, LOC) VALUES (1, 'HRD', 'Pune')
```

Column List

```
INSERT INTO DEPT(ID, NAME, LOC) VALUES (1, 'HRD', 'Baroda'),
 (2,'Sales','Surat'), (3,'Purchase','Pune'), (4,'Account','Mumbai')
```

Inserting multiple rows

dml- insert … values

INSERT inserts new row(s) into an existing table. The INSERT ... VALUES

INSERT [IGNORE] [INTO] tbl_name [PARTITION (*partition_name* [, *partition_name*] ...)] [(*field_name*, . . .)] { VALUES | VALUE } [ROW] ({ *expr* | *DEFAULT* }, . . .), [ROW] (. . .), [ROW] . . . [ON DUPLICATE KEY UPDATE assignment_list]

```
CREATE TABLE student (
  ID INT PRIMARY KEY,
  nameFirst VARCHAR(45),
  nameLast VARCHAR(45),
  DoB DATE ,
  emailID VARCHAR(128)
);
```

e.g.

- INSERT INTO student VALUES (29, 'sharmin', 'patil', '1999-11-10', 'sharmin.patil@gmail.com');
- INSERT INTO student (ID, nameFirst, nameLast, DOB, emailID) VALUES (30, 'john', 'thomas', '1983-11-10', 'john.thomas@gmail.com’);
- INSERT INTO student (ID, nameFirst, emailID) VALUES (31, 'jack', 'jack.thorn@gmail.com');
- INSERT INTO student (ID, nameFirst) VALUES (32, 'james'), (33, 'jr. james'), (34, 'sr. james');

insert multiple rows

dml- insert … values

INSERT inserts new rows into an existing table. The INSERT ... VALUES

```
INSERT [INTO] tbl_name { VALUES | VALUE } [ROW] ( { expr | DEFAULT }, . . .), [ROW]  (. . .), [ROW] (. . .)
```

```
CREATE TABLE student(
  ID INT PRIMARY KEY,
  nameFirst VARCHAR(45),
  nameLast VARCHAR(45),
  DoB DATE ,
  emailID VARCHAR(128)
);
```

e.g.

- `INSERT INTO student (ID, nameFirst) VALUES (32, 'james'), (33, 'jr. james'), (34, 'sr. james');`
- `INSERT INTO student (ID, nameFirst) VALUES ROW (32, 'james'), ROW(33, 'jr. james'), ROW(34, 'sr. james');`

Do not use the * operator in your SELECT statements. Instead, use column names. Reason is that in MySQL Server scans for all column names and replaces the * with all the column names of the table(s) in the SELECT statement. Providing column names avoids this search-and-replace, and enhances performance.

SELECT statement...

```
SELECT what_to_select
FROM which_table
WHERE conditions_to_satisfy;
```

SELECT CLAUSE

The **SELECT** statement retrieves or extracts data from tables in the database.

- You can use one or more tables separated by comma to extract data.
- You can fetch one or more fields/columns in a single SELECT command.
- You can specify star (*****) in place of fields. In this case, SELECT will return all the fields.
- SELECT can also be used to retrieve rows computed without reference to any table e.g. SELECT 1 + 2;

Capabilities of SELECT Statement

1. SELECTION
2. PROJECTION
3. JOINING

Capabilities of SELECT Statement

➢SELECTION

Selection capability in SQL is to choose the record’s/row’s/tuple’s in a table that you want to return by a query.

R

EMPNO	ENAME	JOB	HIREDATE	DEPTNO
1	Saleel	Manager	1995-01-01	10
2	Janhavi	Sales	1994-12-20	20
3	Snehal	Manager	1997-05-21	10
4	Rahul	Account	1997-07-30	10
5	Ketan	Sales	1994-01-01	30

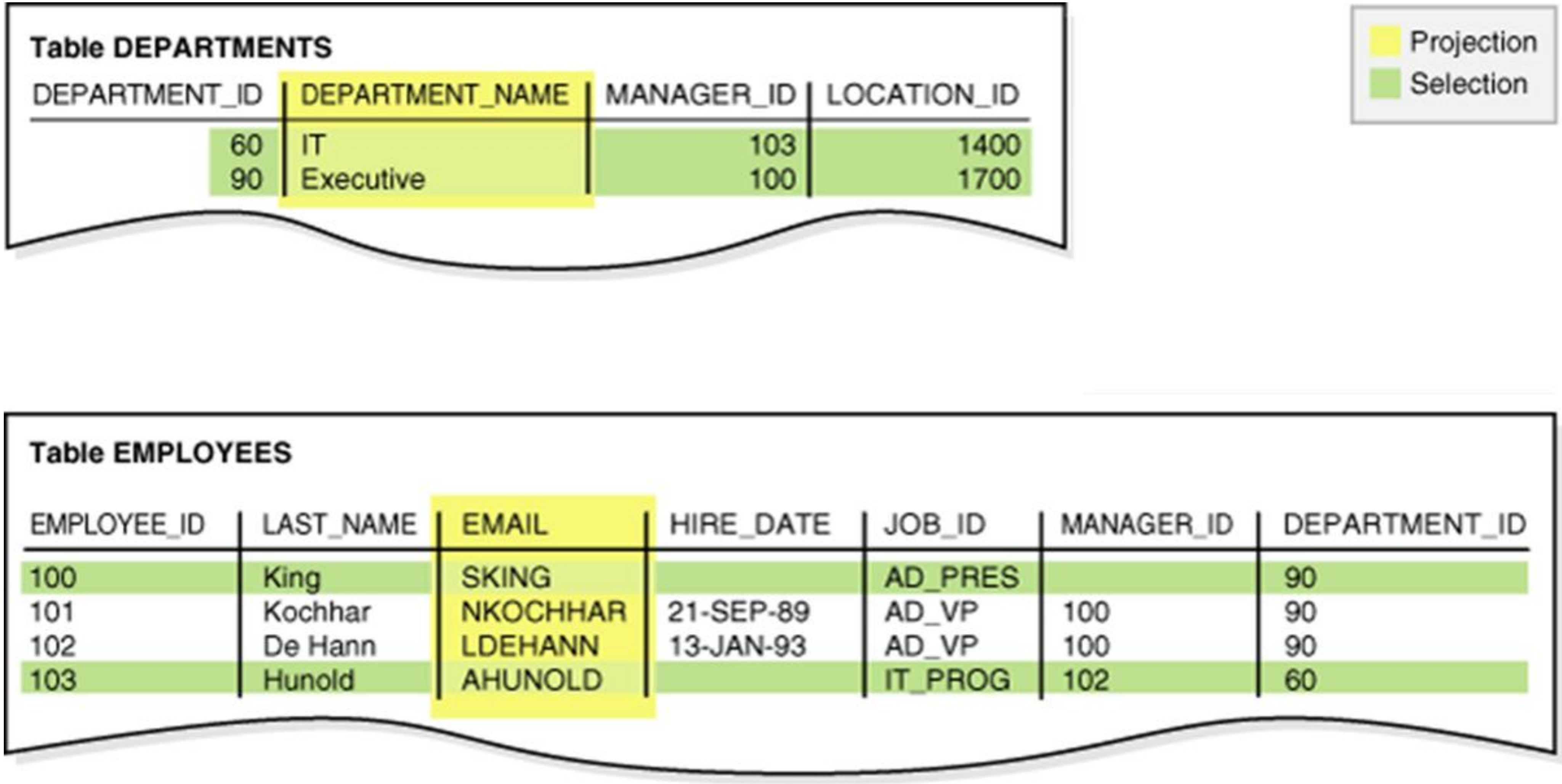
Capabilities of SELECT Statement

➢PROJECTION

Projection capability in SQL to choose the column’s/attribute’s/field’s in a table that you want to return by your query.

R

EMPNO	ENAME	JOB	HIREDATE	DEPTNO
1	Saleel	Manager	1995-01-01	10
2	Janhavi	Sales	1994-12-20	20
3	Snehal	Manager	1997-05-21	10
4	Rahul	Account	1997-07-30	10
5	Ketan	Sales	1994-01-01	30



🟨 Projection

🟩 Selection

Table DEPARTMENTS

DEPARTMENT_ID	DEPARTMENT_NAME	MANAGER_ID	LOCATION_ID
60	IT	103	1400
90	Executive	100	1700

Table EMPLOYEES

EMPLOYEE_ID	LAST_NAME	EMAIL	HIRE_DATE	JOB_ID	MANAGER_ID	DEPARTMENT_ID
100	King	SKING		AD_PRES		90
101	Kochhar	NKOCHHAR	21-SEP-89	AD_VP	100	90
102	De Hann	LDEHANN	13-JAN-93	AD_VP	100	90
103	Hunold	AHUNOLD		IT_PROG	102	60

Capabilities of SELECT Statement

➢JOINING

Join capability in SQL to bring together data that is stored in different tables by creating a link between them.

R

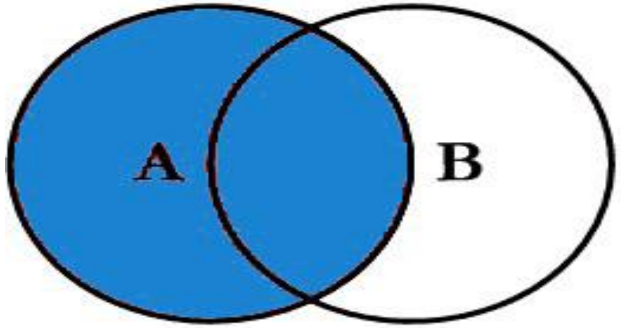
EMPNO	ENAME	JOB	HIREDATE	DEPTNO
1	Saleel	Manager	1995-01-01	20
2	Janhavi	Sales	1994-12-20	10
3	Snehal	Manager	1997-05-21	10
4	Rahul	Account	1997-07-30	20
5	Ketan	Sales	1994-01-01	30

🔗

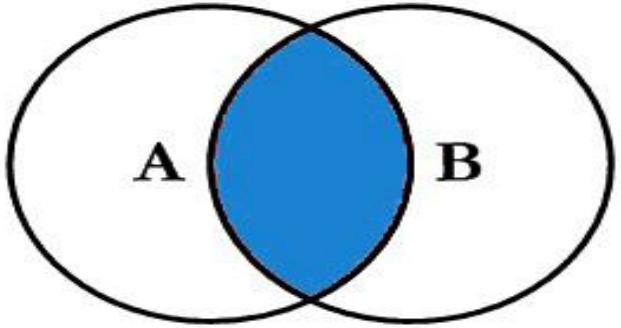
S

DEPTNO	DNAME	LOC
10	HRD	PUNE
20	SALES	BARODA
40	PURCHASE	SURAT

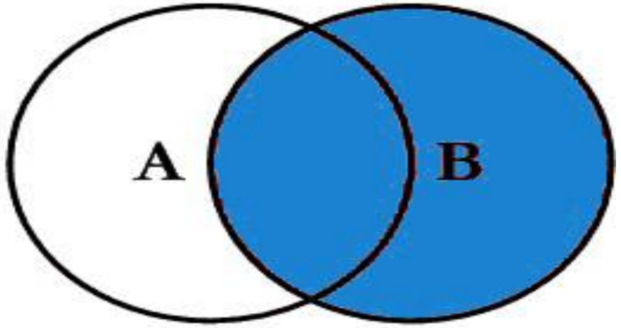
SQL JOINS



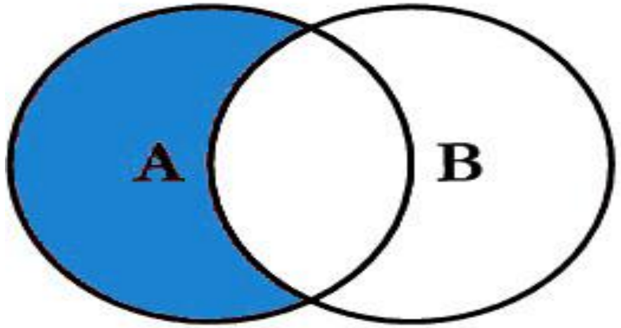
```
SELECT <select_list>
FROM TableA A
LEFT JOIN TableB B
ON A.Key = B.Key
```



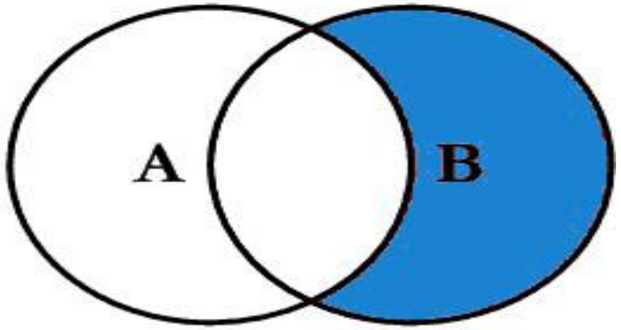
```
SELECT <select_list>
FROM TableA A
INNER JOIN TableB B
ON A.Key = B.Key
```



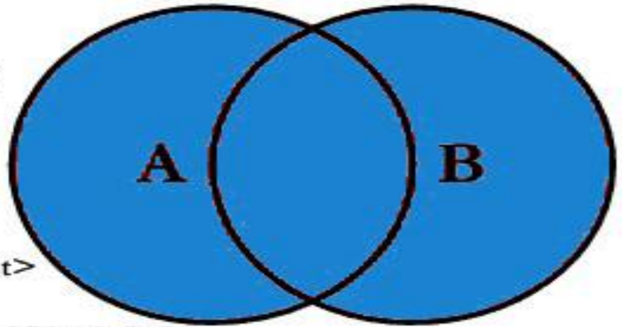
```
SELECT <select_list>
FROM TableA A
RIGHT JOIN TableB B
ON A.Key = B.Key
```



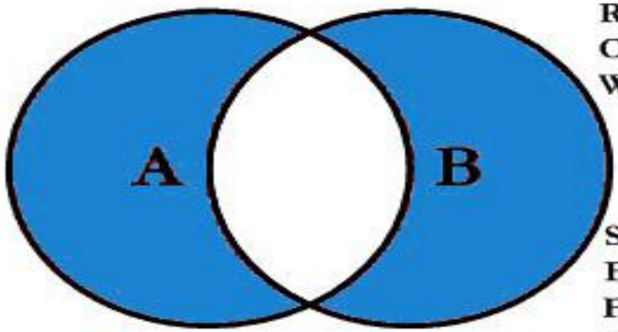
```
SELECT <select_list>
FROM TableA A
LEFT JOIN TableB B
ON A.Key = B.Key
WHERE B.Key IS NULL
```



```
SELECT <select_list>
FROM TableA A
RIGHT JOIN TableB B
ON A.Key = B.Key
WHERE A.Key IS NULL
```



```
SELECT <select_list>
FROM TableA A
FULL OUTER JOIN TableB B
ON A.Key = B.Key
```



```
SELECT <select_list>
FROM TableA A
FULL OUTER JOIN TableB B
ON A.Key = B.Key
WHERE A.Key IS NULL
OR B.Key IS NULL
```

select statement

SELECTION Process

SELECT * FROM <table_references>

selection-list | field-list | column-list

Remember:

- Here, " * " is known as metacharacter (all columns)

PROJECTION Process

SELECT column-list FROM <table_references>

selection-list | field-list | column-list

Remember:

- Position of columns in SELECT statement will determine the position of columns in the output (as per user requirements)

ORDER BY in UPDATE: if the table contains two values 1 and 2 in the id column and 1 is updated to 2 before 2 is updated to 3, an error occurs. To avoid this problem, add an ORDER BY clause to cause the rows with larger id values to be updated before those with smaller values.

In a **SET** statement, = is treated identically to :=

Note:

Here c1 column is a Primary Key

SELECT ename, job, sal, sal * 1.1, sal * 1.25 FROM emp;

- UPDATE temp SET c1 = c1 - 1 ORDER BY c1 ASC; # In case of decrement
- UPDATE temp SET c1 = c1 + 1 ORDER BY c1 DESC; # In case of increment

single-table update

UPDATE is used to change/modify the values of some attributes of one or more selected tuples.

- SET @x := 0;
- UPDATE emp SET id = @x := @x + 1;

- UPDATE t, (SELECT isactive, COUNT(isactive) r1 FROM emp GROUP BY isactive) a SET t.c2 = a.r1 WHERE t.c1 = a.isactive;

```
mysql> SELECT * FROM t;
+-------+--------+      +-------+------+
| c1    | c2     |      | c1    | c2   |
+-------+--------+      +-------+------+
|   0   | NULL |        |   0   |   6  |
|   1   | NULL |        |   1   |  14  |
+-------+--------+      +-------+------+
```

e.g.

1. Update top 2 rows.
2. Update UnitPrice for the top 5 most expensive products.

single-table update

The UPDATE statement updates columns of existing rows in the named table with new values. The SET clause indicates which columns to modify and the values they should be given. The **WHERE** clause, if given, specifies the conditions that identify which rows to update. With **no WHERE** clause, all rows are updated. If the **ORDER BY** clause is specified, the rows are updated in the order that is specified. The **LIMIT** clause places a limit on the number of rows that can be updated.

UPDATE tbl_name SET col_name1 = { *expr1* | *DEFAULT* } [, *col_name2* = { *expr2* | *DEFAULT* }] . . .
   [WHERE *where_condition*]

- UPDATE temp SET dname = 'new_value' LIMIT 2;
- UPDATE temp SET c1 = 'new_value' ORDER BY loc LIMIT 2;
- UPDATE temp SET c1 := 'new_value' WHERE deptno < 50;
- UPDATE temp SET c1 := 'new_value' WHERE deptno < 50 LIMIT 2;
- ALTER TABLE dept ADD SUMSALARY INT;
- UPDATE dept SET sumsalary = (SELECT SUM(sal) FROM emp WHERE emp.deptno = dept.deptno GROUP BY emp.deptno);
- UPDATE candidate SET totalvotes = (SELECT COUNT(*) FROM votes WHERE candidate.id = votes.candidateID GROUP BY votes.candidateID);

- UPDATE duplicate SET id = (SELECT @cnt := @cnt + 1);

single-table delete

DELETE is used to delete tuples from a relation.

delete can violate only in referential integrity.

Important:

- The **DELETE** operation can violate only referential integrity. This occurs if the tuple *t* being deleted is referenced by foreign keys from other tuple *t* in the database.

single-table delete

The DELETE statement deletes rows from tbl_name and returns the number of deleted rows. To check the number of deleted rows, call the *ROW_COUNT()* function. The optional WHERE clause identify which rows to delete. With no WHERE clause, all rows are deleted. If the ORDER BY clause is specified, the rows are deleted in the order that is specified. The LIMIT clause places a limit on the number of rows that can be deleted.

```
DELETE FROM tbl_name
   [WHERE where_condition]
```

Note:

- LIMIT clauses apply to single-table deletes, but not multi-table deletes.
- `DELETE FROM temp;`
- `DELETE FROM temp ORDER BY loc LIMIT 2;`
- `DELETE FROM temp WHERE deptno < 50;`
- `DELETE FROM temp WHERE deptno < 50 LIMIT 2;`

auto_increment column

The **AUTO_INCREMENT** attribute can be used to generate a unique number/identity for new rows.

auto_increment

IDENTITY is a synonym to the *LAST_INSERT_ID* variable.

col_name data_type AUTO_INCREMENT [UNIQUE [KEY] | [PRIMARY] KEY]

Remember:

- There can be only one AUTO_INCREMENT column per table.
- it must be indexed.
- it cannot have a DEFAULT value.
- it works properly only if it contains only positive values.
- It applies only to integer and floating-point types.
- when you insert a value of NULL or 0 into AUTO_INCREMENT column, it generates next value.
- *use LAST_INSERT_ID*() function to find the row that contains the most recent AUTO_INCREMENT value.

- SELECT @@IDENTITY
- SELECT LAST_INSERT_ID()
- SET INSERT_ID = 7

-
  ```
  CREATE TABLE posts (
    c1 INT UNIQUE KEY AUTO_INCREMENT,
    c2 VARCHAR(20)
  ) AUTO_INCREMENT = 2;     // auto_number will start with value 2.
  ```

generated column

A SQL generated column is a type of column that stores values calculated from an expression applied to data in other columns of the same table. The value of a generated column cannot be altered manually and is automatically updated whenever the data it depends on changes.

Remember:

- Stored functions and user-defined functions are not permitted.
- Stored procedure and function parameters are not permitted.
- Variables (system variables, user-defined variables, and stored program local variables) are not permitted.
- Subqueries are not permitted.
- The AUTO_INCREMENT attribute cannot be used in a generated column definition.
- Triggers cannot use NEW.COL_NAME or use OLD.COL_NAME to refer to generated columns.
- Stored column cannot be converted to virtual column and virtual column cannot be converted to stored column.
- Generated column can be made as invisible column.

Note:

- The expression can contain literals, built-in functions with no parameters, operators, or references to any column within the same table. If you use a function, it must be scalar and deterministic.

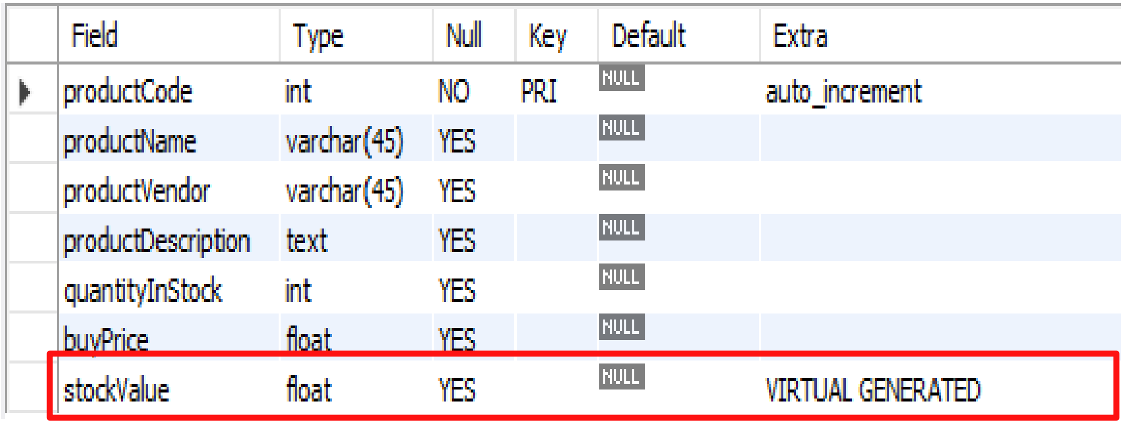
virtual column - generated always

col_name data_type [GENERATED ALWAYS] AS (*expression*) [VIRTUAL | STORED]

- **VIRTUAL**: Column values are not stored, but are evaluated when rows are read, immediately after any BEFORE triggers. A virtual column takes no storage.
- **STORED**: Column values are evaluated and stored when rows are inserted or updated. A stored column does require storage space and can be indexed.

Note:

- The default is **VIRTUAL** if neither keyword is specified.



Field	Type	Null	Key	Default	Extra
productCode	int	NO	PRI	NULL	auto_increment
productName	varchar(45)	YES		NULL	
productVendor	varchar(45)	YES		NULL	
productDescription	text	YES		NULL	
quantityInStock	int	YES		NULL	
buyPrice	float	YES		NULL	
stockValue	float	YES		NULL	VIRTUAL GENERATED

```
CREATE TABLE product(
  productCode INT AUTO_INCREMENT PRIMARY KEY,
  productName VARCHAR(45),
  productVendor VARCHAR(45),
  productDescription TEXT,
  quantityInStock INT,
  buyPrice FLOAT,
  stockValue FLOAT GENERATED ALWAYS AS(quantityInStock * buyPrice) VIRTUAL
);
```

visible / invisible columns

Columns are visible by default. To explicitly specify visibility for a new column, use a VISIBLE or INVISIBLE keyword as part of the column definition for CREATE TABLE or ALTER TABLE.

Note:

- An invisible column is normally hidden to queries, but can be accessed if explicitly referenced. Prior to MySQL 8.0.23, all columns are visible.
- A table must have at least one visible column. Attempting to make all columns invisible produces an error.
- SELECT * does not include invisible columns.

invisible column

col_name data_type INVISIBLE

```
CREATE TABLE employee(
    ID INT AUTO_INCREMENT PRIMARY KEY,
    firstName VARCHAR(40),
    salary INT,
    commission INT,
    total INT DEFAULT(salary + commission) INVISIBLE
    tax INT GENERATED ALWAYS AS (total * .25) VIRTUAL INVISIBLE
) ;
```

```
CREATE TABLE employee(
    ID INT PRIMARY KEY AUTO_INCREMENT INVISIBLE ,
    firstName VARCHAR(40)
) ;
```

- INSERT INTO employee(firstName, salary, commission) VALUES('ram', 4700, -700);
- INSERT INTO employee(firstName, salary, commission) VALUES('pankaj', 3400, NULL);
- INSERT INTO employee(firstName, salary, commission) VALUES('rajan', 3200, 250);
- INSERT INTO employee(firstName, salary, commission) VALUES('ninad', 2600, 0);
- INSERT INTO employee(firstName, salary, commission) VALUES('omkar', 4500, 300);
- SELECT * FROM employee;

- ALTER TABLE employee MODIFY total INT VISIBLE;
- ALTER TABLE employee MODIFY total INT INVISIBLE;

varbinary column

TODO

Note:

- TODO
- TODO
- TODO

varbinary column

col_name VARBINARY

```
CREATE TABLE login (
    ID INT AUTO_INCREMENT PRIMARY KEY,
    userName VARCHAR(40),
    password VARBINARY(40) INVISIBLE
) ;
```

- INSERT INTO login(userName, password) VALUES('ram', 'ram@123');
- INSERT INTO login(userName, password) VALUES('pankaj', 'pankaj');
- INSERT INTO login(userName, password) VALUES('rajan', 'rajan');
- INSERT INTO login(userName, password) VALUES('ninad', 'ninad');
- INSERT INTO login(userName, password) VALUES('omkar', 'omkar');

- SELECT * FROM login;
- SELECT username, CAST(password as CHAR) FROM login;

MySQL Constraints define specific rules to the column(s) data in a database table. While inserting, updating, or deleting the data rows, if the rules of the constraint are not followed, the system will display an error message and the action will be terminated. The SQL Constraints are defined while creating a new table. We can also alter the table and add new SQL Constraints. The MySQL Constraints are mainly used to maintain data integrity.

constraints

CONSTRAINT is used to define rules to allow or restrict what values can be stored in columns. The purpose of inducing constraints is to enforce the integrity of a database.

CONSTRAINTS can be classified into two types –

- *Column Level*
- *Table Level*

The column level constraints can apply only to one column where as table level constraints are applied to the entire table.

Remember:

- PRI => primary key
- UNI => unique key
- MUL=> is basically an index that is neither a **primary key** nor a **unique key**. The name comes from "multiple" because multiple occurrences of the same value are allowed.

constraints

To limit or to restrict or to check or to control.

Note:

- a table with a foreign key that references another table's primary key is **MUL**.
- If more than one of the Key values applies to a given column of a table, Key displays the one with the highest priority, in the order **PRI**, **UNI**, and **MUL**.
- If a table has a PRIMARY KEY or UNIQUE NOT NULL index that consists of a single column that has an integer type, you can use **_rowid** to refer to the indexed column in SELECT statements.

Keys are used to establish relationships between tables and also to uniquely identify any record in the table.

types of Keys?

r = Employee(EmployeeID, FullName, job, salary, PAN, DateOfBirth, emailID, deptno)

- **Candidate Key:** are individual columns in a table that qualifies for uniqueness of all the rows. Here in Employee table EmployeeID, PAN or emailID are Candidate keys.

- **Primary Key**: is the columns you choose to maintain uniqueness in a table. Here in Employee table you can choose either EmployeeID, PAN or emailID columns, EmployeeID is preferable choice.

- **Alternate Key**: Candidate column other the primary key column, like if EmployeeID is primary key then , PAN or emailID columns would be the Alternate key.

- **Super Key**: If you add any other column to a primary key then it become a super key, like EmployeeID + FullName is a Super Key.

- **Composite Key**: If a table do not have any single column that qualifies for a Candidate key, then you have to select 2 or more columns to make a row unique. Like if there is no EmployeeID, PAN or emailID columns, then you can make FullName + DateOfBirth as Composite key. But still there can be a narrow chance of duplicate row.

Remember:

- A primary key cannot be NULL (absence of a value).
- A primary key value must be unique.
- A table has only one primary key.
- The primary key values cannot be changed, if it is referred by some other column.
- The primary key must be given a value when a new record is inserted.
- **An index can consist of 16 columns, at maximum. Since a PRIMARY KEY constraint automatically adds an index, it can't have more than 16 columns.**

Database	**Max Columns in Primary Key**
MySQL	16
PostgreSQL	32
Oracle	32
SQL Server	16
DB2	16
MariaDB	16

PRIMARY KEY constraint

A primary key is a special column (or set of combined columns) in a relational database table, that is used to uniquely identify each record. Each database table needs a primary key.

Note:

- Primary key in a relation is always associated with an **INDEX** object.
- If, we give on a column a combination of **NOT NULL & UNIQUE** key then it behaves like a PRIMARY key.
- If, we give on a column a combination of **UNIQUE key & AUTO_INCREMENT** then also it behaves like a PRIMARY key.
- Stability: The value of the primary key should be stable over time and not change frequently.

clustered and non-clustered index

Indexing in MySQL is a process that helps us to return the requested data from the table very fast. If the table does not have an index, it scans the whole table for the requested data.

MySQL allows two different types of Indexing:

- Clustered Index
- Non-Clustered Index

Clustered Index:-

- Clustered index is used to optimize the speed of most common lookups and DML operations like INSERT, UPDATE, and DELETE command.
- Clustered indexes sort and store the data rows in the table based on their key (primary key) values that can be sorted in only one direction.
- If the table column contains a **primary key** or **not null** and **unique key**, MySQL creates a clustered index.
- Data retrieval is faster than non-cluster index.
- Slower inserts/updates if the indexed column values change frequently, as it may require rearranging rows to maintain the order.

clustered and non-clustered index

Indexing in MySQL is a process that helps us to return the requested data from the table very fast. If the table does not have an index, it scans the whole table for the requested data.

MySQL allows two different types of Indexing:

- Clustered Index
- Non-Clustered Index

Non-Clustered Index:-

- The indexes other than PRIMARY indexes (clustered indexes) called a non-clustered index.
- The non-clustered indexes are also known as secondary indexes.
- A secondary index may be created on one or more virtual columns or on a combination of virtual columns and regular columns.
- The non-clustered index and base table data are both stored in different places, so it does not affect the physical row order in the base table.
- It is not sorted (ordering) the table data.
- Extra space is required to store logical structure
- Data update is faster than clustered index

```
ALTER TABLE table_name
  ADD [ CONSTRAINT constraint_name ]
    PRIMARY KEY (column1, column2, . . . column_n)
```

```
ALTER TABLE table_name
  DROP PRIMARY KEY
```

add /drop Primary Key using Alter

Remember:

- A unique key can be NULL (absence of a value).
- A unique key value must be unique.
- A table can have multiple unique key.
- A column can have unique key as well as a primary key.

UNIQUE KEY constraint

A **UNIQUE key** constraint is a set of one or more than one fields/columns of a table that uniquely identify a record in a database table.

Note:

- Unique key in a relation is always associated with an ***INDEX*** object.

constraints – add unique key

col_name data_type UNIQUE KEY

The following example creates table with **UNIQUE KEY** column.

-
  ```
  CREATE TABLE clients (
     client_id INT,
     first_name VARCHAR(50),
     last_name VARCHAR(50),
     company_name VARCHAR(255),
     email VARCHAR(255) UNIQUE
  );
  ```

-
  ```
  CREATE TABLE brands (
    ID INT,
    brandName VARCHAR(30),
    constraint uni_brandName UNIQUE(brandName)
   );
  ```

-
  ```
  SHOW  INDEX FROM clients;
  ```

-
  ```
  CREATE TABLE contacts (
     ID INT,
     first_name VARCHAR(50),
     last_name VARCHAR(50),
     phone VARCHAR(15),
     UNIQUE(phone)
  );
  ```

- ALTER TABLE users DROP INDEX <COLUMN_NAME>;
- ALTER TABLE users DROP INDEX U_USER_ID;   #CONSTRAINT NAME

```
ALTER TABLE table_name
 ADD [ CONSTRAINT constraint_name ]
  UNIQUE (column1, column2, . . . column_n)
```

```
ALTER TABLE table_name
 DROP INDEX constraint_name;
```

add / drop Unique Key using Alter

```
[CONSTRAINT [symbol]] FOREIGN KEY (col_name, . . .) REFERENCES tbl_name (col_name, . . .)
[ON DELETE CASCADE | SET NULL]
[ON UPDATE CASCADE | SET NULL]
```

FOREIGN KEY constraint

A **FOREIGN KEY** is a **key** used to link two tables together. A **FOREIGN KEY** is a field (or collection of fields) in one table that refers to the PRIMARY **KEY** in another table. The table containing the **foreign key** is called the child table, and the table containing the candidate **key** is called the referenced or parent table.

constraints – foreign key

Remember:

- A foreign key can have a different column name from its primary key.
- DataType of primary key and foreign key column must be same.
- It ensures rows in one table have corresponding rows in another.
- Unlike the Primary key, they do not have to be unique.
- Foreign keys can be null even though primary keys can not.

Note:

- The table containing the FOREIGN KEY is referred to as the child table, and the table containing the PRIMARY KEY (referenced key) is the parent table.
- PARENT and CHILD tables must use the same storage engine,
- and they cannot be defined as temporary tables.

insert, update, & delete – (primary key/foreign key)

A referential constraint could be violated in following cases.

- An **INSERT** attempt to add a row to a child table that has a value in its foreign key columns that does not match a value in the corresponding parent table's column.
- An **UPDATE** attempt to change the value in a child table's foreign key columns to a value that has no matching value in the corresponding parent table's parent key.
- An **UPDATE** attempt to change the value in a parent table's parent key to a value that does not have a matching value in a child table's foreign key columns.
- A **DELETE** attempt to remove a record from a parent table that has a matching value in a child table's foreign key columns.

Note:

- PARENT and CHILD tables must use the same storage engine,
- and they cannot be defined as temporary tables.
- If we don't give constraint name. System will automatically generated the constraint name and will assign to foreign key constraint. **e.g. login_ibfk_1, login_ibfk_2, …..**

Remember:

anomaly – (primary key/foreign key)

Student (parent) Table

RollNo	Name	Mobile	City	State	isActive
1	Ramesh	●●●●	Pune	MH	1
2	Amit	●●●●	Baroda	GJ	1
3	Rajan	●●●●	Surat	GJ	1
4	Bhavin	●●●●	Baroda	GJ	1
5	Pankaj	●●●●	Surat	GJ	1

student_course (child) Table

RollNo	CourceDuration	CourceName
1	1.5 month	RDBMS
2	1.2 month	NoSQL
3	2 month	Networking
1	2 month	Java
2	2 month	.NET

Insertion anomaly:

- If we try to insert a record in Student_Course (child) table with RollNo = 7, it will not allow.

Updation and Deletion anomaly:

- If you try to chance the RollNo from Student (parent) table with RollNo = 6 whose RollNo = 1 , it will not allow.
- If you try to chance the RollNo from Student_Course (child) table with RollNo = 9 whose RollNo = 3 , it will not allow.
- If we try to delete a record from Student (parent) table with RollNo = 1, it will not allow.

alter, drop – (primary key/foreign key)

Remember:

Parent Table

```
student  = {
   rollno INT,  * (PK)
   name VARCHAR(10),
   mobile VARCHAR(10),
   city VARCHAR(10),
   state VARCHAR(10),
   isActive BOOL
}
```

Child Table

```
student_course = {
   rollno INT,   * (FK)
   courceduration VARCHAR(10),
   courcename VARCHAR(10)
}
```

DDL command could be violated in following cases.

Alter command:

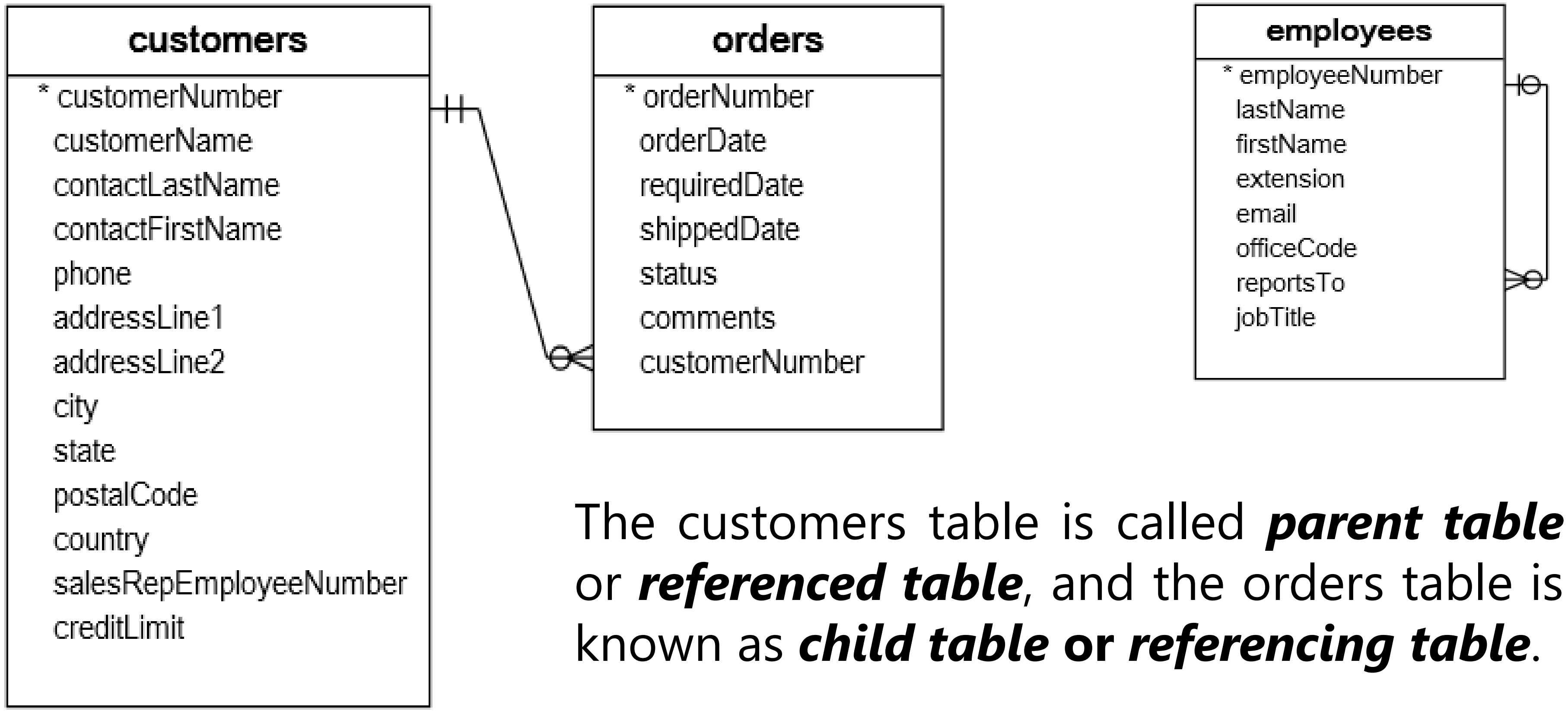
- If we try to modify datatype of RollNo in Student or Student_Course table with VARCHAR, it will not allow.
- If we try to apply auto_increment to RollNo in Student table, it will not allow
- If we try to drop RollNo column from Student table , it will not allow.

Drop command:

- If we try to drop Student (parent) table, it will not allow.

constraints – foreign key

A foreign key is a field in a table that matches another field of another table. A foreign key places constraints on data in the related tables, which enables MySQL to maintain referential integrity.



customers

* customerNumber
customerName
contactLastName
contactFirstName
phone
addressLine1
addressLine2
city
state
postalCode
country
salesRepEmployeeNumber
creditLimit

orders

* orderNumber
orderDate
requiredDate
shippedDate
status
comments
customerNumber

employees

* employeeNumber
lastName
firstName
extension
email
officeCode
reportsTo
jobTitle

The customers table is called ***parent table*** or ***referenced table***, and the orders table is known as ***child table or referencing table***.

```
ALTER TABLE table_name
 ADD [ CONSTRAINT constraint_name ]
  FOREIGN KEY (child_col1, child_col2, . . . child_col_n)
  REFERENCES parent_table (parent_col1, parent_col2, . . . parent_col_n);
```

Add Foreign Key Constraint using Alter

constraints – add foreign key using alter

You can use the **ALTER TABLE** statement to **ADD FOREIGN KEY** on existing column.

```
ALTER TABLE table_name
 ADD [ CONSTRAINT constraint_name ]
  FOREIGN KEY (child_col1, child_col2, . . . child_col_n)
  REFERENCES parent_table (parent_col1, parent_col2, . . . parent_col_n);
```

```
CREATE TABLE users (
  ID INT PRIMARY KEY,
  userName VARCHAR(40),
  password VARCHAR(255),
  email VARCHAR(255) UNIQUE KEY
) ;
```

```
CREATE TABLE login (
  ID INT PRIMARY KEY,
  userID INT,
  loginDate DATE,
  loginTime TIME
) ;
```

- ALTER TABLE login ADD FOREIGN KEY(userID) REFERENCES users(ID);
- ALTER TABLE login ADD constraint fk_userID FOREIGN KEY(userID) REFERENCES users(ID);

```
ALTER TABLE table_name
  DROP  FOREIGN KEY constraint_name
```

Drop Foreign Key Constraint using Alter

constraints – drop foreign key

You can use the **ALTER TABLE** statement to **DROP FOREIGN KEY**.

```
CREATE TABLE users (
   ID INT PRIMARY KEY ,
   userName VARCHAR(40),
   password VARCHAR(255),
   email VARCHAR(255)
) ;
```

```
CREATE TABLE login (
   ID INT PRIMARY KEY,
   userID INT,
   loginDate DATE,
   loginTime TIME,
   FOREIGN KEY(userID) REFERENCES users(ID)
) ;
```

```
CREATE TABLE login (
  ID INT PRIMARY KEY,
  userID INT,
  loginDate DATE,
  loginTime TIME,
  constraint fk_userID FOREIGN KEY(userID)  REFERENCES users(ID)
) ;
```

- ALTER TABLE login DROP FOREIGN KEY fk_userID;
- ALTER TABLE login DROP FOREIGN KEY login_ibfk_1; **// login_ibfk_1 is the default constraint name.**
- SELECT table_name, constraint_name, constraint_type FROM information_schema.table_constraints WHERE table_schema = 'DB2’;

1. CREATE TABLE test (c1 INT, c2 INT, c3 INT, check (c3 = SUM(c1)));

// ERROR

SUM(SAL) MIN(SAL) COUNT(*)

AVG(SAL) MAX(SAL) COUNT(JOB)

Check Constraint

constraints – check

CHECK condition expressions must follow some rules.

- Literals, deterministic built-in functions, and operators are permitted.
- Non-generated and generated columns are permitted, except columns with the AUTO_INCREMENT attribute.
- Sub-queries are not permitted.
- Environmental variables (such as CURRENT_USER, CURRENT_DATE, …) are not permitted.
- Non-Deterministic built-in functions (such as AVG, COUNT, RAND, LAST_INSERT_ID, FIRST_VALUE, LAST_VALUE, ...) are not permitted.
- Variables (system variables, user-defined variables, and stored program local variables) are not permitted.
- Stored functions and user-defined functions are not permitted.

Note:

Prior to MySQL 8.0.16, CREATE TABLE permits only the following limited version of table CHECK constraint syntax, which is parsed and ignored.

Remember:

If you omit the constraint name, MySQL automatically generates a name with the following convention:

- table_name_chk_n

constraints – check

col_name data_type CHECK(*expr*)

The following example creates **USERS** table with **CHECK** column.

```
CREATE TABLE users (
  ID INT PRIMARY KEY,
  userName VARCHAR(40),
  password VARCHAR(255),
  email VARCHAR(255),
  ratings INT CHECK(ratings > 50)
);
```

```
CREATE TABLE users (
  ID INT PRIMARY KEY,
  userName VARCHAR(40),
  password VARCHAR(255),
  email VARCHAR(255),
  ratings INT,
  constraint chk_ratings CHECK(ratings > 50)
);
```

```
CREATE TABLE users (
  ID INT PRIMARY KEY,
  userName VARCHAR(40),
  password VARCHAR(255),
  email VARCHAR(255),
  ratings INT,
  CHECK(ratings > 50)
);
```

```
CREATE TABLE users (
  ID INT PRIMARY KEY,
  userName VARCHAR(40),
  password VARCHAR(255),
  email VARCHAR(255),
  ratings INT,
  constraint chk_ratings  CHECK(ratings > 50),
  constraint chk_email CHECK(LENGTH(email) > 12)
);
```

```
ALTER TABLE table_name
 ADD   [ CONSTRAINT constraint_name ]
   CHECK (conidiation)
```

```
ALTER TABLE table_name
 DROP { CHECK | CONSTRAINT } constraint_name
```

Add / Drop Check Constraint using Alter

constraints – add check using alter

You can use the **ALTER TABLE** statement to **ADD CHECK KEY** on existing column.

```
ALTER TABLE table_name
 ADD  CONSTRAINT [ constraint_name ]
  CHECK (conidiation)
```

```
CREATE TABLE users (
  ID INT PRIMARY KEY,
  userName VARCHAR(40),
  password VARCHAR(255),
  email VARCHAR(255),
  ratings INT
) ;
```

- `ALTER TABLE users ADD CHECK(ratings > 50);`
- `ALTER TABLE users ADD constraint chk_ratings CHECK(ratings > 50);`

```
ALTER TABLE table_name
  DROP { CHECK | CONSTRAINT } constraint_name
```

drop check constraint

constraints – drop check key

You can use the **ALTER TABLE** statement to **DROP CHECK KEY**.

```
ALTER TABLE table_name
 DROP { CHECK | CONSTRAINT } constraint_name
```

```
CREATE TABLE users (
  ID INT PRIMARY KEY,
  userName VARCHAR(40),
  password VARCHAR(255),
  email VARCHAR(255),
  ratings INT,
  constraint chk_ratings CHECK(ratings > 50)
) ;
```

- ALTER TABLE users DROP CHECK chk_ratings;
- ALTER TABLE users DROP constraint chk_ratings;
- ALTER TABLE users DROP CHECK users_chk_1;

```
CREATE TABLE users (
  ID INT PRIMARY KEY,
  userName VARCHAR(40),
  password VARCHAR(255),
  email VARCHAR(255),
  ratings INT,
  CHECK(ratings > 50)
) ;
```

- SELECT table_name, constraint_name, constraint_type FROM information_schema.table_constraints WHERE table_schema = 'DB2' AND (table_name LIKE 'U%' OR table_name LIKE 'L%');

alter table

ALTER TABLE changes the structure of a table.

Note:

- you can add or delete columns,
- create or destroy indexes,
- change the type of existing columns, or
- rename columns or the table itself.
- You cannot change the position of columns in table structure. If not, then what? create a new table with SELECT statement.

alter table

syntax

ALTER TABLE tbl_name

[*alter_specification* [, *alter_specification*] . . .

- | ADD [COLUMN] *col_name column_definition* [FIRST | AFTER *col_name*]
- | ADD [COLUMN] (*col_name column_definition*, . . .)
- | ADD {INDEX|KEY} [index_name] (*index_col_name*, . . .)
- | ADD [CONSTRAINT [*symbol*]] PRIMARY KEY
- | ADD [CONSTRAINT [*symbol*]] UNIQUE KEY
- | ADD [CONSTRAINT [*symbol*]] FOREIGN KEY *reference_definition*
- | CHANGE [COLUMN] *old_col_name new_col_name* column_definition [FIRST|AFTER *col_name*]
- | MODIFY [COLUMN] *col_name column_definition* [FIRST | AFTER *col_name*]
- | DROP [COLUMN] *col_name*
- | DROP PRIMARY KEY
- | DROP {INDEX|KEY} *index_name*
- | DROP FOREIGN KEY *fk_symbol*
- | RENAME [TO|AS] *new_tbl_name*
- | RENAME COLUMN *old_col_name* TO *new_col_name*
- | ALTER [COLUMN] *col_name* { SET DEFAULT {*literal* | (*expr*)} | SET {VISIBLE | INVISIBLE} | DROP DEFAULT }

alter table

Remember:

- **Change Columns** :- You can rename a column using a CHANGE old_col_name new_col_name column_definition clause. To do so, specify the old and new column names and the definition that the column currently has.
- **Modify Columns :-** You can also use MODIFY to change a column's type without renaming it.
- **Dropping Columns :-** If a table contains only one column, the column cannot be dropped. If columns are dropped from a table, the columns are also removed from any index of which they are a part. If all columns that make up an index are dropped, the index is dropped as well.

Note:

- To convert a table from one storage engine to another, use an ALTER TABLE statement that indicates the new engine:

```
ALTER TABLE tbl_name ENGINE = InnoDB;

ALTER TABLE tbl_name ADD col1 INT, ADD col2 INT;

ALTER TABLE tbl_name DROP COLUMN col1, DROP COLUMN col2 , ADD col3 INT;
```

add column

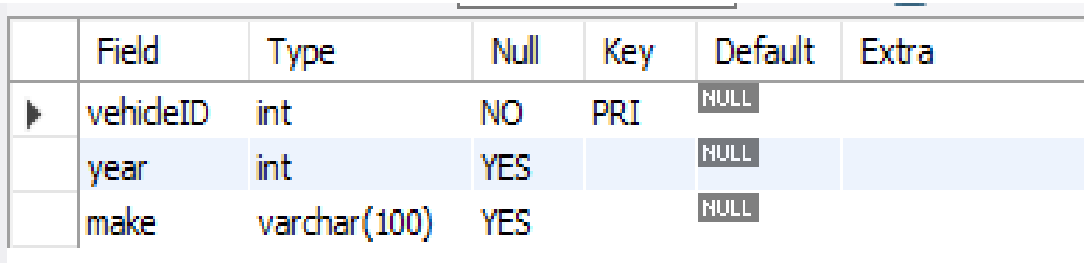
ALTER TABLE tbl_name [alter_specification [, alter_specification] . . .]

alter_specification

- ADD [COLUMN] col_name column_definition [FIRST | AFTER col_name]
- ADD [COLUMN] (col_name column_definition, . . .)

add column

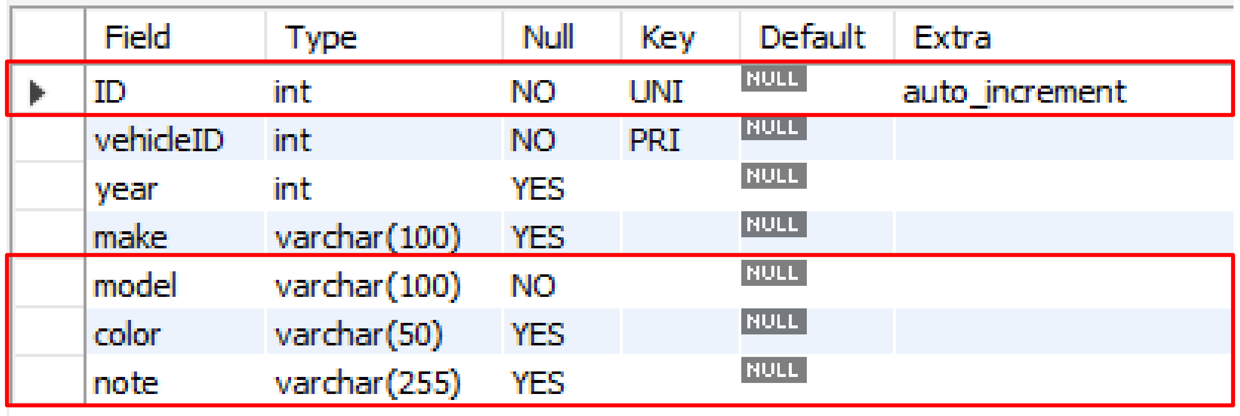
```
CREATE TABLE vehicles(
   vehicleID INT PRIMARY KEY ,
   year INT,
   make VARCHAR(100)
);
```



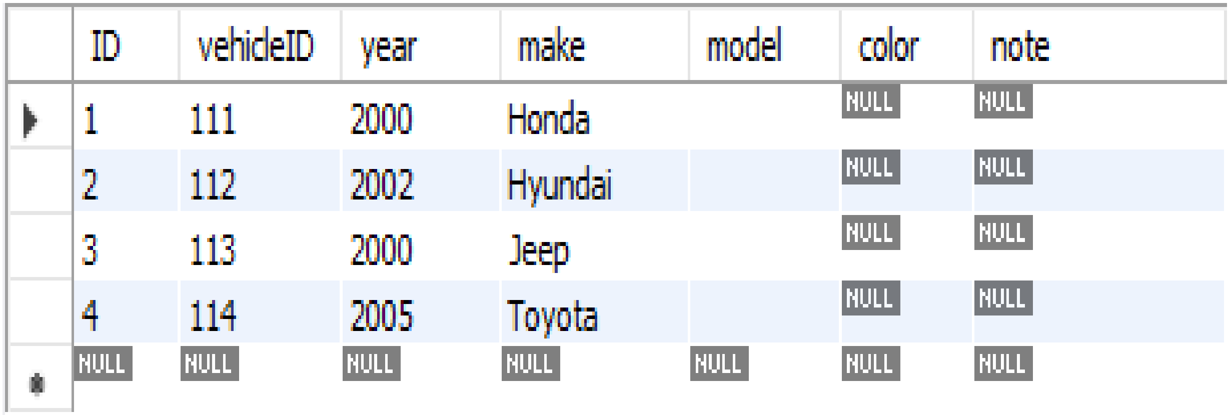
Field	Type	Null	Key	Default	Extra
vehicleID	int	NO	PRI	NULL	
year	int	YES		NULL	
make	varchar(100)	YES		NULL	

```
INSERT INTO vehicles VALUES (111, 2000, 'Honda');
INSERT INTO vehicles VALUES (112, 2002, 'Hyundai');
INSERT INTO vehicles VALUES (113, 2000, 'Jeep');
INSERT INTO vehicles VALUES (114, 2005, 'Toyota');
```

```
ALTER TABLE vehicles
  ADD ID INT UNIQUE auto_increment first,
  ADD model VARCHAR(100) NOT NULL,
  ADD color VARCHAR(50),
  ADD note VARCHAR(255);
```



Field	Type	Null	Key	Default	Extra
ID	int	NO	UNI	NULL	auto_increment
vehicleID	int	NO	PRI	NULL	
year	int	YES		NULL	
make	varchar(100)	YES		NULL	
model	varchar(100)	NO		NULL	
color	varchar(50)	YES		NULL	
note	varchar(255)	YES		NULL	



ID	vehicleID	year	make	model	color	note
1	111	2000	Honda		NULL	NULL
2	112	2002	Hyundai		NULL	NULL
3	113	2000	Jeep		NULL	NULL
4	114	2005	Toyota		NULL	NULL
NULL	NULL	NULL	NULL	NULL	NULL	NULL

modify column

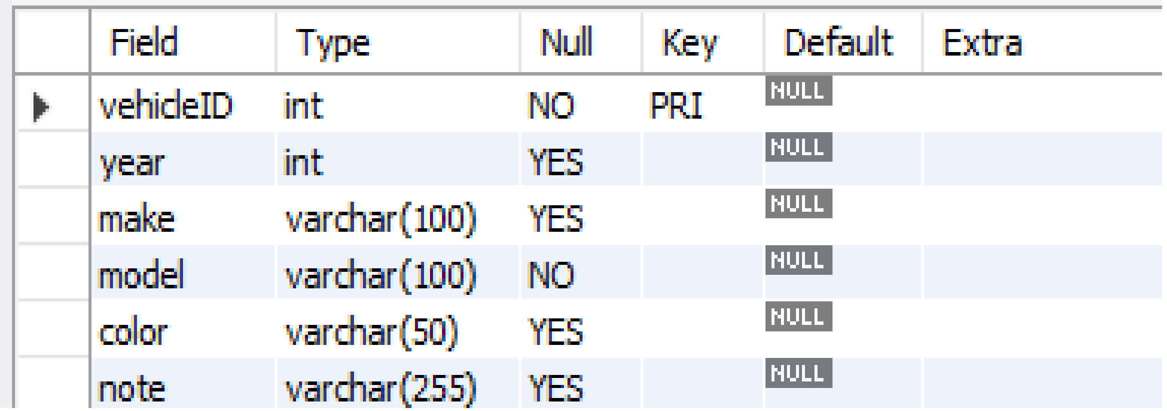
ALTER TABLE tbl_name [alter_specification [, alter_specification] ...]

alter_specification

- MODIFY [COLUMN] col_name column_definition [FIRST | AFTER col_name]

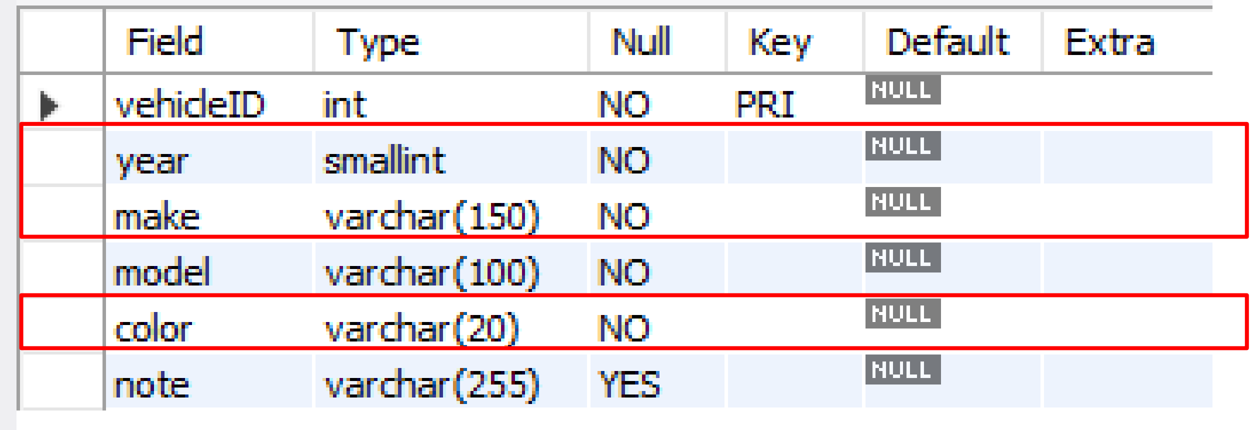
modify column

-
  ```
  CREATE TABLE vehicles(
      vehicleID INT PRIMARY KEY ,
      year INT,
      make VARCHAR(100),
      model VARCHAR(100) NOT NULL,
      color VARCHAR(50),
      note VARCHAR(255)
  );
  ```



	Field	Type	Null	Key	Default	Extra
▶	vehicleID	int	NO	PRI	NULL	
	year	int	YES		NULL	
	make	varchar(100)	YES		NULL	
	model	varchar(100)	NO		NULL	
	color	varchar(50)	YES		NULL	
	note	varchar(255)	YES		NULL	

-
  ```
  ALTER TABLE vehicles
    MODIFY year SMALLINT NOT NULL,
    MODIFY make VARCHAR(150) NOT NULL,
    MODIFY color VARCHAR(20) NOT NULL;
  ```



	Field	Type	Null	Key	Default	Extra
▶	vehicleID	int	NO	PRI	NULL	
	year	smallint	NO		NULL	
	make	varchar(150)	NO		NULL	
	model	varchar(100)	NO		NULL	
	color	varchar(20)	NO		NULL	
	note	varchar(255)	YES		NULL	

- INSERT INTO vehicles VALUES (111, 2000, 'Honda', 'A1', 'silver', ' Honda was the first Japanese automobile manufacturer to release a dedicated luxury brand, Acura, in 1986.');
- INSERT INTO vehicles VALUES (112, 2002, 'Hyundai', 'AC1', 'white', ' Hyundai operates the world's largest integrated automobile manufacturing facility in Ulsan, South Korea which has an annual production capacity of 1.6 million units.');
- INSERT INTO vehicles VALUES (113, 2000, 'Jeep', 'D2', 'black', ' Fiat Chrysler Automobiles has owned Jeep since 2014. Previous owners include the Kaiser Jeep Corporation and American Motors Corporation. Most Jeeps are American-made, except for a select few models. The Toledo Assembly Complex in Ohio manufactures the Jeep Wrangler.');

rename column

ALTER TABLE tbl_name [alter_specification [, alter_specification] ...]

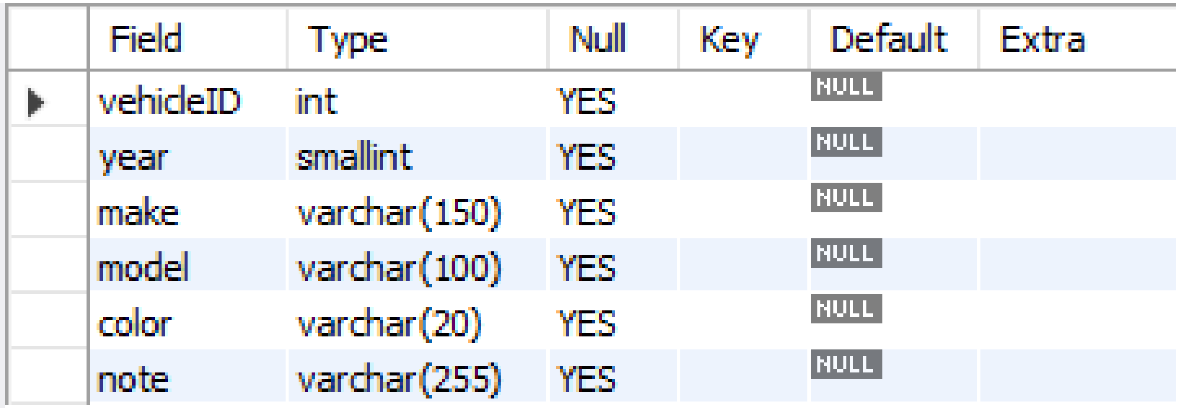
alter_specification

- RENAME COLUMN old_col_name TO new_col_name

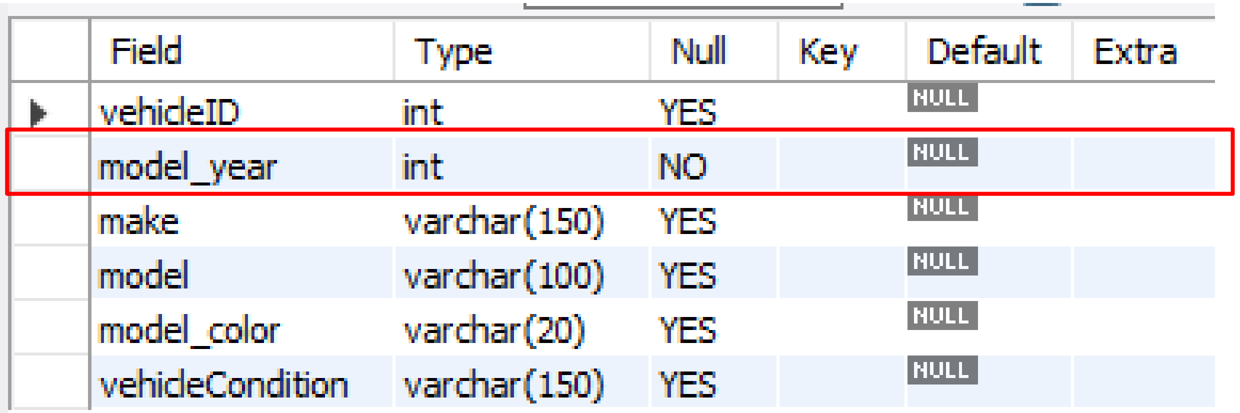
rename column

-
  ```
  CREATE TABLE vehicles (
     vehicleID INT,
     year SMALLINT,
     make VARCHAR(150),
     model VARCHAR(100),
     color VARCHAR(20),
     note VARCHAR(255)
  );
  ```

-
  ```
  ALTER TABLE vehicles
   RENAME COLUMN year TO model_year
  ```



	Field	Type	Null	Key	Default	Extra
▶	vehicleID	int	YES		NULL	
	year	smallint	YES		NULL	
	make	varchar(150)	YES		NULL	
	model	varchar(100)	YES		NULL	
	color	varchar(20)	YES		NULL	
	note	varchar(255)	YES		NULL	



	Field	Type	Null	Key	Default	Extra
▶	vehicleID	int	YES		NULL	
	model_year	int	NO		NULL	
	make	varchar(150)	YES		NULL	
	model	varchar(100)	YES		NULL	
	model_color	varchar(20)	YES		NULL	
	vehicleCondition	varchar(150)	YES		NULL	

change column

ALTER TABLE tbl_name [alter_specification [, alter_specification] ...]

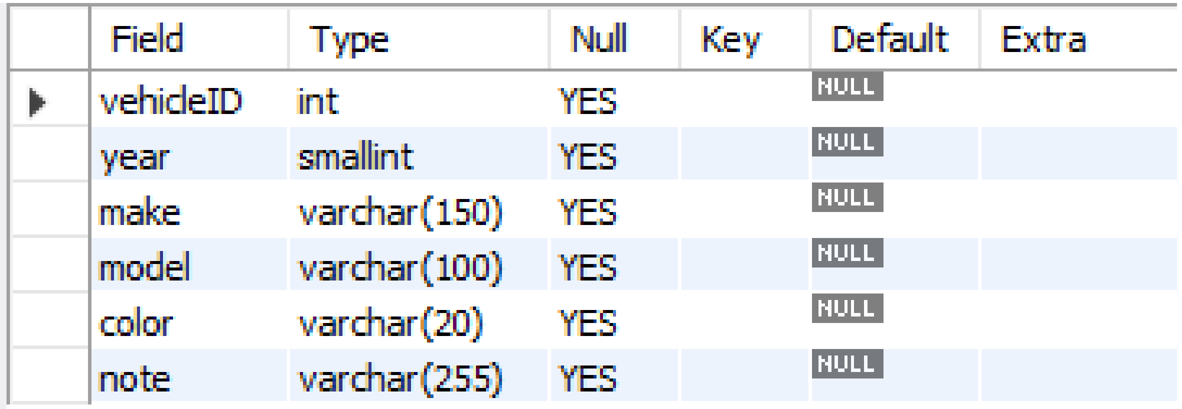
alter_specification

- CHANGE [COLUMN] old_col_name new_col_name column_definition [FIRST | AFTER col_name]

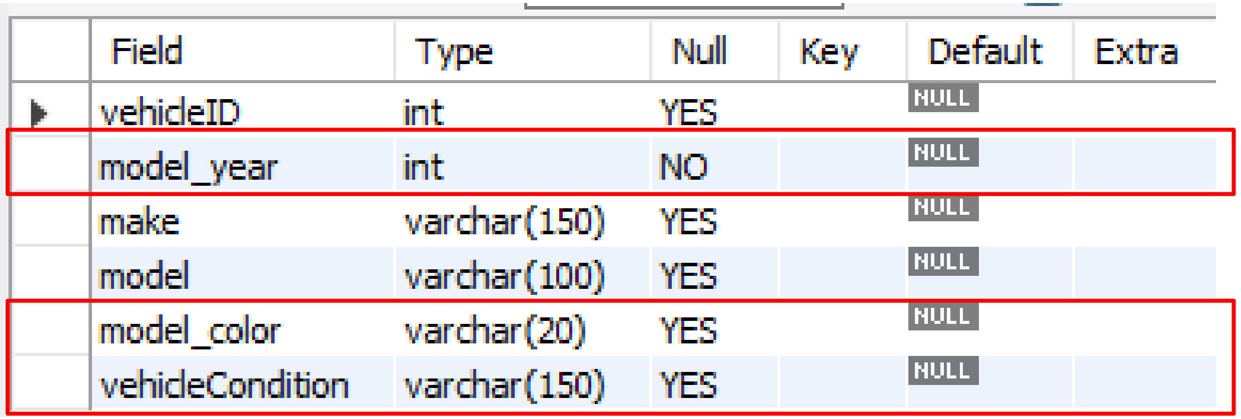
change column

-
  ```
  CREATE TABLE vehicles (
     vehicleID INT,
     year SMALLINT,
     make VARCHAR(150),
     model VARCHAR(100),
     color VARCHAR(20),
     note VARCHAR(255)
  );
  ```

-
  ```
  ALTER TABLE vehicles
   CHANGE year model_year INT,
   CHANGE color model_color VARCHAR(20),
   CHANGE note vehicleCondition VARCHAR(150);
  ```



	Field	Type	Null	Key	Default	Extra
▶	vehicleID	int	YES		NULL	
	year	smallint	YES		NULL	
	make	varchar(150)	YES		NULL	
	model	varchar(100)	YES		NULL	
	color	varchar(20)	YES		NULL	
	note	varchar(255)	YES		NULL	



	Field	Type	Null	Key	Default	Extra
▶	vehicleID	int	YES		NULL	
	model_year	int	NO		NULL	
	make	varchar(150)	YES		NULL	
	model	varchar(100)	YES		NULL	
	model_color	varchar(20)	YES		NULL	
	vehicleCondition	varchar(150)	YES		NULL	

change column

```
CREATE TABLE users (
    ID INT PRIMARY KEY,
    userName VARCHAR(40),
    password VARCHAR(25),
    email VARCHAR(255)
);
```

```
CREATE TABLE login (
    ID INT PRIMARY KEY,
    userID INT,
    loginDate DATE,
    loginTime TIME,
    constraint fk_userID FOREIGN KEY(userID) REFERENCES users(ID)
) ;
```

```
INSERT INTO users VALUES (1, 'rajan', 'ranaj123', 'rajan447.gmail.com');
INSERT INTO users VALUES (2, 'raj', 'raj', 'raj.gmail.com');
```

```
INSERT INTO login VALUES (1, 1, curdate(), curtime());
INSERT INTO login VALUES (2, 1, curdate(), curtime());
INSERT INTO login VALUES (3, 2, curdate(), curtime());
INSERT INTO login VALUES (4, NULL, curdate(), curtime());
```

```
ALTER TABLE users CHANGE ID userID INT;
ALTER TABLE login CHANGE userID UID INT;
```

```
INSERT INTO login VALUES (5, NULL, curdate(), curtime());
```

drop column

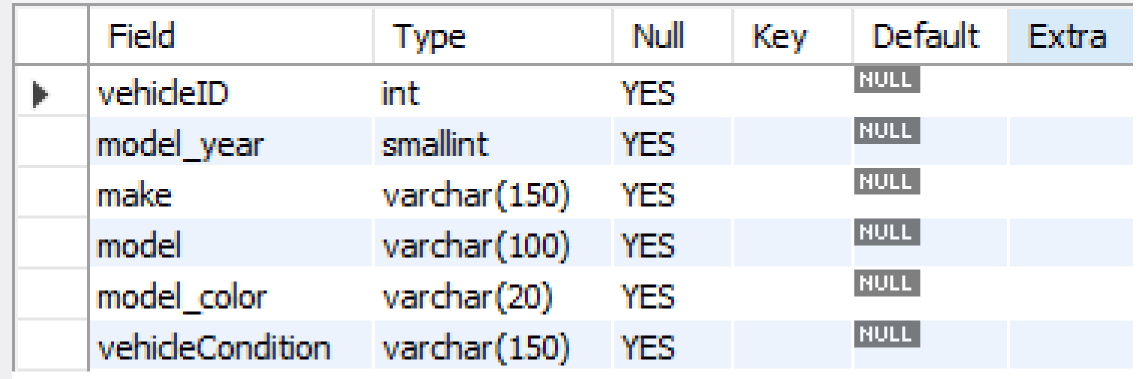
ALTER TABLE tbl_name [*alter_specification* [, *alter_specification*] . . .]

alter_specification

- DROP [COLUMN] *col_name*

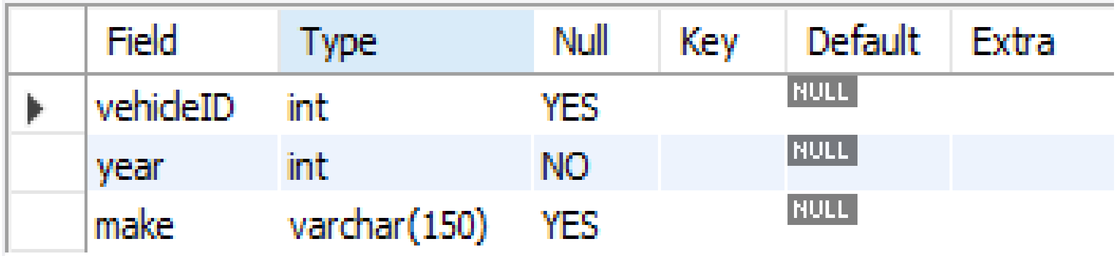
drop column

-
  ```
  CREATE TABLE vehicles(
     vehicleID INT,
     model_year SMALLINT,
     make VARCHAR(150),
     model VARCHAR(100),
     model_color VARCHAR(20),
     vehicleCondition VARCHAR(150)
  );
  ```



	Field	Type	Null	Key	Default	Extra
▶	vehicleID	int	YES		NULL	
	model_year	smallint	YES		NULL	
	make	varchar(150)	YES		NULL	
	model	varchar(100)	YES		NULL	
	model_color	varchar(20)	YES		NULL	
	vehicleCondition	varchar(150)	YES		NULL	

-
  ```
  ALTER TABLE vehicles
     CHANGE model_year year INT NOT NULL,
     DROP model,
     DROP model_color,
     DROP vehicleCondition;
  ```



	Field	Type	Null	Key	Default	Extra
▶	vehicleID	int	YES		NULL	
	year	int	NO		NULL	
	make	varchar(150)	YES		NULL	

alter table

Sample table

```
CREATE TABLE vehicles(
vehicleID INT PRIMARY KEY ,
year INT,
make VARCHAR(100)
);
```

Add new columns to a table

```
ALTER TABLE vehicles
ADD model VARCHAR(100) NOT NULL,
ADD color VARCHAR(50),
ADD note VARCHAR(255);
```

Modify columns

```
ALTER TABLE vehicles
MODIFY year SMALLINT NOT NULL,
MODIFY color VARCHAR(20) NOT NULL,
MODIFY make VARCHAR(150) NOT NULL;
```

Rename columns

```
ALTER TABLE vehicles
CHANGE year model_year SMALLINT NOT NULL,
CHANGE color model_color VARCHAR(20),
CHANGE note vehicleCondition VARCHAR(150);
```

DROP columns

```
ALTER TABLE vehicles
CHANGE model_year year INT NOT NULL,
DROP model,
DROP model_color,
DROP vehicleCondition;
```

drop table

Remember:

- DROP and TRUNCATE are DDL commands, whereas DELETE is a DML command.
- DELETE operations can be rolled back (undone), while DROP and TRUNCATE operations cannot be rolled back (DDL statements are auto committed).
- Dropping a TABLE also drops any TRIGGERS for the table.
- Dropping a TABLE also drops any INDEX for the table.
- Dropping a TABLE will not drops any VIEW for the table.
- If you try to drop a PARENT/MASTER TABLE, it will not get dropped.

drop table

```
DROP [TEMPORARY] TABLE [IF EXISTS] tbl_name [, tbl_name] ...
```

Note:

- All table data and the table definition are removed/dropped.
- If it is desired to delete only the records but to leave the table definition for future use, then the ***DELETE*** command should be used instead of ***DROP TABLE***.

- DROP login;
- DROP TABLE users;
- DROP TABLE login, users;

create table using different engines

```
show engines;
set default_storage_engine = memory;
```

create table with memory engine

- **MEMORY** storage engine tables are visible to another client/user.
- Structure is stored and rows will be removed, after re-starting mysql server (MySQL80) from Services.
- Provides in-memory tables, formerly known as HEAP.
- It sores all data in RAM for faster access than storing data on disks.
- Operations involving non-critical data such as session management or caching.

e.g. `CREATE TABLE temp(c1 INT,  c2 INT) ENGINE = MEMORY;`

- `INSERT INTO temp VALUES(10, 10);`
- `SELECT * FROM temp;`

re-start mysql server.

- `SELECT * FROM temp;`

```
show engines;
set default_storage_engine = csv;
```

create table with csv engine

- **CSV** storage engine tables are visible to another client.
- The CSV storage engine stores data in text/csv files using comma-separated values format.
- The storage engine for the table doesn't support nullable (NULL) columns.
- Doesn't support AUTO_INCREMENT columns.
- Doesn't support PRIMARY KEY and UNIQUE KEY constraints.
- CHECK constraint with NOT NULL is allowed.

e.g.
```
CREATE TABLE x(
    ID INT NOT NULL,
    ename VARCHAR(10) NOT NULL,
    job VARCHAR(10) NOT NULL,
    sal INT NOT NULL) ENGINE = CSV;
```

- INSERT INTO x VALUES(1, 'saleel', 'manager', 3400);
- SELECT * FROM x;

Note:

- ERROR 1194 (HY000): Table 'x' is marked as crashed and should be repaired.
- mysql> REPAIR TABLE x;

create table with blackhole engine

```
show engines;
set default_storage_engine = blackhole;
```

- **BLACKHOLE** tables are visible to another client.
- storage engine acts as a “black hole” that accepts data but throws it away and does not store it.
- Triggers can be written on this type of tables

e.g. CREATE TABLE temp(c1 INT PRIMARY KEY AUTO_INCREMENT, c2 INT UNIQUE, c3 INT NOT NULL, c4 INT CHECK(c4 >= 100)) ENGINE = BLACKHOLE;

- INSERT INTO temp(c2, c3, c4) VALUES(100, 200, 300);
- SELECT * FROM temp;
- DROP TRIGGER IF EXISTS triggername;

```
delimiter $$
CREATE TRIGGER triggername BEFRE INSERT ON temp FOR EACH ROW
begin
   INSERT INTO temp1 VALUES (NEW.c1, NEW.c2);
end $$
delimiter ;
```

create temporary table

- **TEMPORARY** tables are not visible to another client.
- Structure and rows is removed, after exit.

e.g. CREATE TEMPORARY TABLE temp(c1 INT, c2 INT);

- INSERT INTO temp VALUES(10, 10);
- SELECT * FROM temp;
- EXIT

table partitioning

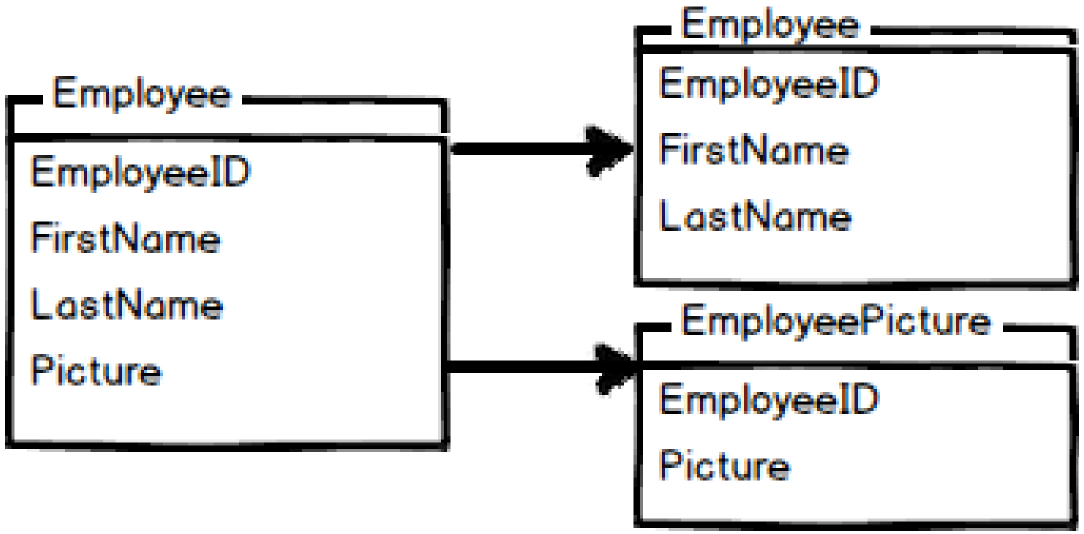
Partitioning separates data into logical units.

table partitioning

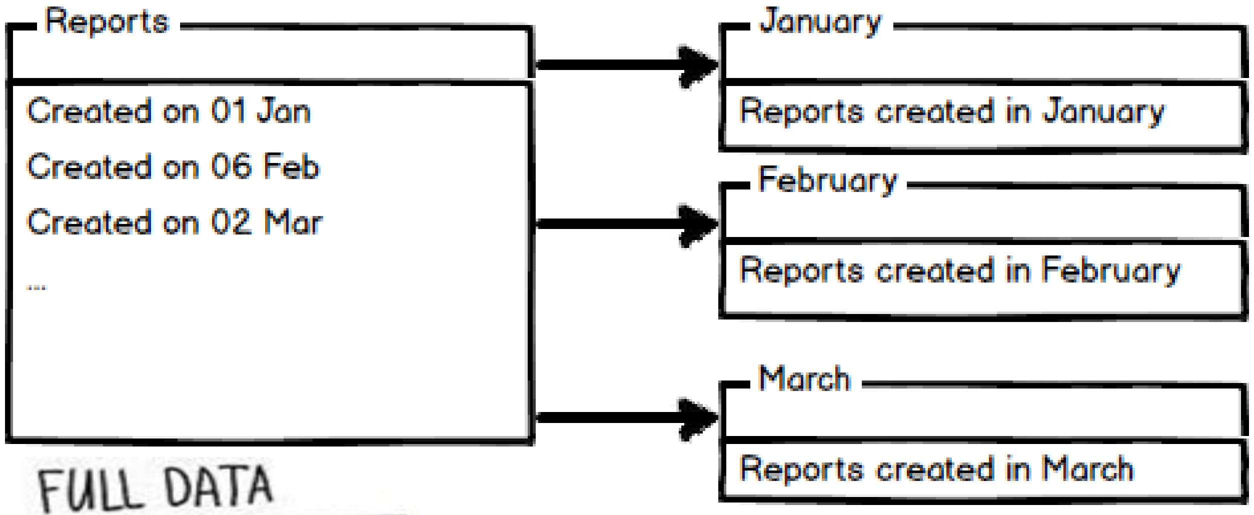
What is a database table partitioning?

Partitioning is the database process where very large tables are divided into multiple smaller parts. By splitting a large table into smaller, individual tables. The main of goal of partitioning is to aid in maintenance of large tables and to reduce the overall response time to read and load data for particular SQL operations.

Vertical Partitioning

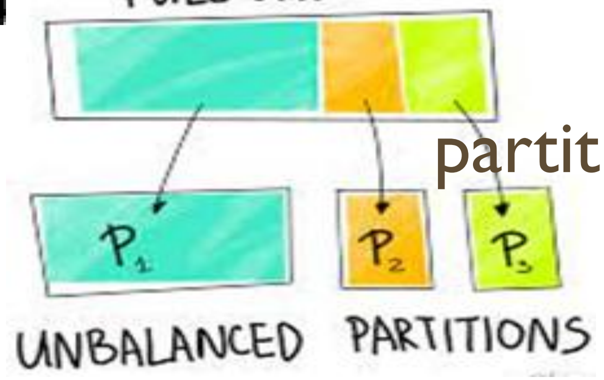


Horizontal Partitioning



MySQL has mainly six types of partitioning, which are given below:

- RANGE Partitioning
- LIST Partitioning
- COLUMNS Partitioning
- HASH Partitioning
- KEY Partitioning
- Subpartitioning



partition skew

table partitioning

Original Table

CUSTOMER ID	FIRST NAME	LAST NAME	FAVORITE COLOR
1	TAEKO	OHNUKI	BLUE
2	O.V.	WRIGHT	GREEN
3	SELDA	BAĞCAN	PURPLE
4	JIM	PEPPER	AUBERGINE

Vertical Partitions

VP1

CUSTOMER ID	FIRST NAME	LAST NAME
1	TAEKO	OHNUKI
2	O.V.	WRIGHT
3	SELDA	BAĞCAN
4	JIM	PEPPER

VP2

CUSTOMER ID	FAVORITE COLOR
1	BLUE
2	GREEN
3	PURPLE
4	AUBERGINE

Horizontal Partitions

HP1

CUSTOMER ID	FIRST NAME	LAST NAME	FAVORITE COLOR
1	TAEKO	OHNUKI	BLUE
2	O.V.	WRIGHT	GREEN

HP2

CUSTOMER ID	FIRST NAME	LAST NAME	FAVORITE COLOR
3	SELDA	BAĞCAN	PURPLE
4	JIM	PEPPER	AUBERGINE

partitioning by range / list

RANGE Partitioning

```
PARTITION BY RANGE (COLUMNS)
   (
     PARTITION part_name1 VALUES LESS THAN (int_value),
     PARTITION part_name2 VALUES LESS THAN (int_value),
     PARTITION part_name3 VALUES LESS THAN MAXVALUE
   )
```

LIST Partitioning

```
PARTITION BY LIST (COLUMNS)
   (
      PARTITION part_name1 VALUES IN (int_value_list),
      PARTITION part_name2 VALUES IN (int_value_list),
      PARTITION part_name3 VALUES IN (int_value_list)
   )
```

RANGE Partitioning

```
e.g. CREATE TABLE employee (
        empno  INT,
        ename  VARCHAR(10),
        salary INT
     )
     PARTITION BY RANGE (salary) (
        PARTITION p0 VALUES LESS THAN (2000),
        PARTITION p1 VALUES LESS THAN (4000),
        PARTITION p2 VALUES LESS THAN (6000),
        PARTITION p3 VALUES LESS THAN MAXVALUE
     );
```

- INSERT INTO employee PARTITION(p0) VALUES(1, 'saleel', 1500);
- SELECT * FROM employee PARTITION(p0);
- UPDATE employee PARTITION(p0) set salary = 1500;
- UPDATE employee PARTITION(p0) set salary = 3000 WHERE empno = 1; // Invalid statement
- DELETE FROM employee PARTITION(p0);

Warehouse	storeID
AC Warehouse	1, 3, 5, 7
National	2, 4, 6, 8
Global	10, 12, 14, 16
Migrant System	11, 13, 15, 17

LIST Partitioning

```
e.g. CREATE TABLE item (
        itemID  INT,
        itemDesc  VARCHAR(10),
        storeID INT
     )
     PARTITION BY LIST(storeID) (
        PARTITION p0 VALUES IN(1, 3, 5, 7),
        PARTITION p1 VALUES IN(2, 4, 6, 8),
        PARTITION p2 VALUES IN(10, 12, 14, 16),
        PARTITION p3 VALUES IN(11, 13, 15, 17)
     );
```

alter / drop partitioning by range / list

Alter Partitioning

RANGE Partitioning

```
ALTER TABLE a ADD PARTITION (PARTITION p3 VALUES LESS THAN(130));
```

- MAXVALUE can only be used in last partition definition

LIST Partitioning

```
ALTER TABLE a ADD PARTITION (PARTITION p3 VALUES IN (10, 11));
```

DROP Partitioning

```
ALTER TABLE a ADD PARTITION p3;
```

create temporary table

Note:

- it is possible to create, alter, drop, and write (Insert, Update, and Delete rows) to TEMPORARY tables.

temporary table

Remember:

- You can use the *TEMPORARY* keyword when creating a table.
- A *TEMPORARY* table is visible only to the current session, and is dropped automatically when the session is closed.
- Use *TEMPORARY* table with the same name as the original can be useful when you want to try some statements that modify the contents of the table, without changing the original table.
- The permanent (original) table becomes hidden (inaccessible) to the client who creates the *TEMPORARY* table with same name as the original.
- If you issue a DROP TABLE statement, the *TEMPORARY* table is removed and the original table reappears, it is possible, only when then original *tbl_name* and temporary *tbl_name* are same.
- The original table also reappears if you rename the *TEMPORARY* table.

  e.g. ALTER TABLE **dept** RENAME TO d;

  Temporary table_name

temporary table

e.g.

```
CREATE TEMPORARY TABLE student (
    ID INT PRIMARY KEY,
    namefirst VARCHAR(45),
    namelast VARCHAR(45),
    DOB DATE,
    emailID VARCHAR(128)
) ;

CREATE TEMPORARY TABLE temp (
    ID INT PRIMARY KEY,
    firstName VARCHAR(45),
    phone INT,
    city VARCHAR(10) DEFAULT 'PUNE',
    salary INT,
    comm INT,
    total INT GENERATED ALWAYS AS(salary + comm) VIRTUAL
) ;
```

create temporary table ... like

Use CREATE TABLE ... LIKE to create an empty table based on the definition of another table.

```
CREATE TEMPORARY TABLE [IF NOT EXISTS] new_tbl LIKE orig_tbl;
```

- CREATE TEMPORARY TABLE tempEmployee LIKE employee;

Remember:

- LIKE works only for base tables, not for VIEWS.
- You can use the TEMPORARY keyword when creating a table. A TEMPORARY table is visible only to the current session, and is dropped automatically when the session is closed.
- Use TEMPORARY table with the same name as the original can be useful when you want to try some statements that modify the contents of the table, without changing the original table.

- CREATE TEMPORARY TABLE *new_tbl* SELECT * FROM *orig_tbl* LIMIT 0;

Do not use the * operator in your SELECT statements. Instead, use column names. Reason is that in MySQL Server scans for all column names and replaces the * with all the column names of the table(s) in the SELECT statement. Providing column names avoids this search-and-replace, and enhances performance.

continue with SELECT statement…

```
SELECT what_to_select
FROM which_table
WHERE conditions_to_satisfy;
```

The asterisk symbol “ * ” can be used in the SELECT clause to denote “all attributes.”

SELECT CLAUSE

The **SELECT** statement retrieves or extracts data from tables in the database.

- You can use one or more tables separated by comma to extract data.
- You can fetch one or more fields/columns in a single SELECT command.
- You can specify star (*****) in place of fields. In this case, SELECT will return all the fields.
- SELECT can also be used to retrieve rows computed without reference to any table e.g. SELECT 1 + 2;

Capabilities of
SELECT Statement

1. SELECTION
2. PROJECTION
3. JOINING

Capabilities of SELECT Statement

➢SELECTION

Selection capability in SQL is to choose the rows in a table that you want to return by a query.

R

EMPNO	ENAME	JOB	HIREDATE	DEPTNO
1	Saleel	Manager	1995-01-01	10
2	Janhavi	Sales	1994-12-20	20
3	Snehal	Manager	1997-05-21	10
4	Rahul	Account	1997-07-30	10
5	Ketan	Sales	1994-01-01	30

Capabilities of SELECT Statement

➢PROJECTION

Projection capability in SQL to choose the columns in a table that you want to return by your query.

R

EMPNO	ENAME	JOB	HIREDATE	DEPTNO
1	Saleel	Manager	1995-01-01	10
2	Janhavi	Sales	1994-12-20	20
3	Snehal	Manager	1997-05-21	10
4	Rahul	Account	1997-07-30	10
5	Ketan	Sales	1994-01-01	30

Capabilities of SELECT Statement

➢JOINING

Join capability in SQL to bring together data that is stored in different tables by creating a link between them.

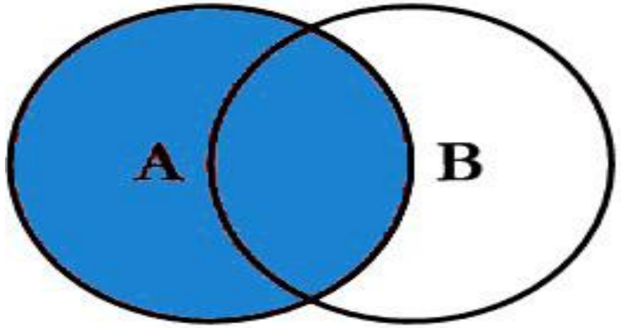
R

EMPNO	ENAME	JOB	HIREDATE	DEPTNO
1	Saleel	Manager	1995-01-01	20
2	Janhavi	Sales	1994-12-20	10
3	Snehal	Manager	1997-05-21	10
4	Rahul	Account	1997-07-30	20
5	Ketan	Sales	1994-01-01	30

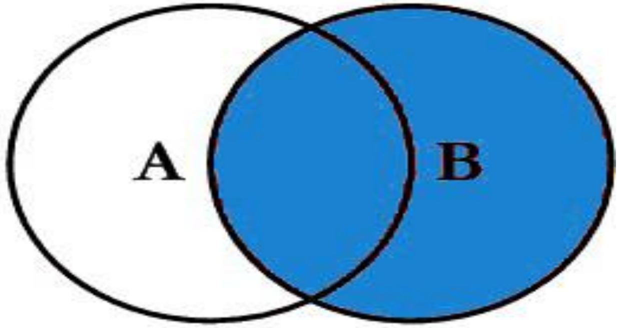
S

DEPTNO	DNAME	LOC
10	HRD	PUNE
20	SALES	BARODA
40	PURCHASE	SURAT

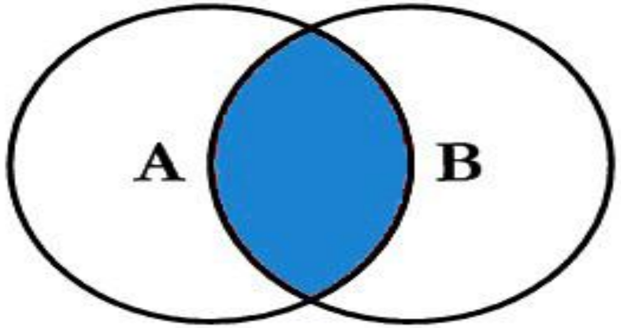
SQL JOINS



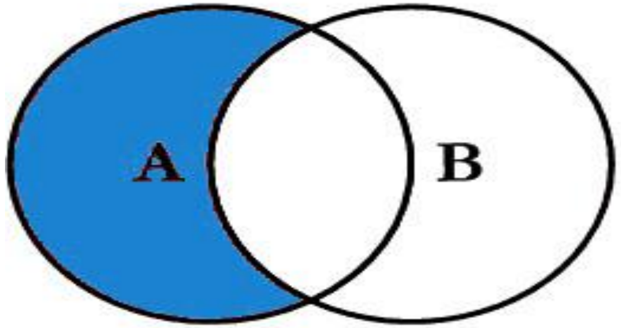
```
SELECT <select_list>
FROM TableA A
LEFT JOIN TableB B
ON A.Key = B.Key
```



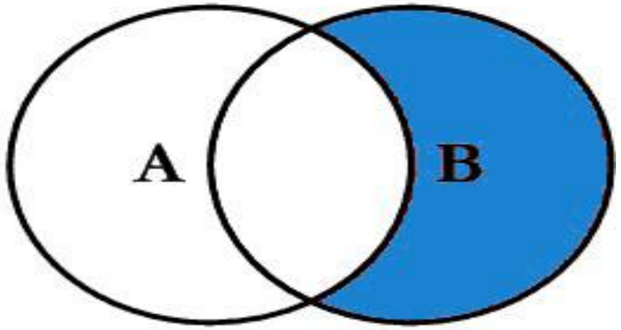
```
SELECT <select_list>
FROM TableA A
RIGHT JOIN TableB B
ON A.Key = B.Key
```



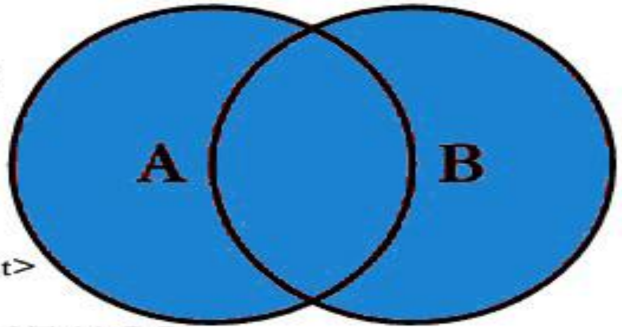
```
SELECT <select_list>
FROM TableA A
INNER JOIN TableB B
ON A.Key = B.Key
```



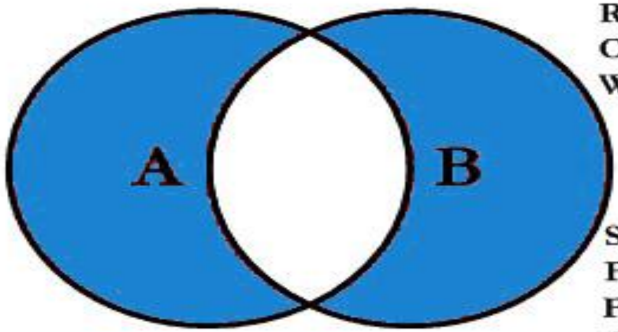
```
SELECT <select_list>
FROM TableA A
LEFT JOIN TableB B
ON A.Key = B.Key
WHERE B.Key IS NULL
```



```
SELECT <select_list>
FROM TableA A
RIGHT JOIN TableB B
ON A.Key = B.Key
WHERE A.Key IS NULL
```



```
SELECT <select_list>
FROM TableA A
FULL OUTER JOIN TableB B
ON A.Key = B.Key
```



```
SELECT <select_list>
FROM TableA A
FULL OUTER JOIN TableB B
ON A.Key = B.Key
WHERE A.Key IS NULL
OR B.Key IS NULL
```

select statement

SELECTION Process

SELECT * FROM <table_references>

selection-list | field-list | column-list

Remember:

- Here, " * " is known as metacharacter (all columns)

PROJECTION Process

SELECT column-list FROM <table_references>

selection-list | field-list | column-list

Remember:

- Position of columns in SELECT statement will determine the position of columns in the output (as per user requirements)

- SELECT 'HELLO' ' WORLD';
- SELECT 'HELLO' AS 'WORLD';
- SELECT ename `EmployeeName` FROM emp;
- SELECT ename AS `EmployeeName` FROM emp;

column - alias

A programmer can use an alias to temporarily assign another name to a **column** or **table** for the duration of a ***SELECT*** query**.**

In the selection-list, a quoted column alias can be specified using identifier **(`)** or string quote **(' or ")** characters.

Note:

- Assigning an alias_name does not actually rename the column or table.
- You cannot use alias in an expression.

select statement - alias

SELECT $\boldsymbol{A}_1$ [[AS] *alias_name*], $\boldsymbol{A}_2$ [[AS] *alias_name*], . . ., $\boldsymbol{A}_N$ FROM ***r*** [[AS] *alias_name*]

column-name as new-name

table-name as new-name

Remember:

- A select_expr can be given an alias using **AS alias_name**. The alias is used as the expression's column name and can be used in **GROUP BY, HAVING,** or **ORDER BY** clauses.
- The **AS** keyword is optional when aliasing a select_expr with an identifier.
- Standard SQL **disallows** references to column aliases in a ***WHERE*** clause.
- A table reference can be aliased using **tbl_name alias_name** or **tbl_name AS alias_name**
- If the column alias contains spaces, **put it in quotes**.
- Alias name is **max 256 characters**.

- SELECT empno AS *EmployeeID*, ename *EmployeeName* FROM emp;
- SELECT ID AS *'Employee ID'*, ename *"Employee Name"* FROM emp;
- SELECT * FROM emp *employee*;

comparison functions and operator

Comparison operations result in a value of 1 **(TRUE),** 0 **(FALSE)**, or **NULL**.

assignment _operator

= (assignment), :=

- The value on the right hand side may be a literal value, another variable storing a value, or any legal expression that yields a scalar value, including the result of a query (provided that this value is a scalar value). You can perform multiple assignments in the same SET statement. You can perform multiple assignments in the same statement.
- Unlike **=,** the **:=** operator is never interpreted as a comparison operator. This means you can use := in any valid SQL statement (not just in SET statements) to assign a value to a variable.

comparison functions and operator

1. ***arithmetic_operators:***
   * | / | DIV | % |MOD | - | +
2. ***comparison_operator:***
   = | <=> | >= | > | <= | < | <> | !=
3. ***boolean_ predicate:***
   IS [NOT] *NULL* | IS [BOOLEAN]
   | *expr* <=> *null*
4. ***predicate***:
   expr [NOT] LIKE *expr* [ESCAPE *char*]
   | *expr* [NOT] IN (*expr1, expr2, . . .*)
   | *expr* [NOT] IN (*subquery*)
   | *expr* [NOT] BETWEEN *expr1* AND *expr2*
5. ***logical_operators***
   { AND | && } | { OR | || }
6. ***assignment _operator***
   = (assignment), :=

operand meaning: the quantity on which an operation is to be done.

e.g.

1. *operand1* * *operand2*
2. *operand1* = *operand2*
3. *operand* IS [NOT] *NULL*
4. *operand* [NOT] LIKE 'pattern'
5. *expr* AND *expr*
6. *Operand := 1001*

- SELECT 23 DIV 6 ; #3
- SELECT 23 / 6 ; #3 .8333

Note:

- AND has higher precedence than OR.

- `WHERE col * 4 < 16`
- `WHERE col < 16 / 4`

- `SELECT CONCAT(1, "saleel");`

column - expressions

"Strings are automatically converted to numbers (this behavior is known as **implicit type conversion (type coercion)** in MySQL.)."

- If a string starts with a number, MySQL extracts the number and uses it.
- If a string does not start with a number, MySQL converts it to 0.

select statement - expressions

Column EXPRESSIONS

SELECT $\boldsymbol{A}_1$, $\boldsymbol{A}_2$, $\boldsymbol{A}_3$, $\boldsymbol{A}_4$, expressions, . . . FROM ***r***

- SELECT 1001 + 1;
- SELECT 1001 + '1';
- SELECT '1' + '1' ;
- SELECT '1' + 'a1';
- SELECT '1' + '1a';
- SELECT 'a1' + 1;
- SELECT '1a' + 1;
- SELECT 1 + -1;
- SELECT 1 + -2;
- SELECT -1 + -1;
- SELECT -1 - 1;

- SELECT -1 - -1;
- SELECT 123 * 1;
- SELECT -123 * 1;
- SELECT 123 * -1 ;
- SELECT -123 * -1;
- SELECT 2 * 0;
- SELECT 2435 / 1;
- SELECT 2 / 0;
- SELECT '2435Saleel' / 1;

- SELECT sal, sal + 1000 AS *'New Salary'* FROM emp;
- SELECT sal, comm, sal + comm FROM emp;
- SELECT sal, comm, sal + IFNULL(comm, 0) FROM emp;
- SELECT ename, ename = ename FROM emp;
- SELECT ename, ename = 'smith' FROM emp;
- SELECT c1, c1 / 1 *R1* FROM numberString;
- SELECT '123abc' = 123;
- SELECT 'abc123' = 0;

Note:

If any expression evaluated with NULL, returns NULL.

- SELECT 2 + NULL ;
- SELECT 2 - NULL ;

- SELECT 2 * NULL ;
- SELECT 2 / NULL ;

identifiers

Certain objects within MySQL, including database, table, index, column, alias, view, stored procedure, stored functions, triggers, partition, tablespace, and other object names are known as **identifiers**.

identifiers

The maximum length for each type of identifiers like (Database, Table, Column, Index, Constraint, View, Stored Program, Compound Statement Label, User-Defined Variable, Tablespace) is 64 characters, whereas for Alias is 256 characters.

- You can refer to a table within the default database as
  1. tbl_name
  2. db_name.tbl_name.

- You can refer to a column as
  1. col_name
  2. tbl_name.col_name
  3. db_name.tbl_name.col_name.

Note:

- You need not specify a ***tbl_name*** or ***db_name.tbl_name*** prefix for a column reference unless the reference would be ambiguous.
- The identifier quote character is the backtick (`)

control flow functions

control flow functions - ifnull

IFNULL function

MySQL IFNULL() takes two expressions, if the first expression is not NULL, it returns the first expression. Otherwise, it returns the second expression, **it returns either numeric or string value.**

IFNULL(*expression1*, *expression2*)

- SELECT IFNULL (1, 2) AS *R1*;
- SELECT IFNULL (NULL, 2) AS *R1*;
- SELECT IFNULL (1/0, 2) AS *R1*;
- SELECT IFNULL (1/0, 'Yes') AS *R1*;
- SELECT comm, IFNULL(comm + comm*.25, 1000) FROM emp;

control flow functions - if

IF function

If **expr1 is TRUE or expr1 <> 0 or expr1 <> NULL**, then IF() returns expr2, otherwise it returns expr3, **it returns either numeric or string value.**

IF(*expr1*, *expr2* , *expr3*)

- SELECT IF(1 > 2, 2, 3) as *R1*;
- SELECT sal, IF(sal = 3000, 'Ok', 'Not Bad') *R1* FROM emp;
- SELECT ename, sal, IF(sal = 3000 AND ename = 'FORD', 'Y', 'N') *R1* FROM emp;
- SELECT ename, sal, comm, IF(comm IS NULL && ename = 'FORD', 'Y', 'N') *R1* FROM emp;
- SELECT deptno, IF(deptno = 10, 'Sales', IF(deptno = 20 , 'Purchase' ,'N/A')) *R1* FROM emp;
- SELECT productid, productname, unitprice, unitsinstock, reorderlevel, IF(unitsinstock < reorderlevel, 'Stock is less', 'Good Stock') as 'Stock Report' FROM products;
- SELECT hiredate, IF((YEAR(hiredate) % 4 = 0 AND YEAR(hiredate) % 100 <> 0) OR YEAR(hiredate) % 400 = 0 ,'Leap Year’, 'Not A Leap Year') FROM emp;

control flow functions - nullif

NULLIF function

Returns **NULL** if expr1 = expr2 is true, otherwise returns expr1.

NULLIF(*expr1*, *expr2*)

- SELECT NULLIF(1, 1) as *R1*;
- SELECT NULLIF(1, 2) as *R1*;

control flow functions - case

CASE function

Returns the result for the first condition that is true. If there was no matching result value, the result after ELSE is returned, or NULL if there is no ELSE part.

CASE value WHEN [*compare_value*] THEN result [WHEN [*compare_value*] THEN result . . .] [ELSE *result*] END

- SELECT deptno, CASE deptno WHEN 10 THEN 'Accounts' WHEN 20 THEN 'Sales' ELSE 'N/A' END *R1* FROM emp;
- SELECT deptno, CASE deptno WHEN 10 THEN 'Accounts' ELSE 'N/A' END *CASE* FROM emp; # error
- SELECT custId, type, amount, CASE type WHEN 'd' THEN amount WHEN 'c' THEN amount * -1 END amount FROM transactions;

- SELECT job, SUM(CASE job WHEN 'manager1' THEN 1 ELSE 0 END) *R1* FROM emp; # returns 0
- SELECT job, SUM(CASE job WHEN 'manager1' THEN 1 END) *R1* FROM emp; # returns NULL

control flow functions - case

CASE function

Returns the result for the first condition that is true. If there was no matching result value, the result after ELSE is returned, or NULL if there is no ELSE part.

CASE WHEN [*condition*] THEN result [WHEN [*condition*] THEN result . . .] [ELSE *result*] END

-
  ```
  SELECT deptno, CASE WHEN deptno = 10 THEN 'Sales' WHEN deptno = 20 THEN 'Purchase' ELSE 'N/A' END R1 FROM emp;
  ```

-
  ```
   SELECT companyname,
    CASE WHEN country IN ('USA', 'Canada') THEN 'North America'
      WHEN country = 'Brazil' THEN 'South America'
      WHEN country IN ('Japan', 'Singapore') THEN 'Asia'
      WHEN country = 'Australia' THEN 'Australia'
      ELSE 'Europe' END as Continent
  FROM suppliers
  ORDER BY companyname;
  ```

-
  ```
  SELECT hiredate, CASE WHEN (YEAR(hiredate) % 4 = 0 AND YEAR(hiredate) % 100 <> 0) OR YEAR(hiredate) % 400 = 0
  THEN 'LEAP YEAR'  END R1 FROM emp;
  ```

control flow functions - case

CASE function

Returns the result for the first condition that is true. If there was no matching result value, the result after ELSE is returned, or NULL if there is no ELSE part.

CASE WHEN [*condition*] THEN result [WHEN [*condition*] THEN result . . .] [ELSE *result*] END

```
* Count(custID)
  ORDER BY CASE orderCount
  WHEN 1 THEN 'One-time Customer'
  WHEN 2 THEN 'Repeated Customer'
  WHEN 3 THEN 'Frequent Customer'
  ELSE 'Loyal Customer' END customerType
```

```
* ORDER BY CASE
  WHEN filter = 'Debit' THEN 1
  WHEN filter = 'Credit' THEN 2
  WHEN filter = 'Total' THEN 3
  END transactionType;
```

```
* ORDER BY FIELD(status, 'In Process',
  'On Hold', 'Cancelled', 'Resolved',
  'Disputed', 'Shipped');
```

```
* ORDER BY CASE status
  WHEN 'active' THEN 1
  WHEN 'approved' THEN 2
  WHEN 'rejected' THEN 3
  WHEN 'submitted' THEN 4
  ELSE 5 END statusType
```

control flow functions - case

CASE function

Returns the result for the first condition that is true. If there was no matching result value, the result after ELSE is returned, or NULL if there is no ELSE part.

CASE WHEN [*condition*] THEN result [WHEN [*condition*] THEN result . . .] [ELSE *result*] END

```
• SELECT cnum, COUNT(*),   CASE
      WHEN COUNT(*) = 1 THEN 'one-time-customer'
      WHEN COUNT(*) = 2 THEN 'repeated-customer'
      WHEN COUNT(*) = 3 THEN 'frequent-customer'
      WHEN COUNT(*) >= 4 THEN 'loyal-customer'
   END "Customer Report"
  FROM orders GROUP BY cnum ORDER BY 2;
```

- DATEDIFF(CURDATE(), hiredate) / 365.25

datetime functions

sysdate(), now(), curdate(), curtime()

In MySQL, the **NOW()** function returns a default value for a **DATETIME**.
MySQL inserts the current **date and time** into the column whose default value is NOW().

In MySQL, the **CURDATE()** returns the current date in 'YYYY-MM-DD'. **CURRENT_DATE()** and **CURRENT_DATE** are the **synonym of CURDATE().**

In MySQL, the **CURTIME()** returns the value of current time in 'HH:MM:SS'. **CURRENT_TIME()** and **CURRENT_TIME** are the **synonym of CURTIME().**

+ or - operator

Date arithmetic also can be performed using INTERVAL together with the + or - operator

date + INTERVAL *expr* unit + INTERVAL *expr* unit + INTERVAL *expr* unit + . . .
date - INTERVAL *expr* unit - INTERVAL *expr* unit - INTERVAL *expr* unit - . . .

- SELECT NOW(), NOW() + INTERVAL 1 DAY;
- SELECT NOW(), NOW() + INTERVAL '1-3' YEAR_MONTH;

unit Value	expr	unit Value	expr
SECOND	SECONDS	DAY_HOUR	'DAYS HOURS' e.g. '1 1'
MINUTE	MINUTES	DAY_MINUTE	'DAYS HOURS:MINUTES' e.g. '1 3:34'
HOUR	HOURS	DAY_SECOND	'DAYS HOURS:MINUTES:SECONDS'
DAY	DAYS	HOUR_MINUTE	'HOURS:MINUTES' e.g. '3:34'
WEEK	WEEKS	HOUR_SECOND	'HOURS:MINUTES:SECONDS'
MONTH	MONTHS	MINUTE_SECOND	'MINUTES:SECONDS' e.g. '27:34'
QUARTER	QUARTERS	YEAR_MONTH	'YEARS-MONTHS' e.g. '1-3'
YEAR	YEARS		

extract

The EXTRACT() function is used to return a single part of a date/time, such as year, month, day, hour, minute, etc.

```
EXTRACT(unit FROM date)
```

Unit Value				
MICROSECOND	SECOND	MINUTE	HOUR	DAY
WEEK	MONTH	QUARTER	YEAR	
MINUTE_SECOND	HOUR_SECOND	DAY_SECOND	DAY_HOUR	
HOUR_MINUTE	DAY_MINUTE	YEAR_MONTH		

- `SELECT EXTRACT(MONTH FROM NOW());`
- `SELECT EXTRACT(YEAR_MONTH FROM NOW()) ;`

Note:

- There must no space between extract function and ().

e.g.

```
SELECT EXTRACT (MONTH FROM NOW());   # error
```

datetime functions

Syntax	Result
DAY(*date*)	DAY() is a **synonym for DAYOFMONTH().**
DAYNAME(*date*)	Returns the name of the weekday for date.
DAYOFMONTH(*date*)	Returns the day of the month for date, in the range 1 to 31
DAYOFWEEK(*date*)	Returns the weekday index for date (1 = Sunday, 2 = Monday, …, 7 = Saturday).
DAYOFYEAR(*date*)	Returns the day of the year for date, in the range 1 to 366
LAST_DAY(*date*)	Takes a date or datetime value and returns the corresponding value for the last day of the month. Returns NULL if the argument is invalid.
MONTH(*date*)	Returns the month for date, in the range 1 to 12 for January to December
MONTHNAME(*date*)	Returns the full name of the month for date.
YEAR(*date*)	Returns the year in 4 digit

- SELECT DAYOFWEEK(NOW()), WEEKDAY(NOW());
- SELECT DAYOFWEEK(ADDDATE(NOW(), INTERVAL 1 DAY)), WEEKDAY(ADDDATE(NOW(), INTERVAL 1 DAY));

datetime functions

Syntax	Result
WEEKDAY(*date*)	Returns the weekday index for date (0 = Monday, 1 = Tuesday, … 6 = Sunday).
WEEKOFYEAR(*date*)	Returns the calendar week of the date as a number in the range from 1 to 53.
QUARTER(*date*)	Returns the quarter of the year for date, in the range 1 to 4.
HOUR(*time*)	Returns the hour for time. The range of the return value is 0 to 23 for time-of-day values.
MINUTE(*time*)	Returns the minute for time, in the range 0 to 59.
SECOND(*time*)	Returns the second for time, in the range 0 to 59.
DATEDIFF(*expr1, expr2*)	Returns the number of days between two dates or datetimes.
STR_TO_DATE(*str, format*)	Convert a string to a date.

- SELECT NOW(), NOW() + INTERVAL 1 DAY, WEEKDAY(NOW() + INTERVAL 1 DAY);
- SELECT * FROM emp WHERE DAY(hiredate) = 17;
- SELECT YEAR(hiredate), (YEAR(hiredate) % 4 = 0 AND YEAR(hiredate) % 100 != 0) OR YEAR(hiredate) % 400 = 0 *R1* FROM emp ;
- SELECT STR_TO_DATE('24/05/2022', '%d/%m/%Y');

datetime formats

datetime formats

Formats	Description
%a	Abbreviated weekday name (Sun-Sat)
%b	Abbreviated month name (Jan-Dec)
%c	Month, numeric (1-12)
%D	Day of month with English suffix (0th, 1st, 2nd, 3rd, □)
%d	Day of month, numeric (01-31)
%e	Day of month, numeric (1-31)
%f	Microseconds (000000-999999)
%H	Hour (00-23)
%h	Hour (01-12)

- SELECT DATE_FORMAT(NOW(), '%a');

datetime formats

Formats	Description
%I	Hour (01-12)
%i	Minutes, numeric (00-59)
%j	Day of year (001-366)
%k	Hour (0-23)
%l	Hour (1-12)
%M	Month name (January-December)
%m	Month, numeric (01-12)
%p	AM or PM
%r	Time, 12-hour (hh:mm:ss followed by AM or PM)
%S	Seconds (00-59)
%s	Seconds (00-59)

- SELECT DATE_FORMAT(NOW(), '%j');

datetime formats

Formats	Description
%T	Time, 24-hour (hh:mm:ss)
%U	Week (00-53) where Sunday is the first day of week
%u	Week (00-53) where Monday is the first day of week
%V	Week (01-53) where Sunday is the first day of week, used with %X
%v	Week (01-53) where Monday is the first day of week, used with %x
%W	Weekday name (Sunday-Saturday)
%w	Day of the week (0=Sunday, 6=Saturday)
%X	Year for the week where Sunday is the first day of week, four digits, used with %V
%x	Year for the week where Monday is the first day of week, four digits, used with %v
%Y	Year, numeric, four digits
%y	Year, numeric, two digits

- SELECT DATE_FORMAT(NOW(), '%Y');

string functions

string functions

Syntax	Result
ASCII(*str*)	Returns the numeric value of the leftmost character of the string str. Returns 0 if str is the empty string. Returns NULL if str is NULL. e.g. • SELECT ASCII(ename) FROM emp;
CHAR(*N*, , . . .)	CHAR() interprets each argument N as an integer and returns a string consisting of the characters given by the code values of those integers. **NULL values are skipped**. e.g. • SELECT CHAR(65, 66, 67); / SELECT CAST(CHAR(65 66, 67) AS CHAR);
CONCAT(*str1*, *str2*, . . .)	Returns the string that results from concatenating the arguments. CONCAT() **returns NULL if any argument is NULL**. e.g. • SELECT CONCAT('Mr. ' , ename) FROM emp; • SELECT CONCAT('My', NULL, 'SQL’); #op will be NULL
ELT(*N*, *str1*, *str2*, *str3*, . . .)	ELT() returns the Nth element of the list of strings: str1 if N = 1, str2 if N = 2, and so on. Returns NULL if N is less than 1 or greater than the number of arguments. e.g. • SELECT ELT(1, 'Bank', 'Of', 'India', 'Kothrud', 'Pune'); • SELECT ELT(1, ename, job, sal) FROM emp; • SELECT hiredate, ELT(MONTH(hiredate),'Winter', 'Winter', 'Spring', 'Spring', 'Spring', 'Summer', 'Summer', 'Summer', 'Autumn', 'Autumn', 'Autumn', 'Winter') R1 FROM emp;

string functions

Syntax	Result
STRCMP(*expr1, expr2*)	STRCMP() returns 0 if the strings are the same, -1 if the first argument is smaller than the second according to the current sort order, and 1 otherwise.
LCASE(*str*)	Returns lower case string. LCASE() **is a synonym for** LOWER().
UCASE(*str*)	Returns upper case string. UCASE() **is a synonym for** UPPER().
LENGTH(*str*)	Returns the length of the string.
LPAD(*str, len, padstr*)	Returns the string str, left-padded with the string padstr to a length of len characters.
RPAD(*str, len, padstr*)	Returns the string str, right-padded with the string padstr to a length of len characters.
REPEAT(*str, count*)	Returns a string consisting of the string str repeated count times. If count is less than 1, returns an empty string. Returns NULL if str or count are NULL.

- SELECT UCASE(ename) FROM emp;
- SELECT sal, LPAD(sal, 20, '*') FROM emp;

string functions

Syntax	Result
LEFT(*str, len*)	Returns the leftmost len characters from the string str, or NULL if any argument is NULL.
RIGHT(*str, len*)	Returns the rightmost len characters from the string str, or NULL if any argument is NULL.
LTRIM(*str*)	Returns the string str with leading space characters removed.
RTRIM(*str*)	Returns the string str with trailing space characters removed.
TRIM(*str*)	Returns the string str with leading and trailing space characters removed.
BINARY *value*	Convert a value to a binary string.

- SELECT ename, BINARY ename FROM emp;

string functions

Syntax	Result
INSTR(*str, substr*)	Returns the position of the first occurrence of substring substr in string str.
REPLACE(*str, from_str, to_str*)	Returns the string str with all occurrences of the string from_str replaced by the string to_str. REPLACE() performs a case-sensitive match when searching for from_str. e.g. • SELECT REPLACE('Hello', 'l', 'x');
REVERSE(*str*)	Returns the string str with the order of the characters reversed.
SUBSTR(*str, pos, len*)	**SUBSTR() is a synonym for SUBSTRING().** e.g. • SELECT SUBSTR ('This is the test by IWAY', 6); • SELECT SUBSTR ('This is the test by IWAY', -4, 4);
MID(*str, pos, len*)	MID function **is a synonym for** SUBSTRING**.**

- SELECT ename, job, IF(ISNULL(phone), '**********', RPAD(LEFT(phone, 4), 10, '*')) FROM emp;
- SELECT ename, job, phone, IF(ISNULL(phone), REPEAT('*',10), RPAD(LEFT(phone, 4), 10, '*')) FROM emp;
- SELECT `user name`, IF(LENGTH(SUBSTR(`user name`, INSTR(`user name`," "))) = 0,"Weak User", `user name`) *R1* FROM emp;
- UPDATE emp SET job = REPLACE(job, job, LOWER(job));

string functions - examples

- SELECT sal, REPEAT('$', sal/100) FROM emp;
- SELECT emailid, REPEAT('*', LENGTH(emailid)) FROM emp;
- SELECT pwd, REPEAT('*', LENGTH(pwd)) password FROM emp;
- SELECT c1, CONCAT(REPEAT('0', 10 - LENGTH(c1)) , c1) FROM leading_zeroes;
- SELECT ename, job, IF(ISNULL(phone), '**********', RPAD(LEFT(phone, 4), 10, '*')) FROM emp;
- SELECT \`user name\`, IF(LENGTH(SUBSTR(\`user name\`, INSTR(\`user name\`," "))) = 0,"Weak User", \`user name\`) R1 FROM emp;
- SELECT LENGTH('saleel') - LENGTH(REPLACE('saleel', 'e', ""));
- SELECT empno, datePresent, LENGTH(datePresent) - LENGTH(REPLACE(datePresent, ",", "")) + 1 "Days Present" FROM emp_attendance;
- SELECT CandidateID, REPLACE(REPLACE(response, ',', ''), 'n', '') R1, LENGTH(REPLACE(REPLACE(response, ',', '') ,'n', '')) R2 FROM vote_response;
- SELECT c1, c1 / 1, SUBSTR(c1, LENGTH(c1 / 1) + 1) FROM numberString;
- SELECT c1, REVERSE(c1) / 1, LENGTH(REVERSE(c1) / 1), REVERSE(SUBSTR(REVERSE(c1), LENGTH(REVERSE(c1) / 1) + 1)) FROM Stringnumber;
- UPDATE emp SET job := REPLACE(job, 'officers', 'Officers');

string functions - examples

- SELECT * FROM emp1 WHERE ename = BINARY "sherlock";
- SELECT * FROM emp1 WHERE ename = BINARY "Sherlock";
- SELECT * FROM emp1 WHERE ename = BINARY UPPER(ename);
- SELECT * FROM emp1 WHERE ename = BINARY LOWER(ename);
- SELECT CONCAT(UCASE(LEFT(ename, 1)), LCASE(SUBSTRING(ename, 2))) *"Title Case"* FROM emp;
- SELECT * FROM emp1 WHERE ename = BINARY CONCAT(UCASE(LEFT(ename, 1)), LCASE(SUBSTRING(ename, 2)));

mathematical functions

mathematical functions

Syntax	Result
ABS(x)	Returns the absolute value of X.
CEIL(x)	CEIL() is a synonym for CEILING().
CEILING(x)	Returns CEIL value.
FLOOR(x)	Returns FLOOR value.
MOD(n, m), n % m, n MOD m	Returns the remainder of N divided by M. MOD(N,0) returns NULL.
POWER(x, y)	This is a synonym for POW().
RAND()	Returns a random floating-point value

ROUND(x)
ROUND(x, d)
	Rounds the argument X to D decimal places. The rounding algorithm depends on the data type of X. D defaults to 0 if not specified. D can be negative to cause D digits left of the decimal point of the value X to become zero.

TRUNCATE(x, d)	Returns the number X, truncated to D decimal places. If D is 0, the result has no decimal point or fractional part. D can be negative to cause D digits left of the decimal point of the value X to become zero.

mathematical functions

```
SELECT FLOOR(RAND() * (b – a + 1) + a );
```

e.g.

- SELECT CEIL(1.23);
- SELECT CEIL(-1.23);
- SELECT FLOOR(1.23);
- SELECT FLOOR(-1.23);
- SELECT ROUND(-1.23);
- SELECT ROUND(-1.58);
- SELECT ROUND(RAND() * 100);
- SELECT FLOOR(RAND() * 899999 + 100000) *OTP*;
- SELECT weight, TRUNCATE(weight, 0) AS *kg*, MID(weight, INSTR(weight, ".") + 1) AS *gms* FROM mass_table;
- SELECT weight, TRUNCATE(weight, 0) AS *kg*, RIGHT(MOD(weight , 1), 2) AS *gms* FROM mass_table;

Note:

- TABLE statement always displays all columns of the table.
- TABLE statement does not support any WHERE clause.
- TABLE statement can be used with temporary tables.

table statement...

TABLE is a DML statement introduced in MySQL 8.0.19 which returns rows and columns of the named table.

table statement

The TABLE statement in some ways acts like SELECT. You can order and limit the number of rows produced by TABLE using ORDER BY and LIMIT clauses, respectively.

TABLE tbl_name [ORDER BY *col_name*] [LIMIT *number* [OFFSET *number*]]

- TABLE emp;
- TABLE emp ORDER BY 2;
- TABLE emp ORDER BY 2 LIMIT 1, 2;
- TABLE t1 UNION TABLE t2;

Remember:

- Here, "*" is known as metacharacter (all columns)

select statement... syntax

SELECT is used to retrieve rows selected from one or more tables (using JOINS), and can include UNION statements and SUBQUERIES.

syntax

select statement

modifiers

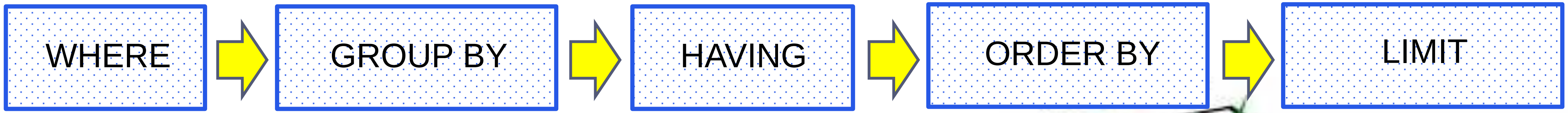
SELECT [ALL / DISTINCT / DISTINCTROW] identifier.* / identifier.A_1 [[as] *alias_name*], identifier.A_2 [[as] *alias_name*], identifier.A_3 [[as] *alias_name*], expression1 [[as] *alias_name*], expression2 [[as] *alias_name*] . . .

- [FROM <identifier.r_1> [as] *alias_name*], <identifier.r_2> [as] *alias_name*], . . .]
- [WHERE < *where_condition1* > { and | or } < *where_condition2* > . . .]
- [GROUP BY < { *col_name* | *expr* | *position* }, . . . [WITH ROLLUP] >]
- [HAVING < *having_condition1* > { and | or } < *having_condition2* > . . .]
- [ORDER BY < { *col_name* | *expr* | *position* } [ASC | DESC], . . . >]
- [LIMIT < { [*offset*,] *row_count* | *row_count* OFFSET *offset* } >]
- [FOR { UPDATE }]
- [{ INTO OUTFILE '*file_name*' | INTO DUMPFILE '*file_name*' | INTO *var_name* [, *var_name*], . . . }]

Remember:

- **ALL** (**modifier is default**) specifies that all matching rows should be returned, including duplicates.
- **DISTINCT** (**modifier**) specifies removal of duplicate rows from the result set.
- **DISTINCTROW** (**modifier**) is a synonym for **DISTINCT**.
- It is an error to specify both modifiers.
- Whenever you use **DISTINCT**, sorting takes place in server.

sequence of clauses



WHERE

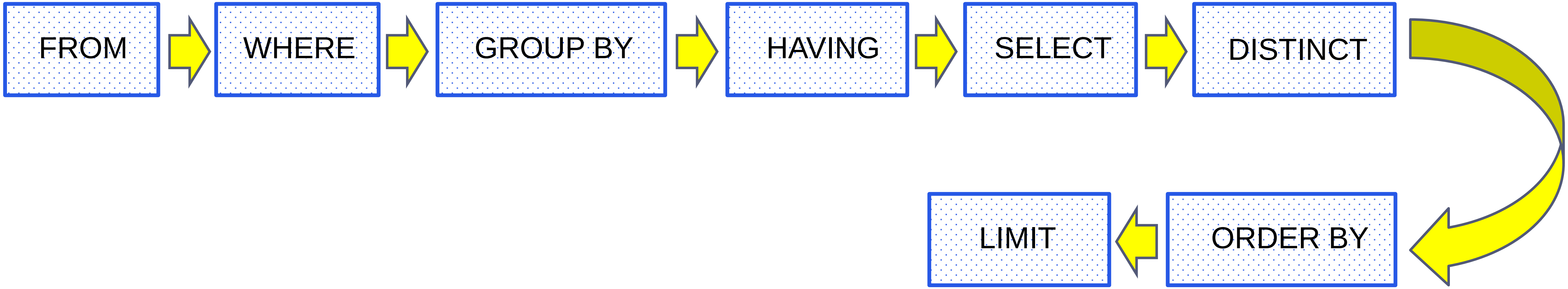
GROUP BY

HAVING

ORDER BY

LIMIT

select statement... execution



FROM

WHERE

GROUP BY

HAVING

SELECT

DISTINCT

ORDER BY

LIMIT

select statement… (is checks for)

Syntax Check

MySQL Database must check each SQL statement for syntactic validity.

```
mysql> SELECT *  FORM emp;

ERROR 1064 (42000): You have an error in your SQL syntax; check the manual that corresponds to your MySQL server
version for the right syntax to use near 'FORM emp' at line 1
```

Semantic Check

A semantic check determines whether a statement is meaningful, for example, whether the objects and columns in the statement exist.

```
mysql> SELECT *  FROM nonexistent_table;

ERROR 1146 (42S02): Table 'db1.nonexistent_table' doesn't exist
```

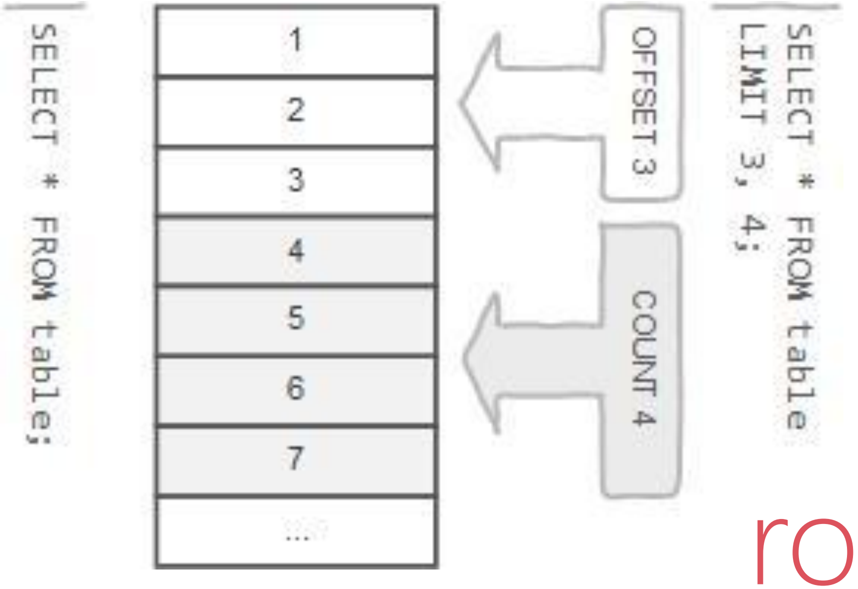
UUID()/ UUID_SHORT()

A UUID is a Universal Unique Identifier and 128-bit long value.

Remember:

- UUID values in MySQL are **unique** across tables, databases, and servers..

- SELECT UUID() AS R1, UUID_SHORT() AS R2 FROM *tbl_name*;



row limiting clause

LIMIT is applied after HAVING

Remember:

- LIMIT enables you to pull a section of rows from the middle of a result set. Specify two values: The number of rows to skip at the beginning of the result set, and the number of rows to return.

Note:

- Limit value are not to be given within **(. . .)**
- Limit takes one or two numeric arguments, which must both be **non-negative** integer value.

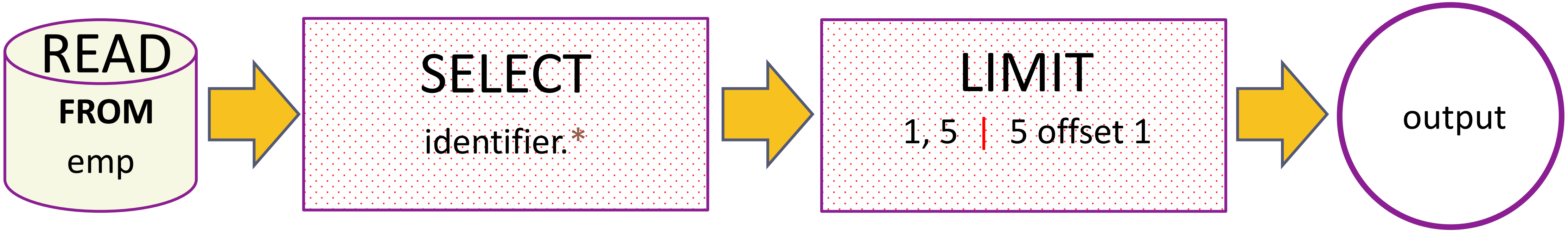
select - limit

SELECT A_1, A_2, A_3, . . . FROM *r*

[LIMIT { [*offset*,] *row_count* | *row_count* OFFSET *offset* }]

You can specify an offset using OFFSET from where SELECT will start returning records. By default ***offset is zero.***

- SELECT * FROM emp LIMIT 5 OFFSET 1;



- SELECT * FROM student LIMIT 5;
- SELECT * FROM student LIMIT 1, 5;
- SELECT * FROM student LIMIT 5 offset 1;
- SELECT RAND(), student.* FROM student ORDER BY 1 LIMIT 1;
- SELECT student.* FROM student ORDER BY RAND() LIMIT 1;

order by clause

SQL allows the user to order the tuples in the result of a query by the values of one or more of the attributes that appear in the query result, by using the ORDER BY clause.

Remember:

- The default sort order is ascending **ASC**, with smallest values first. To sort in descending (reverse) order, add the **DESC** keyword to the name of the column you are sorting by.
- You can sort on multiple columns, and you can sort different columns in different directions.
- If the **ASC** or **DESC** modifier is not provided in the ORDER BY clause, the results will be sorted by expression in **ASC** (ascending) order. This is equivalent to ORDER BY expression ASC.

select - order by

When doing an ORDER BY, NULL values are placed **first** if you do ORDER BY ... ASC and **last** if you do ORDER BY ... DESC.

SELECT A_1, A_2, A_3, A_n FROM *r*

[ORDER BY { A_1, A_2, A_3, . . . | *expr* | *position* } [ASC | DESC] , . . .]

"Ordered by attributes A_1, A_2, A_3 …"

- Tuples are sorted by specified attributes
- Results are sorted by A_1 first
- Within each value of A_1, results are sorted by A_2 then within each value of A_2, results are sorted by A_3

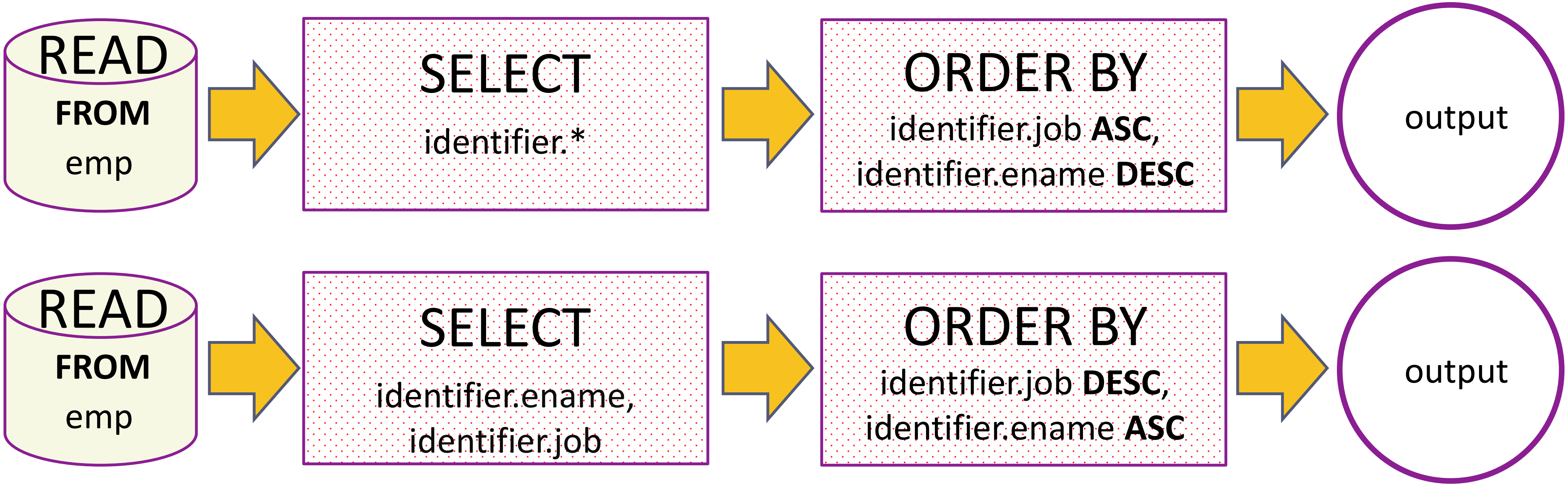
- SELECT * FROM ***r*** ORDER BY *key_part1, key_part2;* // optimizer does not use the index.
- SELECT *key_part1*, *key_part2* FROM ***r*** ORDER BY *key_part1*, *key_part2*; // optimizer uses the index.

select - order by

The ORDER BY clause is used to sort the records in your result set.

SELECT A_1, A_2, A_3, A_n FROM *r*

[ORDER BY { A_1, A_2, A_3, . . . | *expr* | *position* } [ASC | DESC] , . . .]



READ
FROM
emp

SELECT
identifier.*

ORDER BY
identifier.job **ASC**,
identifier.ename **DESC**

output

READ
FROM
emp

SELECT
identifier.ename,
identifier.job

ORDER BY
identifier.job **DESC**,
identifier.ename **ASC**

output

select - order by

SELECT A_1, A_2, A_3, A_n FROM *r*

[ORDER BY { $A_1, A_2, A_3, \ldots$ | *expr* | *position* } [ASC | DESC] , . . .]

- SELECT * FROM emp ORDER BY comm;
- SELECT * FROM emp ORDER BY comm IS NULL ;
- SELECT * FROM emp ORDER BY comm IS NOT NULL ;
- SELECT * FROM emp ORDER BY 1 + 1;
- SELECT * FROM emp ORDER BY True;
- SELECT sal FROM emp ORDER BY -sal;
- SELECT ename, LENGTH(ename) FROM emp ORDER BY LENGTH(ename), ename DESC ;
- SELECT * FROM emp ORDER BY IF(job = 'manager', 3, IF(job = 'salesman', 2, NULL)) ;
- SELECT * FROM emp ORDER BY FIELD(job, 'manager', 'salesman') ;
- SELECT * FROM emp ORDER BY ISNULL(comm), comm ;
- SELECT ename `e` FROM emp ORDER BY `e` ;
- SELECT ename `e` FROM emp ORDER BY e ;
- SELECT ename 'e' FROM emp ORDER BY 'e' ;
- SELECT * FROM emp ORDER BY CASE WHEN ename='sharmin' THEN 0 ELSE 1 END, _ename_;

Remember:

In **WHERE** clause operations can be performed using…

- *CONSTANTS*
- *TABLE columns*
- *FUNCTION calls (PRE-DEFINED / UDF)*

* In SQL, a logical expression is often called a *predicate*.

where clause

The WHERE Clause is used when you want to retrieve specific information from a table excluding other irrelevant data.

Note:

Expressions in WHERE clause can use.

- *Arithmetic operators*
- *Comparison operators*
- *Logical operators*

Note:

- All comparisons return FALSE when either argument is NULL, so no rows are ever selected.

select - where

We can use a conditional clause called WHERE clause to filter out results. Using WHERE clause, we can specify a selection criteria to select required records from a table.

SELECT A_1, A_2, A_3, . . . FROM r_1, r_2, r_3, . . . [WHERE *P*]

- r_i are the relations (tables)
- A_i are attributes (columns)
- P is the selection predicate

SQL permits us to use the notation (v_1, v_2,...,v_n) to denote a tuple of arity (attribute) n containing values v_1, v_2,...,v_n.

WHERE (a_1, a_2) <= (b_1, b_2)

WHERE (EMP.DEPTNO, DNAME) = (DEPT.DEPTNO, 'SALES');

Remember:

- A predicate is a condition expression that evaluates to a boolean value, either **true** or **false**.
- Predicates can be used as follows: In a SELECT statement's ***WHERE*** clause or ***HAVING*** clause to determine which rows are relevant to a particular query.

A value of zero is considered false. Nonzero values are considered true.

- `SELECT true, false, TRUE, FALSE, True, False;`

select - where

SELECT $A_1, A_2, A_3, \ldots$ FROM $r_1, r_2, r_3, \ldots$ [WHERE *P*]

2. comparison_operator:

= | <=> | >= | > | <= | < | <> | !=

5. logical_operators

{ AND | && } | { OR | || }

What will be the result of the query below?

- SELECT 1 = 1;
- SELECT True = 1;
- SELECT True = 2;
- SELECT True = True;
- SELECT 0 = 0;
- SELECT False = False;
- SELECT False = 1;
- SELECT 'a' = 1;
- SELECT 'a' = 0;

- SELECT * FROM emp WHERE ename = 0;
- SELECT * FROM emp WHERE ename = 1;
- SELECT * FROM emp WHERE ename = False;
- SELECT * FROM emp WHERE ename = True;
- SELECT * FROM emp WHERE True AND False;
- SELECT * FROM emp WHERE True OR False;
- SELECT * FROM emp WHERE True AND 1;
- SELECT * FROM emp WHERE True OR 0;

Note:

AND has higher precedence than **OR.**

- EXPLAIN ANALYZE SELECT * FROM emp WHERE job = 'salesman' OR job = 'manager' AND sal > 2000;

select - where

SELECT $A_1, A_2, A_3, \ldots$ FROM $r_1, r_2, r_3, \ldots$ [WHERE P]

WHERE state = 'NY' OR 'CA' --Illegal

WHERE salary > 20000 AND < 30000 –Illegal

WHERE state NOT = 'CA' --Illegal

Logical Operators		

AND, &&	Logical AND	e.g. SELECT 1 AND 1; / SELECT 1 AND 0;
		SELECT 0 AND NULL; / SELECT NULL AND 0;
		SELECT 1 AND NULL; / SELECT NULL AND 1;

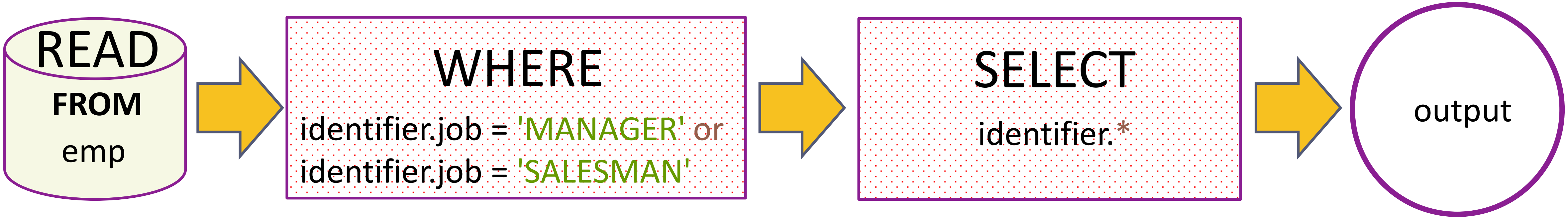
OR, ||	Logical OR	e.g. SELECT 1 OR 1; / SELECT 1 OR 0;
		SELECT 0 OR NULL; / SELECT NULL OR 0;
		SELECT 1 OR NULL; / SELECT NULL OR 1;

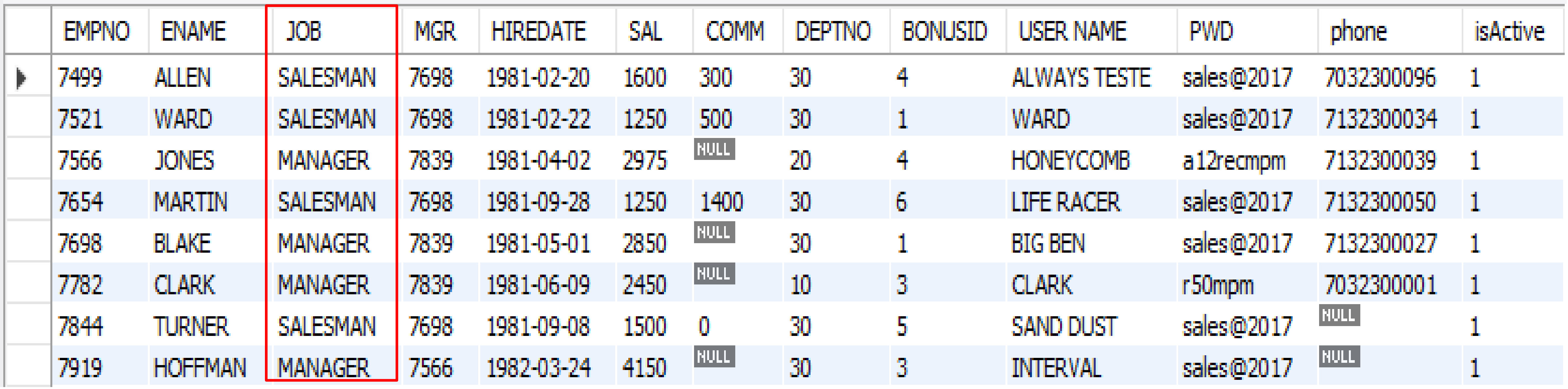
NOT, !	Negates value	e.g. SELECT NOT 1;

- **Logical AND.** Evaluates to 1 if all operands are non-zero and not NULL, to 0 if one or more operands are 0, otherwise NULL is returned.
- **Logical OR.** When both operands are non-NULL, the result is 1 if any operand is nonzero, and 0 otherwise. With a NULL operand, the result is 1 if the other operand is nonzero, and NULL otherwise. If both operands are NULL, the result is NULL.
- **Logical NOT.** Evaluates to 1 if the operand is 0, to 0 if the operand is nonzero, and NOT NULL returns NULL.

select - where

- SELECT * FROM emp WHERE job = 'MANAGER' OR job = 'SALESMAN';





	EMPNO	ENAME	JOB	MGR	HIREDATE	SAL	COMM	DEPTNO	BONUSID	USER NAME	PWD	phone	isActive
▶	7499	ALLEN	SALESMAN	7698	1981-02-20	1600	300	30	4	ALWAYS TESTE	sales@2017	7032300096	1
	7521	WARD	SALESMAN	7698	1981-02-22	1250	500	30	1	WARD	sales@2017	7132300034	1
	7566	JONES	MANAGER	7839	1981-04-02	2975	NULL	20	4	HONEYCOMB	a12recmpm	7132300039	1
	7654	MARTIN	SALESMAN	7698	1981-09-28	1250	1400	30	6	LIFE RACER	sales@2017	7132300050	1
	7698	BLAKE	MANAGER	7839	1981-05-01	2850	NULL	30	1	BIG BEN	sales@2017	7132300027	1
	7782	CLARK	MANAGER	7839	1981-06-09	2450	NULL	10	3	CLARK	r50mpm	7032300001	1
	7844	TURNER	SALESMAN	7698	1981-09-08	1500	0	30	5	SAND DUST	sales@2017	NULL	1
	7919	HOFFMAN	MANAGER	7566	1982-03-24	4150	NULL	30	3	INTERVAL	sales@2017	NULL	1

combining and & or - where

Note:

AND has higher precedence than **OR.**

- SELECT * FROM andor WHERE ename = 'saleel' AND city = 'pune' OR city = 'baroda';
- SELECT * FROM andor WHERE ename = 'saleel' AND (city = 'pune' OR city = 'baroda');

- SELECT ename, job, comm FROM emp WHERE comm = 0 OR comm IS NULL AND job = 'CLERK';
- SELECT ename, job, comm FROM emp WHERE (comm = 0 OR comm IS NULL) AND job = 'CLERK';

- EXPLAIN ANALYZE SELECT * FROM emp WHERE job = 'salesman' OR job = 'manager' AND sal > 2000;

select - where

SELECT A_1, A_2, A_3, . . . FROM r_1, r_2, r_3, . . . [WHERE *P*]

What will be the output of the following statement?

- SELECT "Hello" # "World ";
- SELECT 10 + 10 as *Result* WHERE False;
- SELECT 10 + 10 as *Result* WHERE True;
- SELECT 10 + 10 as *Result* WHERE 10 - 10;
- SELECT 10 + 10 as *Result* WHERE 10 - 0;
- SELECT 10 + 10 as *Result* WHERE 10 - 30;
- SELECT '5' * '5' as *Result*;
- SELECT 5 * 5 - '-5' as *Result*;

- SELECT * FROM emp WHERE comm IS UNKNOWN;
- SELECT * FROM emp WHERE comm IS NOT UNKNOWN;

- *operand* IS [NOT] *NULL*

3. *boolean_ predicate:*

IS [NOT] NULL | *expr* <=> NULL

is null / is not null

- "*IS NULL*" is the keyword that performs the Boolean comparison. It returns true if the supplied value is NULL and false if the supplied value is not NULL.
- *"IS NOT NULL*" is the keyword that performs the Boolean comparison. It returns true if the supplied value is not NULL and false if the supplied value is null.
- SQL uses a three-valued logic: besides true and false, the result of logical expressions can also be unknown. SQL's three valued logic is a consequence of supporting null to mark absent data.

Note:

- IS UNKNOWN is synonym of *IS NULL*.
- IS NOT UNKNOWN is synonym of *IS NOT NULL*.

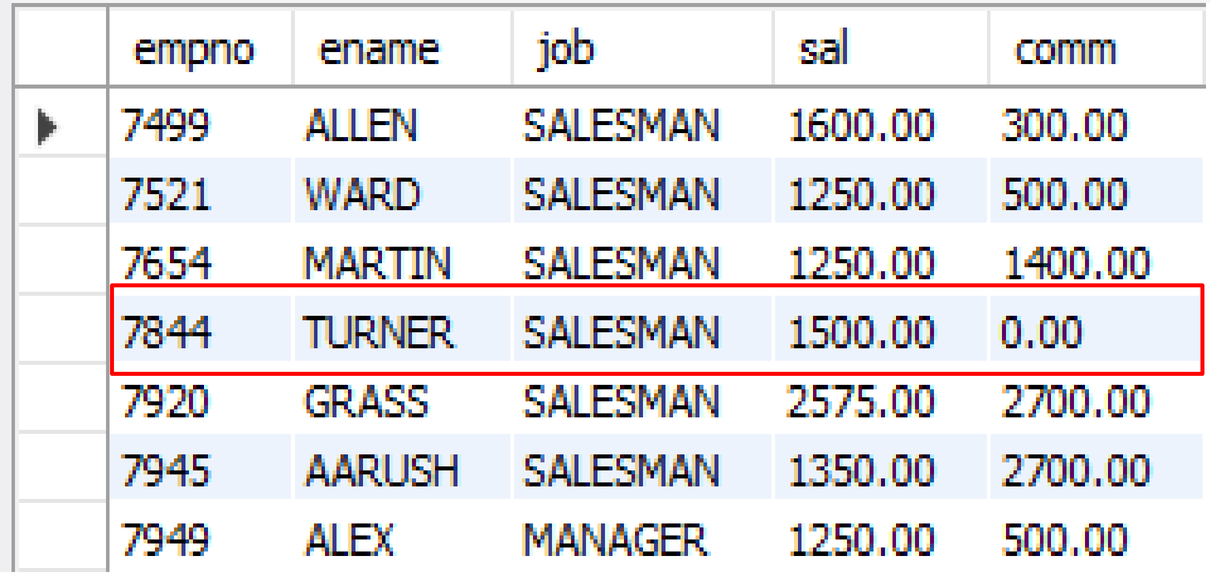
Remember:

is null / is not null

SELECT * FROM emp WHERE comm = NULL; # will return Empty set

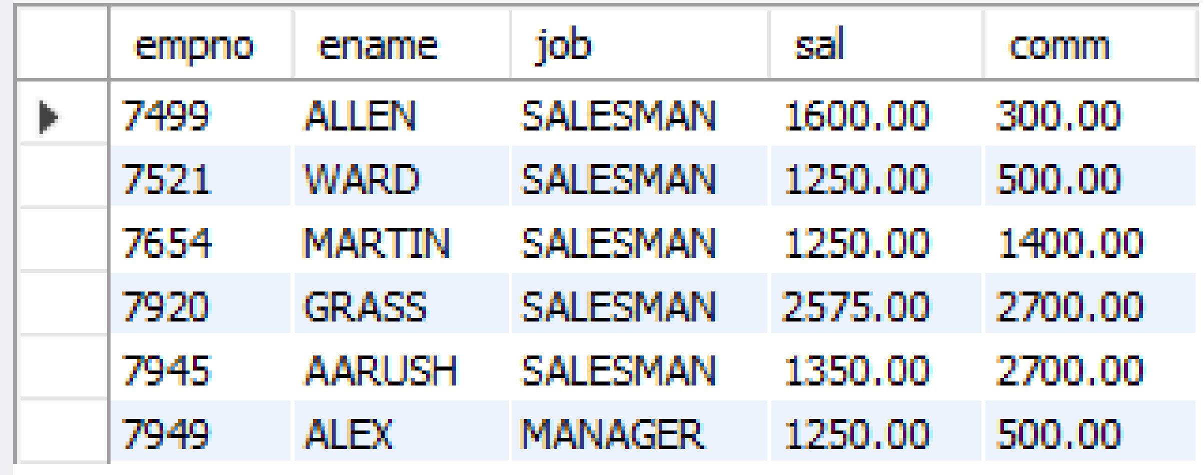
- SELECT empno, ename, job, sal, comm FROM emp WHERE comm IS NOT NULL;

- SELECT empno, ename, job, sal, comm FROM emp WHERE comm IS NOT UNKNOWN;



	empno	ename	job	sal	comm
▶	7499	ALLEN	SALESMAN	1600.00	300.00
	7521	WARD	SALESMAN	1250.00	500.00
	7654	MARTIN	SALESMAN	1250.00	1400.00
	7844	TURNER	SALESMAN	1500.00	0.00
	7920	GRASS	SALESMAN	2575.00	2700.00
	7945	AARUSH	SALESMAN	1350.00	2700.00
	7949	ALEX	MANAGER	1250.00	500.00

- SELECT empno, ename, job, sal, comm FROM emp WHERE comm is TRUE;



	empno	ename	job	sal	comm
▶	7499	ALLEN	SALESMAN	1600.00	300.00
	7521	WARD	SALESMAN	1250.00	500.00
	7654	MARTIN	SALESMAN	1250.00	1400.00
	7920	GRASS	SALESMAN	2575.00	2700.00
	7945	AARUSH	SALESMAN	1350.00	2700.00
	7949	ALEX	MANAGER	1250.00	500.00

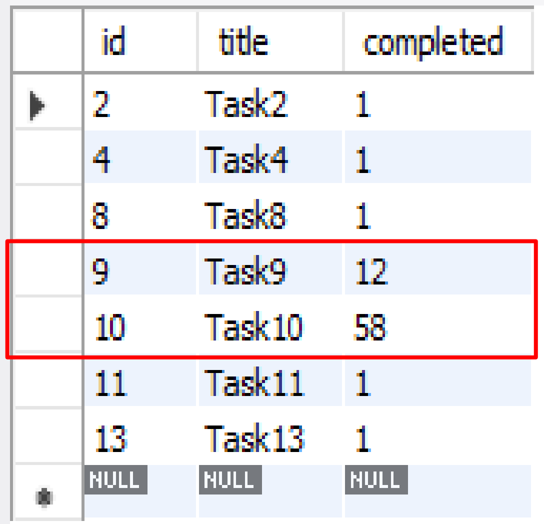
select – boolean

- BOOL and BOOLEAN are synonym of TINYINT(1)

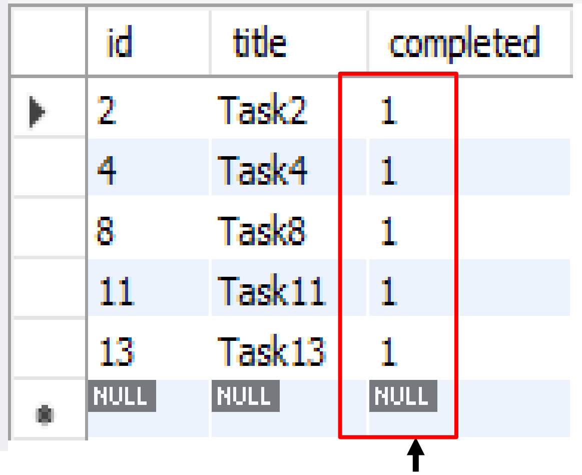
A value of zero is considered false. Nonzero values are considered true.

```
SELECT true, false, TRUE, FALSE, True, False;
```

- SELECT * FROM tasks WHERE completed;
- SELECT * FROM tasks WHERE completed IS True;
- SELECT * FROM tasks WHERE completed = 1;
- SELECT * FROM tasks WHERE completed = True;

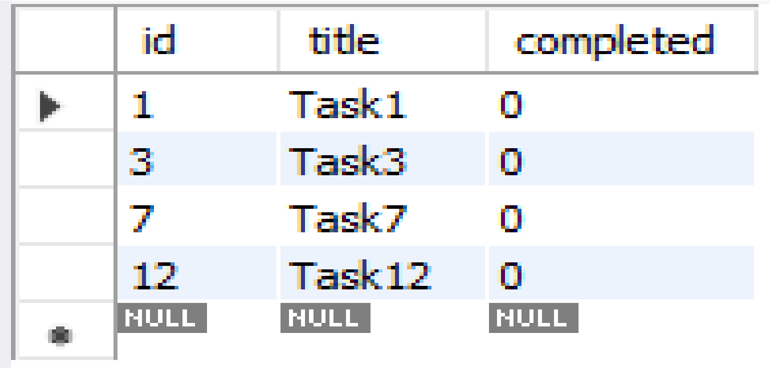


	id	title	completed
▶	2	Task2	1
	4	Task4	1
	8	Task8	1
	9	Task9	12
	10	Task10	58
	11	Task11	1
	13	Task13	1
*	NULL	NULL	NULL



	id	title	completed
▶	2	Task2	1
	4	Task4	1
	8	Task8	1
	11	Task11	1
	13	Task13	1
*	NULL	NULL	NULL

- SELECT * FROM tasks WHERE NOT completed;
- SELECT * FROM tasks WHERE completed IS False;
- SELECT * FROM tasks WHERE completed = 0;
- SELECT * FROM tasks WHERE completed = False;



	id	title	completed
▶	1	Task1	0
	3	Task3	0
	7	Task7	0
	12	Task12	0
*	NULL	NULL	NULL

select – boolean

- BOOL and BOOLEAN are synonym of TINYINT(1)

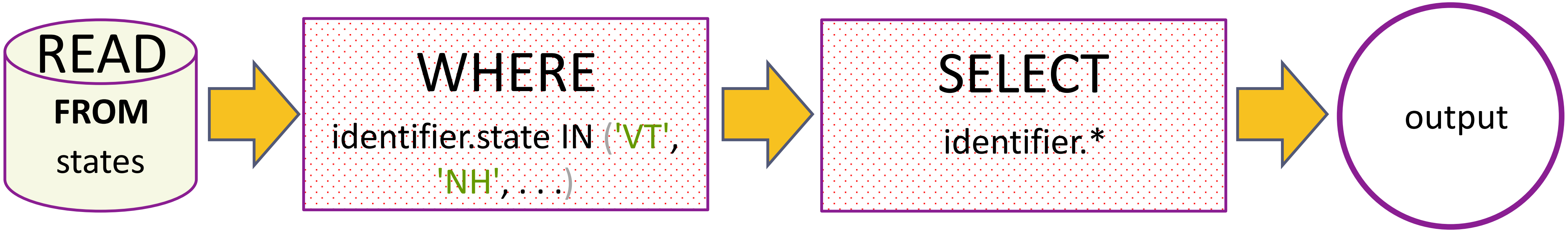
A value of zero is considered false. Nonzero values are considered true.

```
SELECT true, false, TRUE, FALSE, True, False;
```

What will be the result of the query below?

- SELECT * FROM emp WHERE 1;
- SELECT * FROM emp WHERE True;
- SELECT * FROM emp WHERE 0;
- SELECT * FROM emp WHERE False;
- SELECT * FROM emp WHERE ename = '' OR 0;
- SELECT * FROM emp WHERE ename = '' OR 1;
- SELECT * FROM emp WHERE ename = '' OR 1 = 1;

- SELECT * FROM emp WHERE ename = 'smith' OR True;
- SELECT * FROM emp WHERE ename = 'smith' AND True;
- SELECT * FROM emp WHERE ename IN('smith', True);
- SELECT * FROM emp WHERE ename = 'smith' OR False;
- SELECT * FROM emp WHERE ename = 'smith' AND False;
- SELECT * FROM emp WHERE ename IN('smith', False);



READ

FROM

states

WHERE

identifier.state IN ('VT', 'NH', . . .)

SELECT

identifier.*

output

***4. predicate*:**

expr [NOT] IN (*expr1, expr2, . . .*)

| *expr* [NOT] IN (*subquery*)

in

The IN statement is used in a WHERE clause to choose items from a set. The IN operator allows you to determine if a specified value matches any value in a set of values or value returned by a subquery.

SELECT . . . FROM $\mathbf{r}_1$ WHERE (
state = 'VT' OR
state = 'NH' OR
state = 'ME' OR
state = 'MA' OR
state = 'CT' OR
state = 'RI'
);

- SELECT . . . FROM $\mathbf{r}_1$ WHERE state IN ('VT', 'NH', 'ME', 'MA', 'CT', 'RI');
- SELECT . . . FROM $\mathbf{r}_1$ WHERE state IN (SELECT . . .);

A IN (***B1***, ***B2***, ***B3***, etc.)   A is found in the list (B1, B2, etc.)

in

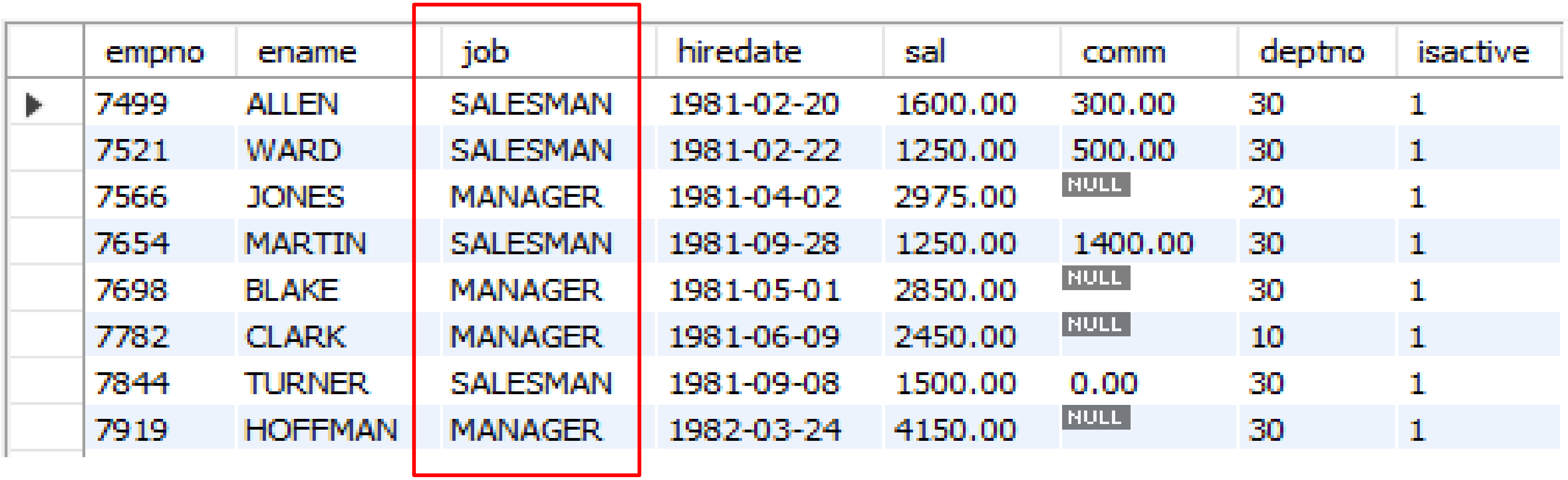
syntax

column | expression IN (*v1, v2, v3, . . .*)
column | expression IN (*subquery*)

Remember:

- If a value in the column or the expression is equal to any value in the list, the result of the IN operator is TRUE.
- The IN operator is equivalent to multiple OR operators.
- To negate the IN operator, you use the NOT IN operator.

- SELECT empno, ename, job, hiredate, sal, comm, deptno, isactive FROM emp WHERE job IN ('salesman', 'manager');



	empno	ename	job	hiredate	sal	comm	deptno	isactive
▶	7499	ALLEN	SALESMAN	1981-02-20	1600.00	300.00	30	1
	7521	WARD	SALESMAN	1981-02-22	1250.00	500.00	30	1
	7566	JONES	MANAGER	1981-04-02	2975.00	NULL	20	1
	7654	MARTIN	SALESMAN	1981-09-28	1250.00	1400.00	30	1
	7698	BLAKE	MANAGER	1981-05-01	2850.00	NULL	30	1
	7782	CLARK	MANAGER	1981-06-09	2450.00	NULL	10	1
	7844	TURNER	SALESMAN	1981-09-08	1500.00	0.00	30	1
	7919	HOFFMAN	MANAGER	1982-03-24	4150.00	NULL	30	1

Problem with NOT IN:

not in

a

c1	c2
1	1
2	1
3	1
4	1
5	1

b

c1	c2
1	7
NULL	7
3	7

- `SELECT * FROM a WHERE c1 NOT IN(1, 2, NULL);`
- `SELECT * FROM a WHERE c1 NOT IN(SELECT c1 FROM b );`

  ```
  Empty set (0.00 sec)
  ```

"color NOT IN (Red, Blue, NULL)" This is equivalent to: "NOT(color=Red OR color=Blue OR color=NULL)" *in*

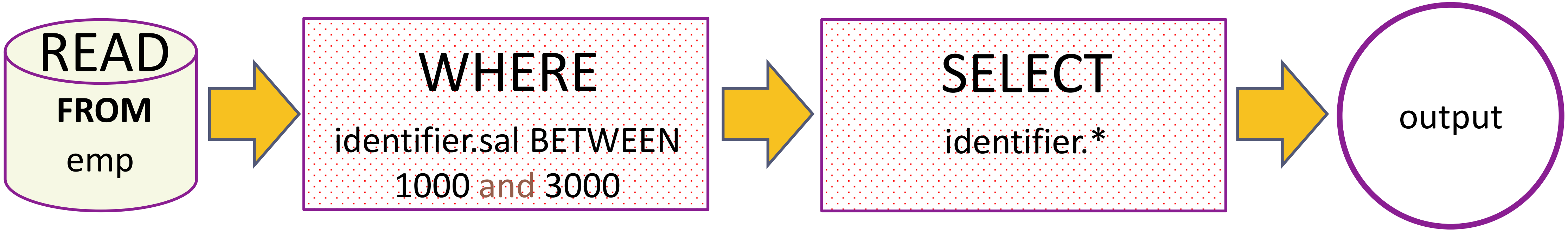
Remember:

- On the left side of the IN() predicate, the row constructor contains only column references.
- On the right side of the IN() predicate, there is more than one row constructor.

What will be the result of the query below?

- SELECT * FROM emp WHERE deptno IN (10);
- SELECT * FROM emp WHERE deptno IN (10, 20);
- SELECT * FROM emp WHERE False IN (10, 20, 0);
- SELECT * FROM emp WHERE True IN (10, 20, 1);
- SELECT * FROM emp WHERE 10 IN (10, 20);
- SELECT * FROM emp WHERE 7788 IN (empno, mgr); ←
- SELECT * FROM emp WHERE 1 IN (10, 20, True, False);
- SELECT * FROM emp WHERE deptno IN (10, 20) OR True;
- SELECT * FROM emp WHERE deptno IN (10, 20) AND True;
- SELECT * FROM emp WHERE deptno IN (SELECT deptno FROM dept);
- SELECT * FROM emp WHERE deptno IN (SELECT deptno FROM dept WHERE dname='accounting');
- SELECT * FROM emp WHERE deptno IN (TABLE deptno); # ERROR 1241 (21000): Operand should contain 1 column(s)

- SELECT * FROM emp WHERE 1 NOT IN (NULL);
- SELECT * FROM emp WHERE deptno IN (10, 20);
- SELECT * FROM emp WHERE False IN (10, 20, 0);
- SELECT * FROM emp WHERE True IN (10, 20, 1);
- SELECT * FROM emp WHERE 10 IN (10, 20);



READ

FROM

emp

WHERE

identifier.sal BETWEEN 1000 and 3000

SELECT

identifier.*

output

4. ***predicate***:

expr [NOT] BETWEEN *expr1* AND *expr2*

between

The BETWEEN operator is a logical operator that allows you to specify a range to test.

A BETWEEN ***B*** AND ***C***	A is between B and C

between

syntax

WHERE salary BETWEEN (20000 AND 30000) – Illegal

column | expression BETWEEN *start_expression* AND *end_expression*

Remember:

- The BETWEEN operator returns TRUE if the expression to test is greater than or equal to the value of the start_expression and less than or equal to the value of the end_expression.
- You can use the greater than or equal to (**>=**) and less than or equal to (**<=**) to substitute the BETWEEN operator.

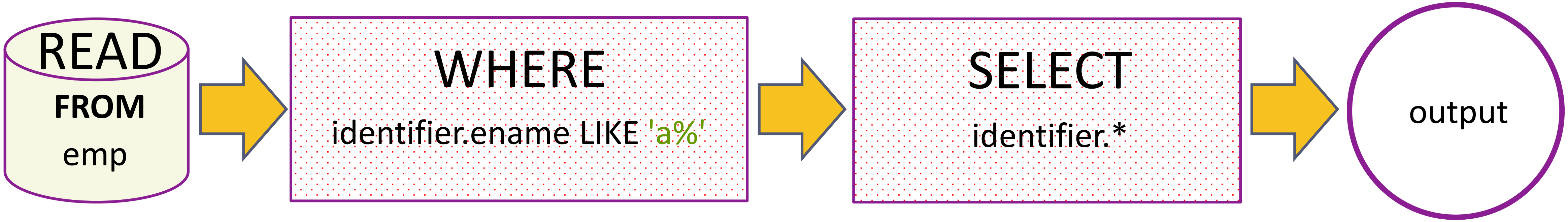
Note:

- if any input to the BETWEEN or NOT BETWEEN is NULL, then the result is UNKNOWN.

e.g.

```
SELET empno, ename, job, hiredate, sal, comm, deptno, isactive FROM emp WHERE sal BETWEEN 1000 AND NULL;
```

- `SELECT * FROM salespeople WHERE FORMAT(comm, 2) > 0.1 AND FORMAT(comm, 2) < 0.26;`



***4. predicate*:**

expr [NOT] LIKE *expr* [ESCAPE *char*]

like

The LIKE operator is a logical operator that tests whether a string contains a specified pattern or not.

like - string comparison functions

syntax

column | expression LIKE 'pattern' [ESCAPE *escape_character*]

Remember:

- **%** matches any number of characters, even zero characters. ("%" represents any sequence of characters.)
- _ matches exactly one character. ("_" represents a single character.)
- If we use **default escape character '\'**, then don't use ESCAPE keyword.

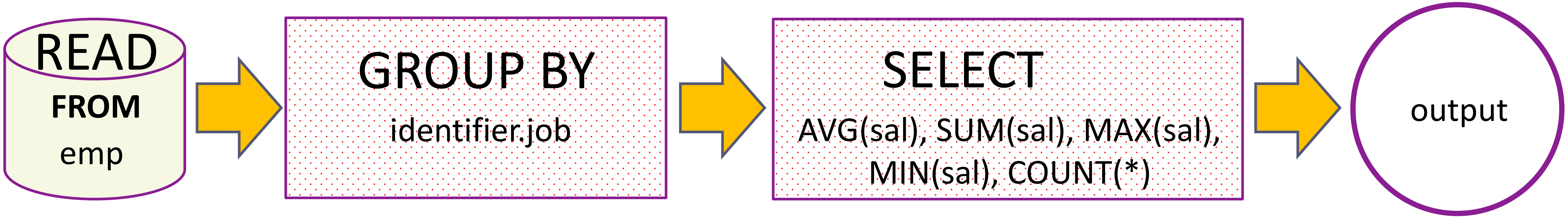
Note:

- The ESCAPE keyword is used to escape pattern matching characters such as the (%) percentage and underscore (_) if they form part of the data.
- If you do not specify the ESCAPE character, \ is assumed.

like

What will be the result of the query below?

- SELECT * FROM emp WHERE ename LIKE 's%';
- SELECT * FROM emp WHERE 'saleel' LIKE 's%';
- SELECT * FROM emp WHERE True LIKE '1';
- SELECT * FROM emp WHERE True LIKE '1%';
- SELECT * FROM emp WHERE True LIKE 001;
- SELECT * FROM emp WHERE True LIKE 100;
- SELECT * FROM emp WHERE False LIKE 100 OR 0;
- SELECT * FROM emp WHERE False LIKE 0 AND 1;



READ FROM emp → GROUP BY identifier.job → SELECT AVG(sal), SUM(sal), MAX(sal), MIN(sal), COUNT(*) → output

aggregate functions

SUM, AVG, MAX, MIN, COUNT, and GROUP_CONCAT

SELECT . . . . . . FROM table_name WHERE <condition> / GROUP BY column_name

this is invalid

SUM(colNM) / AVG(colNM) / MAX(colNM)
MIN(colNM) / COUNT(colNM) / COUNT(*)

- SET *SQL_MODE* = ' ';
- SET *SQL_MODE* = IGNORE_SPACE;

Remember:

None of the below two queries get executed unsuccessfully. The reason is that a condition in a WHERE clause cannot contain any aggregate function (or group function) without a subquery!

- SELECT empno, ename, sal, deptno FROM emp WHERE sal = MAX(sal); #error
- SELECT empno, ename, sal, deptno FROM emp WHERE MAX(sal) = sal; #error

aggregate functions

Remember:

There are 3 places where aggregate functions can appear in a query.

- in the SELECT-LIST/FIELD-LIST (the items before the FROM clause).
- in the ORDER BY clause.
- in the HAVING clause.

Note:

- The aggregate functions allow you to perform the calculation of a set of rows and **return a *single* value**.
- The WHERE clause cannot refer to aggregate functions. e.g. WHERE SUM(sal) = 5000 # Invalid, Error
- The HAVING clause can refer to aggregate functions. e.g. HAVING SUM(sal) = 5000 # Valid, No Error
- Nesting of aggregate functions are not allowed.

  e.g.

  ```
  SELECT MAX(COUNT(*)) FROM emp GROUP BY deptno;
  ```
- Blank space between aggregate functions like (SUM, MIN, MAX, COUNT) are not allowed.

  e.g.

  ```
  SELECT SUM (sal) FROM emp;
  ```
- The GROUP BY clause is often used with an aggregate function to perform calculation and **return a single value for each subgroup**.
- To eliminate duplicates before applying the aggregate function is available by including the keyword DISTINCT.

Things to… Remember:

aggregate function

TODO

AVG([DISTINCT] *expr*) [*over_clause*]

- If there are no matching rows, AVG() **returns NULL.**
- AVG() may take a numeric argument, and it returns a average of non-NULL values.

e.g.

- SELECT AVG(1) *"R1"*;
- SELECT AVG (NULL) *"R1"*;
- SELECT AVG (1) *"R1"* WHERE True;
- SELECT AVG(1) *"R1"* WHERE False;
- SELECT AVG(1) *"R1"* FROM emp;
- SELECT AVG(sal) *"R1"* FROM emp WHERE empno = -1;
- SELECT AVG(sal) *"Avg Salary"* FROM emp;
- SELECT job, AVG(sal) *"Avg Salary"* FROM emp GROUP BY job;

Things to… Remember: aggregate function

TODO

SUM([DISTINCT] *expr*) [*over_clause*]

- If there are no matching rows, SUM() **returns NULL.**
- SUM() may take a numeric argument , and it returns a sum of non-NULL values.

e.g.

- SELECT SUM(1) *"R1"*;
- SELECT SUM(NULL) *"R1"*;
- SELECT SUM(2 + 2 * 2);
- SELECT SUM(1) *"R1"* WHERE True;
- SELECT SUM(1) *"R1"* WHERE False;
- SELECT SUM(1) *"R1"* FROM emp;
- SELECT SUM(sal) *"R1"* FROM emp WHERE empno = -1;
- SELECT SUM(sal) *"Total Salary"* FROM emp;
- SELECT job, SUM(sal) *"Total Salary"* FROM emp GROUP BY job;

Things to… Remember:

aggregate function

TODO

SUM([DISTINCT] *expr*) [*over_clause*]

- If there are no matching rows, SUM() **returns NULL.**
- SUM() may take a numeric argument , and it returns a sum of non-NULL values.

r = { -2, 1, 2, -1, 3, -2, 1, 2, 1 }

- SELECT SUM(c1) *"R1"* FROM r;
- SELECT SUM(IF(c1 >= 0, c1, NULL)) FROM r;
- SELECT SUM(IF(c1 < 0, c1, NULL)) FROM r;

Things to… Remember:

aggregate function

TODO

MAX([DISTINCT] *expr*) [*over_clause*]

- If there are no matching rows, MAX() **returns NULL**.
- MAX() may take a string, number, and date argument, and it returns a maximum of non-NULL values.

e.g.

- SELECT MAX(1) *"R1"*;
- SELECT MAX(NULL) *"R1"*;
- SELECT MAX('VIKAS');
- SELECT MAX(1) *"R1"* WHERE True;
- SELECT MAX(1) *"R1"* WHERE False;
- SELECT MAX(1) *"R1"* FROM emp;
- SELECT MAX(sal) *"R1"* FROM emp WHERE empno = -1;
- SELECT MAX(sal) *"Maximum Salary"* FROM emp;
- SELECT job, MAX(sal) *"Maximum Salary"* FROM emp GROUP BY job;

Things to… Remember:

aggregate function

TODO

MIN([DISTINCT] *expr*) [*over_clause*]

- If there are no matching rows, MIN() **returns NULL.**
- MIN() may take a string, number, and date argument, and it returns a minimum of non-NULL values.

e.g.

- SELECT MIN(1) *"R1"*;
- SELECT MIN(NULL) *"R1"*;
- SELECT MIN(1) *"R1"* WHERE True;
- SELECT MIN(1) *"R1"* WHERE False;
- SELECT MIN(1) *"R1"* FROM emp;
- SELECT MIN(sal) *"R1"* FROM emp WHERE empno = -1;
- SELECT MIN(sal) *"Minimum Salary"* FROM emp;
- SELECT job, MIN(sal) *"Minimum Salary"* FROM emp GROUP BY job;

Things to… Remember:

aggregate function

TODO

COUNT([DISTINCT] *expr*) [*over_clause*]

- If there are no matching rows, COUNT() **returns 0.**
- Returns a count of the number of non-NULL values.
- COUNT(*) is somewhat different in that it returns a count of the number of rows retrieved, whether or not they contain NULL values.
- COUNT (*) is a special implementation of the COUNT function that returns the count of all the rows in a specified table.
- COUNT (*) also considers Nulls and duplicates.
- SQL does not allow the use of DISTINCT with COUNT (*)

Note:

- **COUNT (*):** Returns a number of rows in a table including duplicates rows and rows containing null values in any of the columns.
- **COUNT (EXP):** Returns the number of non-null values in the column identified by expression.
- **COUNT (DISTINCT EXP):** Returns the number of unique, non-null values in the column identified by expression.
- **COUNT (DISTINCT *):** is illegal.

Things to… Remember: *aggregate function*

TODO

COUNT([DISTINCT] *expr*) [*over_clause*]

e.g.

- SELECT COUNT(*) *"R1"*;
- SELECT COUNT(NULL) *"R1"*;
- SELECT COUNT(*) *"R1"* WHERE True;
- SELECT COUNT(*) *"R1"* WHERE False;
- SELECT COUNT(0) FROM emp;
- SELECT COUNT(1) FROM emp;
- SELECT COUNT(*) FROM emp WHERE empno = -1;
- SELECT COUNT(comm) *"R1"* FROM emp;
- SELECT job, COUNT(*) *"R1"* FROM emp GROUP BY job;
- SELECT CASE WHEN sal <= 1500 THEN 'low' WHEN sal > 1501 and sal < 3000 THEN 'medium' WHEN sal >= 3000 THEN 'high' END *"R1"*, COUNT(*) FROM emp GROUP BY *R1*;

Things to… Remember:

aggregate function

TODO

```
GROUP_CONCAT([DISTINCT] expr
                        [ORDER BY { unsigned_integer | col_name | expr }  [ASC | DESC] [, col_name . . .]]
                        [SEPARATOR str_val])
```

e.g.

- SELECT job, GROUP_CONCAT(ename) FROM emp GROUP BY job;

- SELECT job, CONCAT(GROUP_CONCAT(ename),' (', COUNT(*), ')') FROM emp GROUP BY job;
- SELECT job, CONCAT(GROUP_CONCAT(sal),' (', MAX(sal), ')') FROM emp GROUP BY job;
- SELECT job, CONCAT(GROUP_CONCAT(sal),' (', SUM(sal), ')') FROM emp GROUP BY job;

Things to… Remember:

aggregate function examples

TODO

-
  ```
  SELECT productname,
  SUM(CASE WHEN storelocation = 'North' THEN totalsales END) North,
  SUM(CASE WHEN storelocation = 'South' THEN totalsales END) South,
  SUM(CASE WHEN storelocation = 'East' THEN totalsales END) East,
  SUM(CASE WHEN storelocation = 'West' THEN totalsales END) West,
  SUM(CASE WHEN storelocation = 'Central' THEN totalsales END) Central,
  SUM(totalsales) TotalSales FROM pivot_table GROUP BY productname;
  ```

-
  ```
  SELECT itemname,
  COUNT(CASE WHEN color = 'white' AND size = 'medium' THEN 1 END) White,
  COUNT(CASE WHEN color = 'dark' AND size = 'medium' THEN 1 END) Dark,
  COUNT(CASE WHEN color = 'pastel' AND size = 'medium' THEN 1 END) Pastel FROM shop GROUP BY itemname;
  ```

$$G_{A_1, A_2, \ldots, A_n,}\ G_{F_1(A_1), F_2(A_2), \ldots, F_m(A_m)}\ (r)$$

Group Attributes

Group Function Attributes

group by clause

Remember:

- Standard SQL does not allow you to use an ALIAS in the GROUP BY clause, however, MySQL supports this.
- GROUP BY is used in conjunction with aggregating functions to group the results by the unaggregated columns.

Note:

- DISTINCT (if used outside an aggregation function) that is superfluous.

e.g.

```
SELECT DISTINCT COUNT(ename) FROM emp;
```

This function's will produce a single value for an entire group or a table.

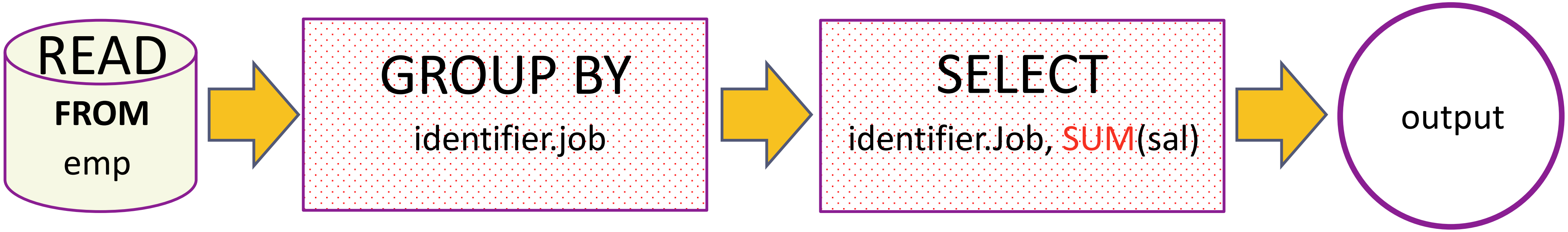
select - group by

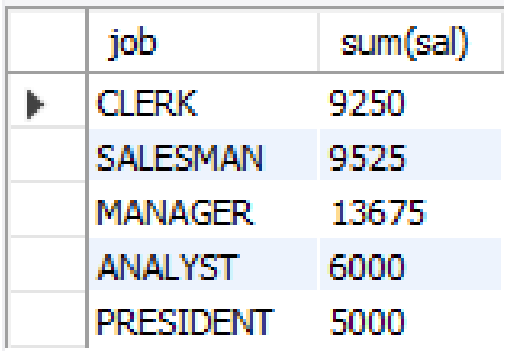
You can use GROUP BY to group values from a column, and, if you wish, perform calculations on that column.

SELECT G_1, G_2, . . . , $F_1(A_1)$, $F_2(A_2)$, . . . FROM r_1, r_2, . . .

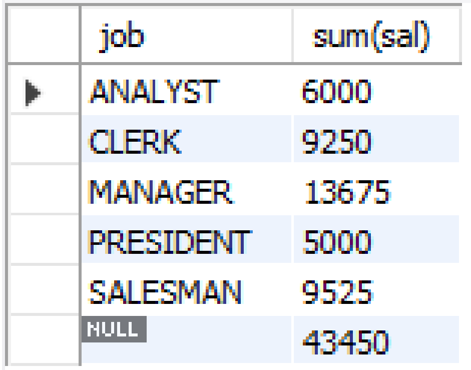
[GROUP BY {G_1, G_2, . . . | *expr* | *position*}, . . . [WITH ROLLUP]]

- SELECT job, SUM(sal) FROM emp GROUP BY job;
- SELECT job, SUM(sal) FROM emp GROUP BY job WITH ROLLUP;





job	sum(sal)
CLERK	9250
SALESMAN	9525
MANAGER	13675
ANALYST	6000
PRESIDENT	5000



job	sum(sal)
ANALYST	6000
CLERK	9250
MANAGER	13675
PRESIDENT	5000
SALESMAN	9525
NULL	43450

Remember:

- The WHERE clause **cannot refer** to aggregate functions. [WHERE SUM(sal) = 5000 # Error]
- The HAVING clause **can refer** to aggregate functions. [HAVING SUM(sal) = 5000 # No Error]

having clause

The MySQL **HAVING clause** is used in the SELECT statement to specify filter conditions for a group of rows. **HAVING clause** is often used with the GROUP BY clause. When using with the GROUP BY clause, we can apply a filter condition to the columns that appear in the GROUP BY clause.

Note:

- Columns given in **HAVING** clause must be present in selection-list.

e.g.

1. SELECT COUNT(*) FROM emp HAVING deptno=10; *
2. SELECT deptno, COUNT(*) FROM emp GROUP BY deptno HAVING job='manager'; *

* ERROR: Unknown column '. . .' in 'having clause'

- **HAVING** is merged with **WHERE** if you do not use GROUP BY or Aggregate Functions (COUNT(), . . .)

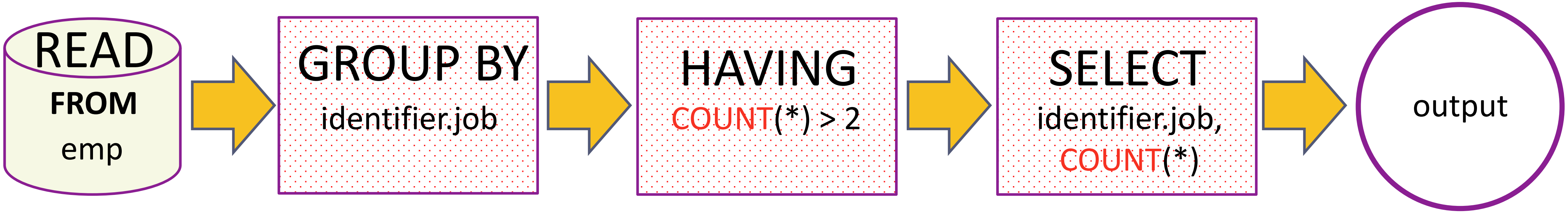
select - having

SELECT G_1, G_2, . . . , $F_1(A_1)$, $F_2(A_2)$, . . . FROM r_1, r_2, . . .

[GROUP BY {G_1, G_2, . . . | *expr* | *position*}, . . . [WITH ROLLUP]]

[HAVING *having_condition*]

- SELECT COUNT(*), job FROM emp GROUP BY job HAVING COUNT(*) > 2;



READ

FROM

emp

GROUP BY

identifier.job

HAVING

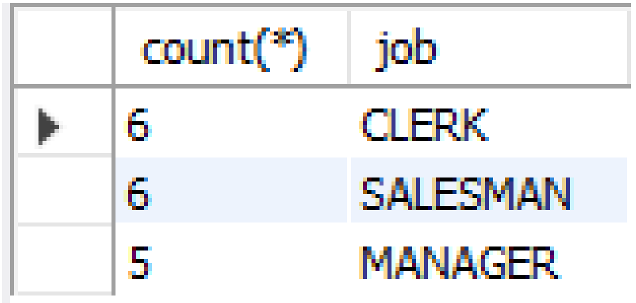
COUNT(*) > 2

SELECT

identifier.job,

COUNT(*)

output



	count(*)	job
▶	6	CLERK
	6	SALESMAN
	5	MANAGER

window function

Note:

MySQL does not support these window function features.

- DISTINCT syntax for aggregate functions.
- Nested window functions
- Window function cannot be the part of WHERE condition

window function

Use ORDER BY *expr* with PARTITION BY *expr* to see the effect of PARTITION BY *expr*.

- RANK() OVER([PARTITION BY *expr1*, *expr2*, . . .] ORDER BY *expr1* [ASC|DESC], . . .)
- DENSE_RANK() OVER([PARTITION BY *expr1*, *expr2*, . . .] ORDER BY *expr1* [ASC|DESC], . . .)
- ROW_NUMBER() OVER([PARTITION BY *expr1*, *expr2*, . . .] ORDER BY *expr1* [ASC|DESC], . . .)
- LAG(*expr* [, *N* [, *default*]]) OVER([PARTITION BY *expr1*, *expr2*, . . .] ORDER BY *expr1* [ASC|DESC], . . .)
- LEAD(*expr* [, *N* [, *default*]]) OVER([PARTITION BY *expr1*, *expr2*, . . .] ORDER BY *expr1* [ASC|DESC], . . .)

Note:

The N and default argument in the function is optional.

- **expr**: It can be a column or any built-in function.
- **N**: It is a positive value which determine number of rows preceding/succeeding the current row. If it is omitted in query then its default value is 1.
- **default**: It is the default value return by function in-case no row precedes/succeedes the current row by N rows. If it is missing then it is by default NULL.

window function- examples

- SELECT ROW_NUMBER() OVER() R1, emp.* FROM emp;
- SELECT RANK() OVER(PARTITION BY job ORDER BY sal) R1, ename, sal, job FROM emp;
- SELECT DENSE_RANK() OVER(PARTITION BY job ORDER BY sal) R1, ename, sal, job FROM emp;
- SELECT ordid, total, SUM(total) OVER(ORDER BY ordid) FROM ord;
- SELECT * FROM (SELECT ROW_NUMBER() OVER() R1, emp.* FROM emp) d WHERE R1> (SELECT COUNT(*) - 2 FROM emp); // Print n last records
- SELECT id, trainID stationname, timing, TIMEDIFF(LEAD(timing) OVER(PARTITION BY trainid ORDER BY timing), timing) R2 FROM traintimetable; // train time difference between to stations.
- SELECT id, trainID, stationname 'From Station', timing 'Departure Time' , LEAD(stationname) OVER(PARTITION BY trainid ORDER BY id) 'To Station', LEAD(timing) OVER(PARTITION BY trainid ORDER BY id) 'Arrival Time' FROM traintimetable;

window function- examples

- SELECT custId, type, amount, CASE type WHEN 'd' THEN amount WHEN 'c' THEN amount * -1 END *amount* FROM transactions;
- SELECT year, quarter, amount, SUM(amount) OVER(PARTITION BY year ORDER BY quarter) *R1* FROM quarter_revenue;
- SELECT custId, type, amount, SUM(CASE type WHEN 'd' THEN amount WHEN 'c' THEN amount * -1 END) OVER(PARTITION BY custID ORDER BY _id) *amount* FROM transactions;
- SELECT ordid, custid, total, SUM(total) OVER(PARTITION BY custid ORDER BY ordid) *R1* FROM ord;

user-defined variables

user-defined variables

TODO

Remember:

- A user variable name can contain other characters if you quote it as a string or identifier (for example, @'my-var', @"my-var", or @`my-var`).
- User-defined variables are session specific. A user variable defined by one client cannot be seen or used by other clients.
- All variables for a given client session are automatically freed when that client exits.
- User variable names are not case sensitive. Names have a maximum length of 64 characters.
- If the value of a user variable is selected in a result set, it is returned to the client as a string.
- If you refer to a variable that has not been initialized, it has a value of NULL and a type of string.

e.g. `SELECT @variable_name;`

user-defined variables

You can store a value in a user-defined variable in one statement and refer to it later in another statement. This enables you to pass values from one statement to another.

SET *@variable_name* = *expr* [, *@variable_name* = *expr*] . . .

Remember:

- for SET, either = or := can be used as the assignment operator.
- You can also assign a value to a user variable in statements (SELECT, …) other than SET. In this case, the assignment operator must be := and **not** = because latter is treated as the **comparison operator =**.

- set @v1 = 1001, @v2 := 2, @v3 = 'Saleel';
- set @v1 = 1001, @v2 = 2, @v3 := @v1 + @v2;
- SELECT @v1 := MIN(sal), @v2 := MAX(SAL) FROM emp;
- SELECT @v1, @v2, @v3;

Examples:

common sql statements mistakes

- SELECT ename, job, sal, comm FROM emp WHERE comm = NULL; #using comparison operator to check NULL
- SELECT job, COUNT(job) FROM emp; #not giving group by clause
- SELECT job, COUNT(job) FROM emp WHERE COUNT(job) > 4; #use of aggregate function in where clause
- SELECT job, deptno, COUNT(job) FROM emp GROUP BY job; #not giving all the columns in group by clause
- SELECT ename, COUNT(job) FROM emp GROUP BY ename; #grouping by a unique key
- SELECT ename, sal, sal + 1000 *R1* FROM emp WHERE *R1* > 2400; #use of alias name in where clause
- SELECT ename, sal FROM emp WHERE sal BETWEEN (1000 and 4000); #use of () in between comparison operator

r1 = { col1, col2, col3 }

- INSERT INTO ***r1*** VALUSE(10, 10); #number of values are less than the number of columns in the table
- INSERT INTO ***r1*** VALUSE(10, 10, 10, 10); #number of values are more than the number of columns in the table